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Prospection and Collection of *Striga gesnerioides* Seeds in Three Major Cowpea Producing Regions in Niger

N. Aichatou ABDOULAYE[1], Romaric NANEMA [3], Mamadou A. COULIBALY[1], J. B. TIGNEGRE [2] and J. D. ZONGO[3],

1 Institut National de la Recherche Agronomique du Niger (INRAN),
CERRA de MARADI, BP 240, Maradi, Niger

2 Institut de l'Environnement et de la recherche Agronomique
(l'Institut de l'Environnement et de la recherche Agronomique INRA), Ouagadougou, Burkina Faso

3 Université Ouaga I Zoseph KI- ZERBO de Ouagadougou

Abstract

Cowpea, *Vigna unguiculata* (L.) Walp is a legume crop that plays an important nutritional role in the live of people in developing countries in Sub Saharan Africa. Cowpea is grown in all agro ecological areas of Niger and is used in several forms: young leaves, green pods and dry grains through a variety of culinary meals. However, cowpea production is reduced by many biotic and abiotic constraints. Among the biotic Striga gesnerioides is one of the most important limiting factors in arid and semi-arid areas. Popular cowpea varieties grown in Niger are very susceptible to Striga. A total of 53 samples of Striga seeds had been collected in 3 major cowpea producing regions over two rainy seasons (2011 & 2012). Striga infestation ranged from 10 to 100% in all the sites of the three regions prospected. A striga map was draw and a National collection of Striga seeds was established.

Key words: ***Cowpea, Striga gesnerioides, Prospection, Seeds collection.***

1. Introduction

The total area cultivated with cowpea in the world is 9.8 million ha of which 9.3 million ha in West Africa (Amusa and Adegbite, 2006). Niger is the second largest producer with a production of 1, 568,253 MT (FAOSTAT, 2015) on about 4,132,000 ha (IITA, 2013). Niger is also the first exporter of cowpea in the world (IITA, 2013). Grown in all the ecological zones of Niger, cowpea is important to the small scale Nigerien farmers, because (i) as a cash crop, the export constitutes an important source of foreign exchange, (ii) it provides a food source due to its very high nutritive value both for humans and animals; so, it contribute to achieving food security, and (iii) from an agronomic point of view, as leguminous specie, the crop enriches soil with nitrogen and well adapted in intercropping. However, despite the various benefits of cowpea, its production is hampered by *Striga gesnerioides*, a cowpea root parasite. Cowpea is the most important host for *S. gesnerioides* in Africa. *S. gesnerioides* cause particularly serious damage to cowpea in the Sahel-Sudan belt of West and Central Africa. In this zone, the production losses were estimated in millions of tons each year and the increasing occurrence of *Striga* infestation (Muranaka *et al*., 2007). In fact, in infected fields, yield losses can be very high, 83–100% depending on the cultivar (Cardwell & Lane 1995). Cowpea varieties that are cultivated in Niger are mostly susceptible to *S. gesnerioides*; therefore developing *Striga* resistant cowpea varieties is very important to boost production in Niger. A strategy is then needed to control this constraint; several strategies are possible for *Striga* control, however the use of resistant varieties is the cheapest and most effective method of control. Breeding for resistance will need (i) assembling a collection of *S. gesnerioides* seeds from different cowpea production zones in the country and (ii) carrying out a large-scale screening of cowpea germplasm in infested fields and in pots to identify effective sources of resistance. Although *Striga* is among the major constraints to cowpea production in Niger (*S. gesnerioides* seeds were not available for researchers who wanted to breed for *S. gesnerioides* resistance in Niger; also there were no data or estimation of the infestation zones of *S. gesnerioides* in Niger. So this work was conducted: (i) To explore in the three main cowpea production area in Niger for the identification of infestation areas of *S. gesnerioides* and evaluate the level of the infestation; (ii) to collect a sufficient quantity of viable and germinable *S.gesnerioides* seeds for artificial infestations; (iii) to establish a National collection of *S .gesnerioides* seeds from various cowpea production areas in Niger.

2. Methodology

2.1. Prospection and Collection period

Seed was collected in the rainy season (from September to November) during both 2011 and

2012 cropping seasons. The prospection of infested areas was done during the same time.

The evaluation of the level of infestation of visited zones was done using the method used by Akanvou *et al*., (2006) with little modification. In the present study, the density of *Striga* was evaluated in fields by the countage of *Striga* shoot per meter square using the rating from 1 to 9:
1 = *Very weak infestation* (1 to 10 *Striga* shoot); 3 = *weak infestation* (10 to 30 *Striga* shoot); 5 = *Medium infestation* (30 to 50 *Striga* shoot); 7 = *High infestation* (50 to 100 *Striga* shoot); 9 = *very high infestation* (more than 100*Striga* shoot).

Prospection and Collection areas

Seeds were collected in Maradi, Zinder and Dosso (figure 1), which are the three main cowpea production regions of Niger.

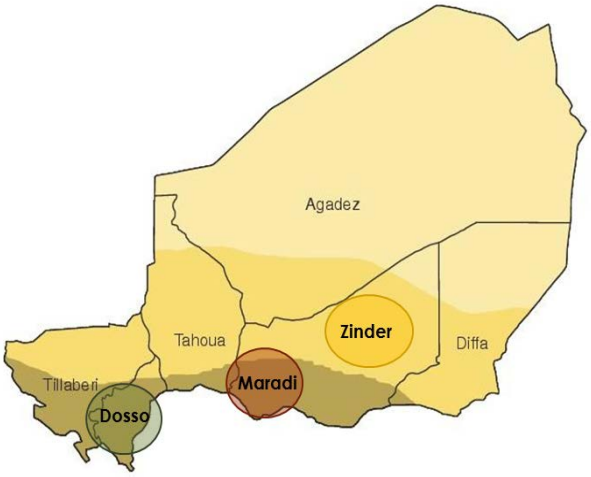

***Figure* 1**: Regions targeted for collection.

2.2. Collection procedure

The identification of departments and villages has been made in collaboration with local extension agents. In each region *S. gesnerioides* infested department have been identified by the Heads of agricultural districts. Then, in each department two villages were chosen with at least 10 km between one another as *S. gesnerioides* is autogamous. In Zinder region, the sampling has been done in the following departments: Magaria, Matameye and Mirriah. The sampling in Maradi's region has been done in Madarounfa, Tchadoua, Tessaoua, Aguié, Gazoua and Mayahi. Departments of Dogon Doutchi, Matankari, Koré Mairuwa, Dosso, and Gaya were involved in the region of Dosso.

The method used for samples collection, drying, threshing and storage is described by Bernerand *et al*, (1997). In infested fields, healthy *Striga gesnerioides* flowers were harvested randomly; this precaution was taken in order to limit the quantity of trash during the sieving as well as to reduce the presence of sand in Striga seeds. Precautions have also been taken to avoid harvesting the inflorescences with large and swollen capsules because they contain larvae of weevil (*Smicronyx Spp*.) and their seeds are not healthy (Berner *et al*, 1997). For the flowers collection, big bags or large paper envelopes were used depending on the availability of *Striga gesnerioides* (Photo I). The objective is to collect the maximum of *Striga* inflorescences. The collection sites coordinates were recorded using a GPS (Global Positioning System).

2.3. Seeds Drying

The harvested *S. gesnerioides* flowers were dried at room temperature for 14 days for small samples. Larger samples (photo 1) were exposed outside on polyethylene sheet in a wind sheltered area (photo 2). Once dried, shake the *Striga* flowers on the sheet to collect seeds contained in the pods.

Photo 1: *Striga* gesnerioides collected in bags.

Photo 2: *Striga* exposed to sun for drying

2.4. Seeds sieving and storage

Once collected on the sheet, *Striga* seeds were sieved using two sieves of 250 µm and 150 µm. Gloves were used for the treatment and sieves and all material used were cleaned between samples. *Striga gesnerioides* seeds obtained has been stored in hermetically sealed containers labeled with the collection site name and date (photo 3).

Photo 3: *S. gesnerioides* seeds instorage

3. Results

Striga seeds were successfully collected in 53 sites in both 2011 and 2012. The collection comprises 53 samples, of which 17 were collected from Zinder, 23 from Maradi, and 13 from Dosso (see table I and figure II for sites details).

A total of 53 samples were collected, of which 17 were from Zinder, 23 from Maradi, and 13 from Dosso (figure III).

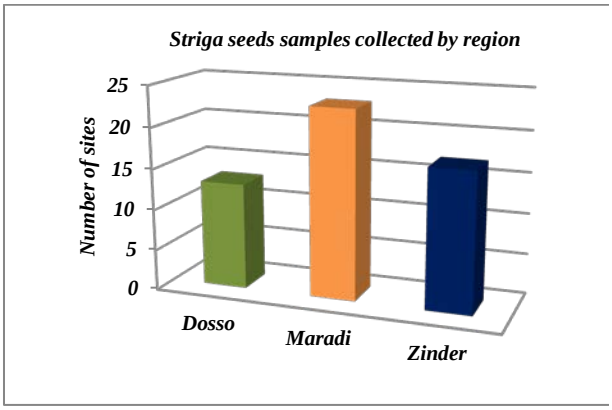

Figure 2: Samples collected repartition by regions

Striga gesnerioides infestation's levels in study areas

In Zinder region, the level of infestation was high to very high in the visited fields in the departments of Magaria and Mirriah (about 100% of fields were infected by *Striga gesnerioides*). In the department of Matamèye this level of infestation varied from very weak infestation of the site at Dan Barto and Bako raouni(10% of the field infected), to a weak infestation at Korgom (25%)and a high infestation was observed at Kadazaki (85%). In the Maradi region, all the departments and villages visited were highly infested by *Striga* (about 95% of visited fields). In this region, it was observed the great extent of the infestation and especially noted the concern of cowpea producers with respect to parasitic plant damages. As a result of striga attack, farmers listed: stunted plants, reduced haulm production, and low plant productivity. In the Dosso region, a different picture has been observed in term of infestation: a very high infestation level was observed in the departments of Kore Mairuwa, Togone (Doutchi), Matankari where fields were highly damaged by *Striga* with null grain production. But a weak infestation (10%); were observed at Tanda and Tara; at Sia the fields were highly infested (85 %). Bana's sites visited were free of striga infestation. The prospection permitted to get a first map of *Striga gesnerioides* presence and distribution in the three main cowpea production zones in Niger (figure 3).

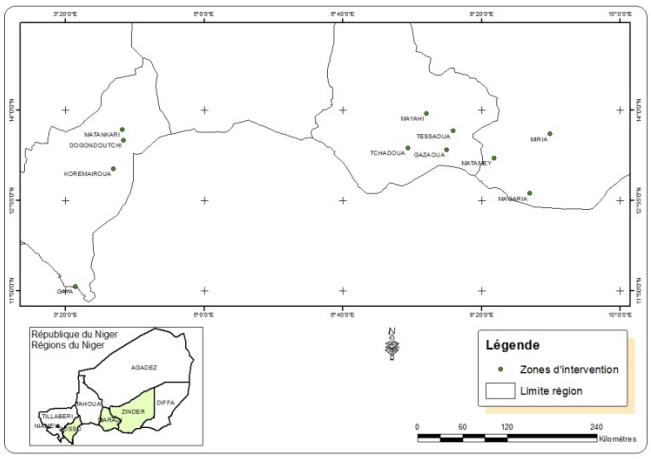

Figure 3: *Striga gesnerioides* infestation zones in 3 cowpea production area in Niger

4. Discussions

It is important to note that this study is the first one done in Niger on *Striga gesnerioides* distribution within the main cowpea production zones. From the data collected, it is clear from this prospection that *Striga gesnerioides* is present in all the regions of Maradi and Zinder and Dosso. The high spot infestation sites identified during this prospection were Galadi (Gabi), Tessawa (Maradi), Togone (Doutchi), Sia (Gaya), AngoualGamji (Magaria), Mirriah, FodéBeri (Dosso). high infestation could be explained by the fact that most of cowpea producers of those planted late maturing local varieties that are varieties very susceptible to *Striga*

gesnerioides. Thus the cultivation of these susceptible varieties in the same field in a repetitive manner naturally increases the number of Striga seed stock in the soil. At the same time, the rapid growth rate of the Niger's population farmers to over-exploit arable land with practically no fallow, and especially under or no use of fertilizers, resulting in nutrient-washed, poor soils and also these zones experienced most of time drought what can increase the expansion of *Striga*. These observations are consistent with those of Bebawi, (1987), Parker, (1991), Berner *et al*. (1995) or Charles Kouakou 2015 who mentionned that in general the presence of *Striga* is frequently related to low soil fertility. These statements justify the number of samples collected less important at Tanda and Bana because these areas belong to the most fertile and the most watered zone of the country with a Sudanian type climate. This explains the number of samples collected less important in Dosso than in the two other regions (Maradi & Zinder).

Conclusion

Prospection missions revealed that *S. gesnerioides* is widely present in all major cowpea production areas in Niger. it also provides basic information on the extent of *S. gesnerioides* infested areas and an evaluation of the level of infestation of this parasitic in Dosso, Maradi and Zinder regions that are the main cowpea production areas in Niger. The results of this study made possible to have a first *S. gesnerioides* seeds stock. The collected *S. gesnerioides* seeds served as inoculum source in artificial infestations during the various phenotypic screenings to identify cowpea genotypes resistant to *S. gesnerioides* in Niger. Seeds will also be indispensable for the study of genetic diversity in order to accurately determine the *Striga* race (s) present in Niger. This study should be completed in the future to estimate the surfaces of *S. gesnerioides* infested areas in Niger.

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