Available online at www.sciencedirect.com
SCIENCE DIRECT
Agriculture, Ecosystems and Environment 116 (2006) 251–254
Agriculture Ecosystems & Environment
www.elsevier.com/locate/agee

Infestation of crop fields by *Striga* species in the savanna zones of northeast Nigeria

I.Y. Dugje [a], A.Y. Kamara [b,*], L.O. Omoigui [b]

[a] *Department of Crop Production, University of Maiduguri, PMB 1069 Maiduguri, Nigeria*
[b] *International Institute of Tropical Agriculture, Ibadan, Nigeria*

Received 28 May 2005; received in revised form 24 February 2006; accepted 28 February 2006
Available online 5 April 2006

Abstract

Parasitism of crop plants by *Striga* species is a major constraint in the savanna zones of West Africa. Farmers ranked *Striga* as a leading constraint during a livelihood analysis of 30 communities in northeast Nigeria. A field survey was conducted to ascertain the extent of infestation by *Striga* spp. About 935 crop and fallow fields were surveyed across 30 communities in three agro-ecological zones.

Four major *Striga species* were identified: *Striga hermonthica* in sorghum or maize; *Striga aspera* in rice; *Striga densiflora* in pearl millet and fallow and *Striga gesnerioides* in cowpea. About 68% of all fields sampled were infested, about 75% of compound fields and 60% of bush fields. The level of infestation was 60% in southern Guinea, 68% in Sudan and 74% in northern Guinea savanna. The level of infestation of cereal fields by *S. hermonthica* was in the order of Sudan savanna > Northern Guinea > Southern Guinea. Infestation of cowpea with *S. gesnerioides* was in the order of Northern Guinea savanna > Sudan savanna > Southern Guinea savanna. Across the three ecozones, about 85% of fields planted to maize and sorghum were infested with *S. hermonthica* and 81% of cowpea fields with *S. gesenerioides*. *S. aspera* infested 40–59% of rice fields and *S. densiflora* infested 27–60% of millet fields and fallow.

Keywords: *Striga hermonthica*; *Striga densiflora*; *Striga gesnerioides*; *Striga aspera*; Savannas; Maize; Sorghum; Cowpea

1. Introduction

The parasitic angiosperm, *Striga*, is an obligate root parasite, which infects cereal and legume crops in sub-Saharan Africa (Parker, 1991). Sauerborn (1991) estimated that about 21 million ha were infested with *Striga* in Africa. The extent of infestation of savanna ecologies in Nigeria may be higher, Lagoke et al. (1991) reported over 40% of the arable land in the savannas, about 50 million ha out of about 93 million ha, were already moderately or severely infested. They predicted infestation of further 40% during the next 10 years, bringing the level of infestation to 80% by 2001.

Crop losses ranging between 10 and 100% from the parasitic weeds have been reported (Lagoke et al., 1991). *Striga* impairs photosynthetic efficiency and exerts phytotoxic effects (Ransom et al., 1996) on its host. Manyong et al. (1996) reported that *Striga hermonthica* (Del.) Benth had become a serious problem in areas of poor market access where farmers did not apply fertilizer adequately to maize in the northern Guinea Savanna of Nigeria. Emechebe et al. (1991) also described farmers' fields of cowpea in the northern Guinea Savanna as being completely blighted by *Striga gesnerioides* (Willd.) Vatke, with losses as high as 100%.

Farmers rated *Striga* infestation as leading priority constraint together with low soil fertility, during a community livelihood analysis in 30 communities in Borno State, northeast Nigeria (PROSAB, 2004). The general trend in farming systems in the three agro-ecological zones showed that farmlands were cultivated with short fallow

* Corresponding author at: International Institute of Tropical Agriculture (IITA) Nigeria, c/o L.W. Lambourn & Co., Carolyn House, 26 Dingwall Road, CR9 3EE, UK. Tel.: +234 76 232732; fax: +234 76 232732.
E-mail address: A.Kamara@cgiar.org (A.Y. Kamara).

0167-8809/$ – see front matter © 2006 Elsevier B.V. All rights reserved.
doi:10.1016/j.agee.2006.02.013

periods or none. This often resulted in environmental degradation, such as soil erosion, leaching, reduced soil fertility, and *Striga* infestation (PROSAB, 2004). Farmers cope with low soil fertility and *Striga* by employing land rotation, and applying organic manure and inorganic fertilizer. The use of inorganic fertilizers was introduced about 40 years ago by Government extension agents and has been tried at one time or another by almost all communities. Fertilizers result in higher yields but are rather expensive owing to the withdrawal of Government subsidies and sometimes not available at the appropriate time. There has been an increasing desire to use fertilizers but the quantity applied per unit area is low and use is decreasing because of high cost and lack of access (PROSAB, 2004)

The present study was conducted to determine the level and extent of infestation of crop and fallow fields with *Striga* in order to draw up strategies to combat its menace and increase food production in northeast Nigeria.

2. Materials and methods

The study area consisted of 30 communities selected from four Local Government Areas in the Southern part of Borno State (11°50′E and 10°25′N) of northeast Nigeria. The estimated area was 16,100 km^2 inhabited by 700,000 people according to the 1991 National population census (Anonymous, 1996). Three savanna zones were surveyed, Sudan (SS), Northern Guinea (NGS), and Southern Guinea (SGS) based on length of growing season, rainfall, vegetation and temperature. Average annual rainfall in SS ranged from about 500 to 800 mm; average temperatures were between 22 and 37 °C and length of growing season was 100–120 days (June–September). In NGS, average annual rainfall was from 900 to 1000 mm; average temperatures were between 23 and 35 °C and length of growing season was 120–150 days (June–October). In the SGS, average rainfall was from 1000 to 1200 mm, average temperatures were between 22 and 35 °C and length of growing season was 150–18 days (May–October). Soils ranged from sandy clay (SS) to clay loam in NGS and SGS (Anonymous, 1996; PROSAB, 2004).

The study was conducted through a field survey of *Striga* spp. in the 30 participating communities (10 communities in each agro-ecological zone). Each community is a cluster of two or more settlements. Simple random sampling technique was adopted where available fields were randomly selected from the four cardinal points (north, east, west, and south) of each community. At least four compound and bush fields each were selected for each available crop and fallow. Fields less than 1 km from the edge of the community were considered to be compound fields; those more than 1 km distant were considered bush fields. Emerged *Striga* plants were counted from each field as described by Kim (1994). Five 1 m^2 quadrats were marked out with sticks in each plot along a diagonal transect. Emerged *Striga* plants were identified and counted from each quadrat. *Striga* spp. were identified based on the developmental and morphological features described by Ramaiah et al. (1983). *Striga* plant counts were made in maize (*Zea mays* L.), sorghum (*Sorghum bicolor* (L.) Moench), pearl millet (*Pennisetum glaucum* (L.) R. Br), rice (*Oryza sativa* L.), cowpea (*Vigna unguiculata* (L.) Walp.) and fallow fields in the three zones between September and November 2004.

2.1. Statistical analysis

All data were converted to a hectare basis and subjected to analysis of variance (ANOVA) using the general linear model (GLM) procedure of the Statistical Analysis Systems (SAS) Package (SAS, 1990). Statistically significant differences between means of numbers of emerged *Striga*/ha were compared using Standard error.

3. Results and discussions

Four common *Striga species* were identified in the field: *S. hermonthica*, *S. aspera* (Willd.) Benth., *S. gesnerioides*, and *S. densiflora*, Benth. This finding agrees with that of Gworgwor et al. (2001) who found the four major *Striga* spp. to be important parasitic weeds in northeast Nigeria. Maize and sorghum fields were mostly infested by *S. hermonthica*. Rice fields were mainly infested by *S. aspera*. Some weedy rice fields were also infested with *S. densiflora*, though the species was mainly found attacking late maturing pearl millet and grass species in fallow fields. *S. gesnerioides* was the dominant parasitic weed species present in sole cowpea fields and few fields of cereal + cowpea intercrops.

Sixty-eight percent of the total of 935 fields sampled in the three zones were infested by the *Striga* spp., 60% of bush fields and 75% of compound fields. Thus *Striga* spp. infested 60, 68, and 74% of the fields in SGS, SS and NGS, respectively. The levels of infestation of the fields were as follows: 34% fallows, 44% rice and 77% maize, 82%cow-pea, 84% pearl millet and 94% sorghum. Compound fields of sorghum, cowpea, rice, pearl millet and fallow were more severely infested than bush fields. Bush fields planted to maize were more infested than compound fields. This could be attributed to the farmers' preference for applying organic manure and fertilizers in compound fields of maize.

The level of infestation by each *Striga* species revealed that 85.5% of the fields sampled were infested with *S. hermonthica*, while 44.1% by *S. aspera*, 58.8% by *S. densiflora* and 82.8% were infested by *S. gesnerioides*. The high level of infestation in sorghum, cowpea, and maize fields may be caused by continuous cropping of these three crops, as they constitute the major staple food crops in the region (PROSAB, 2004). The prevalence of *S. hermonthica* is owing to the widespread production of maize and sorghum in the study area. Both *S. hermonthica* and *S. gesnerioides* were prevalent in some cereal and cowpea intercrops.