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Indigenous knowledge of *Striga gesnerioides* (Willd.) Vatke, in Burkina Faso

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***Striga gesnerioides* is one of the major constraints to cowpea production in West Africa. In Burkina Faso, *Striga* is a national phenomenon despite the control measures proposed by research. This study aims to collect farmers' perceptions of *S. gesnerioides*. Thus, a survey was conducted among cowpea producers in 15 localities across the four agroclimatic zones of Burkina Faso. Data collected were related to farmers' ability to distinguish *S. gesnerioides* from *Striga hermonthica*, their perceptions of yield losses, local control strategies they use and the social utility of *Striga*. The study revealed a good knowledge of the pest by farmers. Farmers identified *S. gesnerioides* by its small height, its bushy growth habit and the haustorium that distinguishes it. They attributed 20 to 100% yield losses to the effects of the parasite. The most widely used indigenous control method is by manually uprooting the plants. Despite of its harmfulness to cowpeas, *S. gesnerioides* is used in traditional medicine to treat diabetes and curing animal's wounds and urinary problems.**

Key words: Farmers' perceptions, ethnobotanical survey, *Striga gesnerioides*, use.

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp.) is the main legume in sub-Saharan Africa produced for its dry seeds rich in proteins (≥ 25%), carbohydrates, vitamins and minerals, and supplements the diet mainly consisting of cereals in countries where cowpea is a major food crop (Gupta et al., 2016; Omoigui et al., 2018). It is an important staple in human nutrition, food security and income generation for producers, especially in the arid savanna regions of West Africa (Omoigui et al., 2018; Snapp et al., 2018). However, its production is hampered by several abiotic and biotic constraints including parasitic phanerogams. Parasitic plants are in fact noxious bio-aggressors of cultivated plants. Parasitic phanerogams of the genus *Striga* constitute a major economic problem in more than fifty countries throughout the world. For example, sub-Saharan Africa has been estimated to be over 50 million hectares allocated to cereals and legumes production are infested by *Striga*

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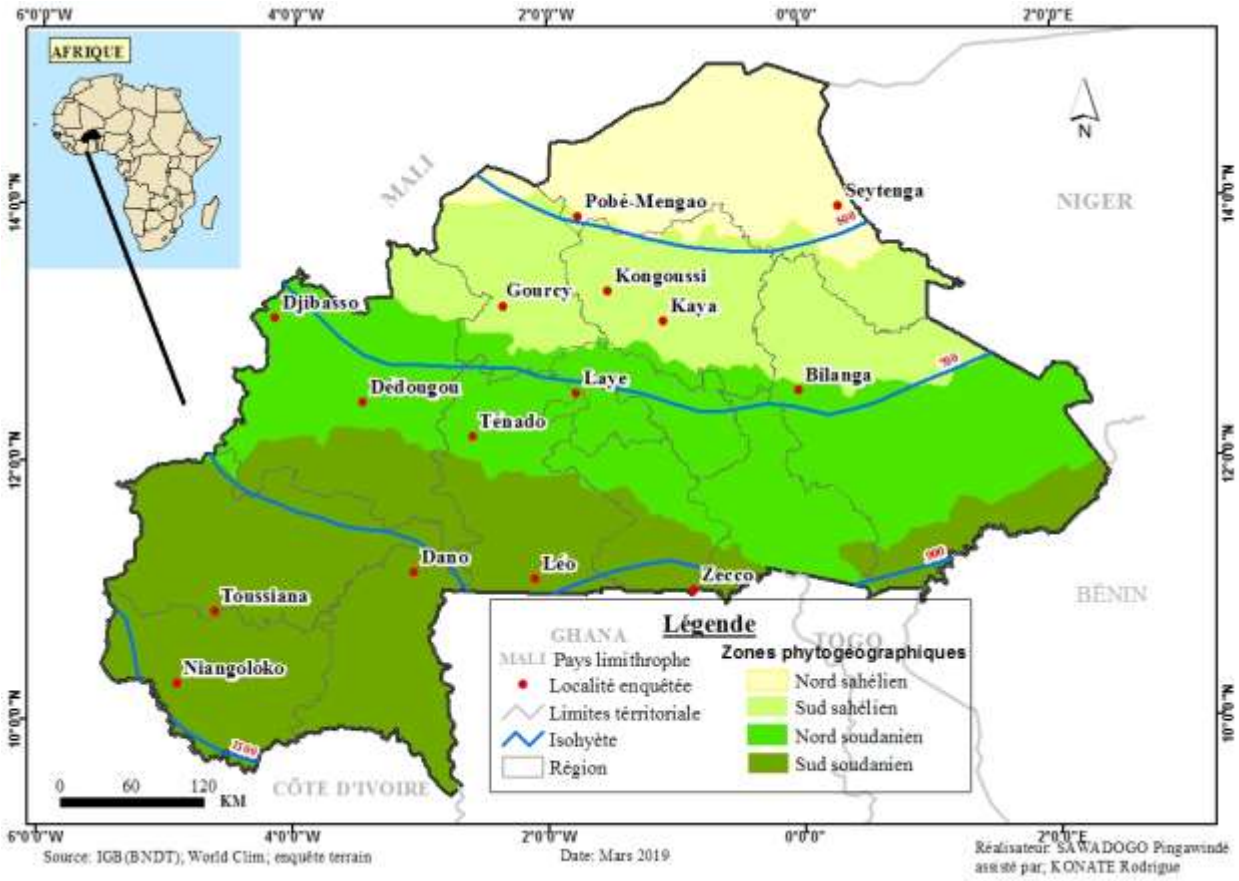

Figure 1. Map showing the different survey sites.
Source: Sawadogo (2020).

(Westwood et al., 2010; Dafaallah, 2019). More than 30 species of *Striga* have been identified worldwide (Spallek et al., 2013); of which, 13 have been recorded in Burkina Faso (Boussim et al., 2011). Among *Striga* species, four are parasitic causing considerable damage to crops (Csurhes et al., 2013; Dafaallah, 2019). *Striga hermonthica, Striga aspera* and *Striga asiatica* parasitize cereals crops and *Striga gesnerioides* is parasite of legumes crops. The principal control method used by farmers is manual weeding (Haruna et al., 2018). However, this control method is inefficient because *Striga* continues to emerge after the last weeding. As a consequence, *S. gesnerioides* is getting more widespread in Burkina Faso. The control of this weed requires the involvement of farmers to develop participatory control strategies (Haruna et al., 2018). Therefore, it is urgent to strengthen participatory learning processes that involve farmers, whereby the importance of this study. Participatory Rural Appraisal (PRA), is an important tool in the integrated management of *Striga* to enhance a better understanding of the nature and magnitude of *Striga* issue (Batieno, 2014; Dieni, 2017). Therefore, the present study aims to determine farmers' perceptions and their indigenous knowledge on *S. gesnerioides* in Burkina Faso.

MATERIALS AND METHODS

Study sites

The localities covered by the study were chosen to cover the four agro-climatic zones (north-Sahelian zone, south-Sahelian zone, north-Sudanian zone and south-Sudanian zone). In addition, the choice of survey sites was made taking into account ethnic groups in order to interview as many ethnic groups as possible. The survey was conducted in 15 localities in 11 administrative regions of Burkina Faso from September to October, 2018. The geographical coordinates of the various sites were recorded using a GARMIN GPS and incorporated into the ArcGis 10.0 mapping software. Figure 1 illustrates the geographical position of the localities covered.

Sampling

Two hundred and sixty-five people were interviewed in the 15 sites across the four phytogeographical sectors of Burkina Faso. The youngest respondent was 15 years old and the oldest 97 years old. In each location, cowpea producers of the major indigenous ethnic

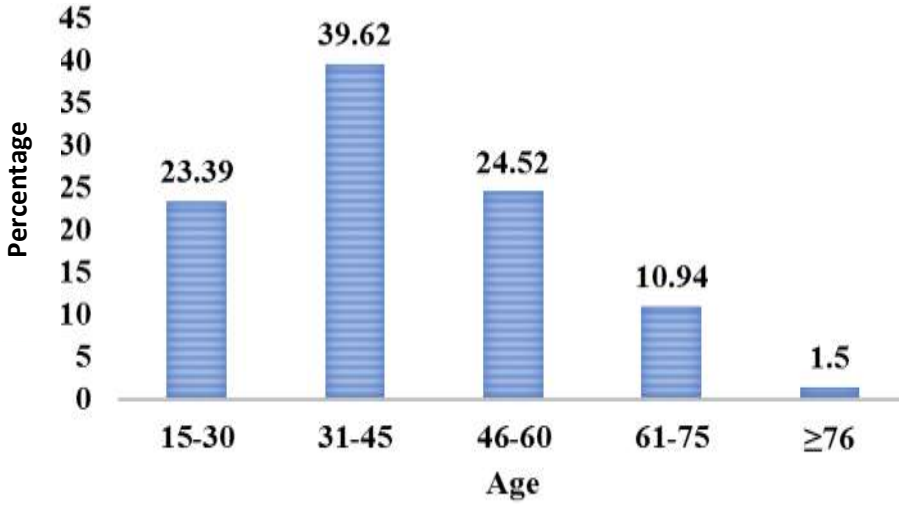

Figure 2. Number of interviewed farmers by age group.

group were selected for questionnaire administration.

Questionnaire administration

Cowpea farmers of at least 15 years old, irrespective of their gender, were interviewed. A minimum number of 10 farmers were interviewed in each locality. SPHINX software was used to develop the questionnaire which included both closed and open-ended questions. Open-ended questions have the advantage of giving the opportunity to the respondents to provide the maximum information they have and are therefore adapted to ethnobotanical studies (Thompson and Juan, 2006). In order to meet the objectives of the study, information was collected on the ability of farmers to differentiate between *Striga* infesting cereal from that of legumes, local strategies to control *Striga* and its social usefulness.

Statistical analyses

The data were analysed with SPHINX LEXICA software for frequency. Descriptive statistics such as frequencies were determined. The Chi-square test for goodness-of-fit was also applied to determine whether there are significant differences or not between some studied parameters. EXCEL 2010 sheet was used to generate graphs.

RESULTS

Number of respondents by age group

Two hundred and sixty-five people were interviewed in the 15 sites across the four phytogeographical sectors of Burkina Faso. The youngest respondent was 15 years old and the oldest 97 years old. Indeed, about 40% of the respondents are between 31 and 45 years old (Figure 2). Gender analysis of the data showed that out of the 265 producers interviewed, 184 (69.4%) were males and 81 (30.6%) were females.

Characterization of *S. gesnerioides* by farmers

The results showed that 264 respondents out of 265 knew *Striga* before this study. The majority of them (81.90%) were able to distinguish *S. gesnerioides* from other *Striga* spp. Only 17.70% of the interviewed farmers were unable to distinguish between the two *Striga* spp. The $\chi 2$ test revealed that there is no significant difference between men and women farmers for their ability to differentiate *Striga* spp. (Table 1). In contrast, respondents' knowledge about *Striga* spp. varied between regions (Table 2).

Morphological criteria for the identification of *S. gesnerioides* by farmers

The most used morphological criterion by farmers to recognize *S. gesnerioides* is its height (size 75.5%) (Figure 3). Farmers identified *S. gesnerioides* through its bushy growth habit and short height. In addition, *S. gesnerioides* was recognized by farmers through its very small leaves, the colour of its stem and flowers. Another criterion characterizing *S. gesnerioides* is the presence of haustorium attached on its host roots (Figure 4).

Farmers' perception of *S. gesnerioides* emergence period

The study revealed that the emergence of *S. gesnerioides* starts from the second weeding, which coincides with the appearance of flower buds, until pods maturity. In fact, more than 83.8% of the farmers interviewed stated that the emergence of *S. gesnerioides* coincides with the period of flower bud setting (Figure 5).

Table 1. Farmers' knowledge of *Striga gesnerioides* by gender.

Sex	Yes	No	Total	Chi-Square	P-Value
Male	154	29	183		
Female	63	18	81	1.559	0.212
Total	217	47	264		

Table 2. Farmers' knowledge of *Striga gesnerioides* by region.

Region	Yes	No	Total	Chi-Square	P-Value
Boucle du Mouhoun	36	11	47		
Centre-Nord	34	1	35		
Centre-Ouest	29	5	34		
Est	26	2	28		
Sahel	26	0	26		
Centre-Sud	14	11	25	57.8 96	< 0.0001
Haut-Bassins	13	7	20		
Plateau-Central	15	0	15		
Nord	10	3	13		
Cascade	3	8	11		
Sud-Ouest	11	0	11		
Total	217	48	265		

Alpha = 0.05.

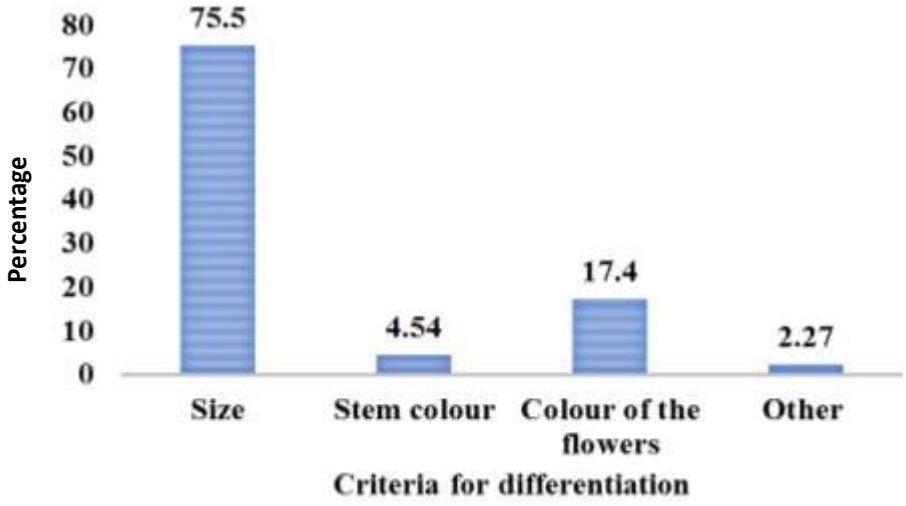

Figure 3. Proportions of morphological criteria used by farmers to characterize *Striga gesnerioides*.

However, some farmers mentioned a continuous *Striga* emergence throughout the life cycle of its host.

Farmers' perception of symptoms and cowpea yield losses related to *S. gesnerioides*

The most common symptoms of *S. gesnerioides* attacks from cowpea producers view are leaf discoloration (yellowish leaves) and plant stunting (Figure 6). Early defoliation and flower fall were also cited. As regard to yield losses due to *Striga*, the majority of respondents reported that it is generally higher than 50% (Figure 7). In very poor soils conditions characterized by high infestation density, yield losses can reach 80 to 100%. The yield loss estimates varied between regions (Table 3).

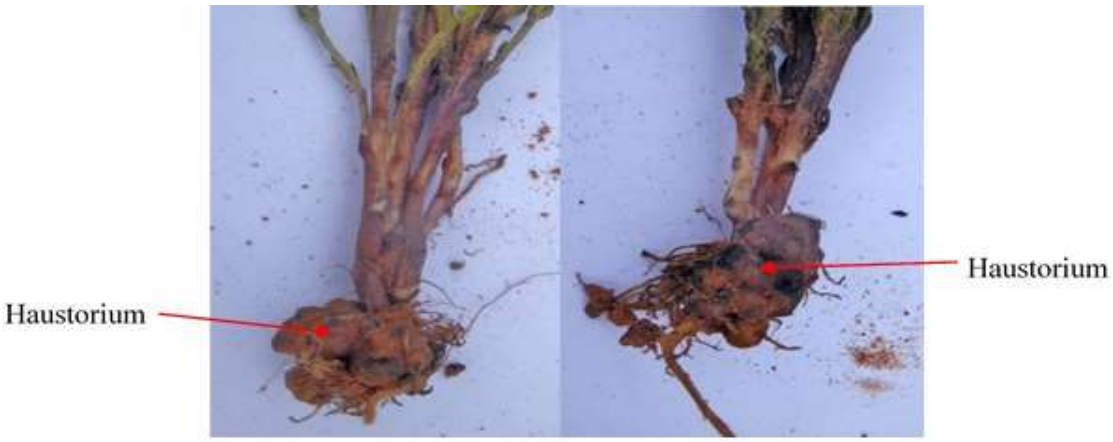

Figure 4. Haustorium developed by *Striga gesnerioides* on its host roots.

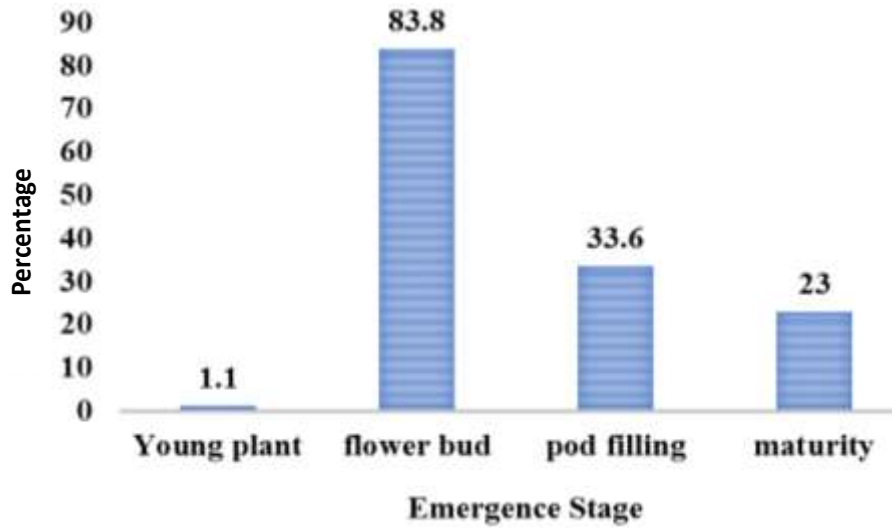

Figure 5. Farmers' opinion on the emergence period of *Striga gesnerioides*.

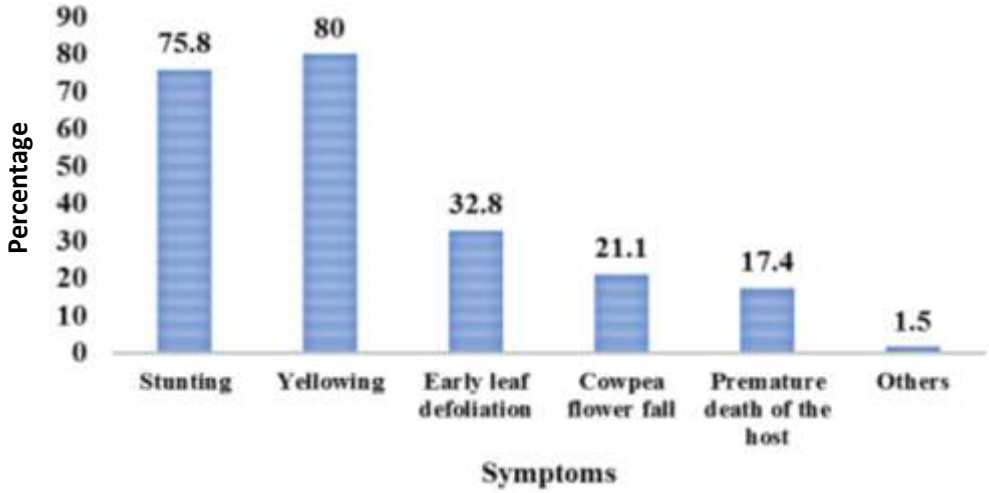

Figure 6. Proportions of different symptoms of *Striga gesnerioides* attacks on cowpea.

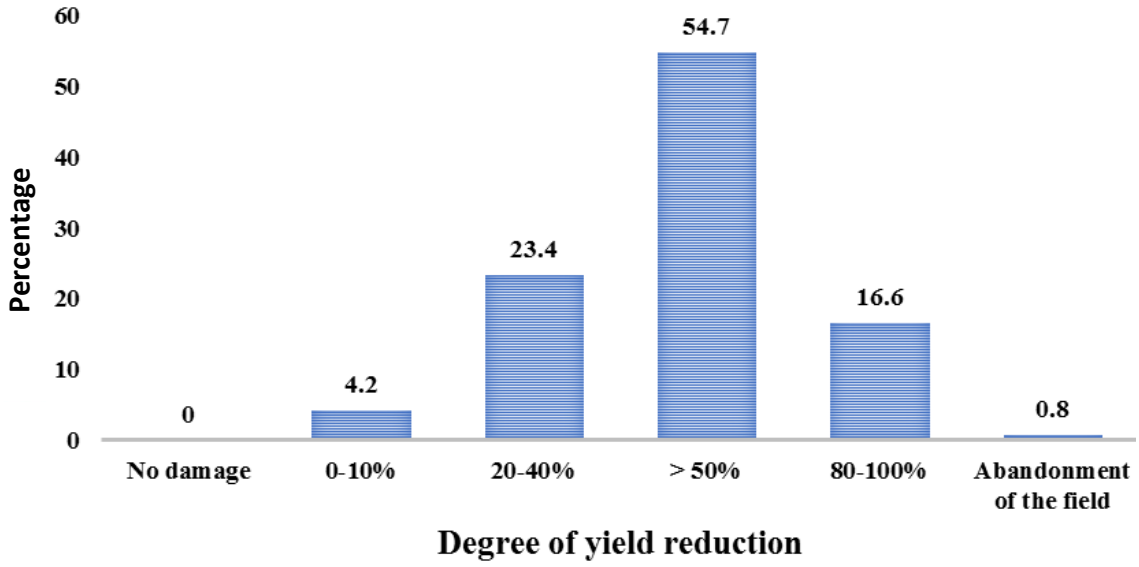

Figure 7. Estimated yield losses due to *Striga gesnerioides*.

Table 3. Estimate of cowpea yield losses per region.

Region	0-10%	20-40%	>50%	80-100%	Field abandonment	Total	Chi-square	P-value
Boucle du Mouhoun	5	10	24	6	2	47	58.686	0.029
Centre-Nord	5	8	17	5	0	35		
Centre-Ouest	0	7	18	9	0	34		
Est	0	2	21	5	0	28		
Sahel	0	10	13	3	0	26		
Centre-Sud	0	7	17	1	0	25		
Haut-Bassins	1	2	12	5	0	20		
Plateau-Central	1	5	6	3	0	15		
Nord	0	1	8	4	0	13		
Cascade	0	7	3	1	0	11		
Sud-Ouest	0	3	6	2	0	11		
Total	12	62	145	44	2	265		

Main strategies used by farmers to control *S. gesnerioides*

The most widely indigenous practice used for controlling *S. gesnerioides* is manual uprooting before the parasite flowers (Figure 8). 86% of cowpea producers use method as the main technique of controlling *Striga*. In addition, cropping systems are practiced with the aim of reducing losses. In farmers' opinion, cowpea and cereals association prevent them from entire yield loss in case of severe *S. gesnerioides* attack because they will at least harvest the cereal crop planted. Moreover, some farmers among the *Nuni* ethnic group in Léo, believe that brushing their hoe with black goat fats will prevent emergence of *Striga* or mitigate its damages.

Social utility of *S. gesnerioides*

The results of the survey revealed that *S. gesnerioides* and other species of the genus *Striga* have no culinary use for humans. Only 27% of the producers surveyed stated that *Striga* has some virtues for humans and animals (Figure 9). Both fresh and dry *Striga* plants are consumed by livestock.

The donkey is the animal which grazes more on *Striga* according to the farmers interviewed. In addition to the donkey, it is occasionally grazed by camels, horses, oxen and small ruminants.

On the medicinal level, *S. gesnerioides* is said to play a significant role in human and animal health. In terms of human health, it would be used to repel mosquitoes

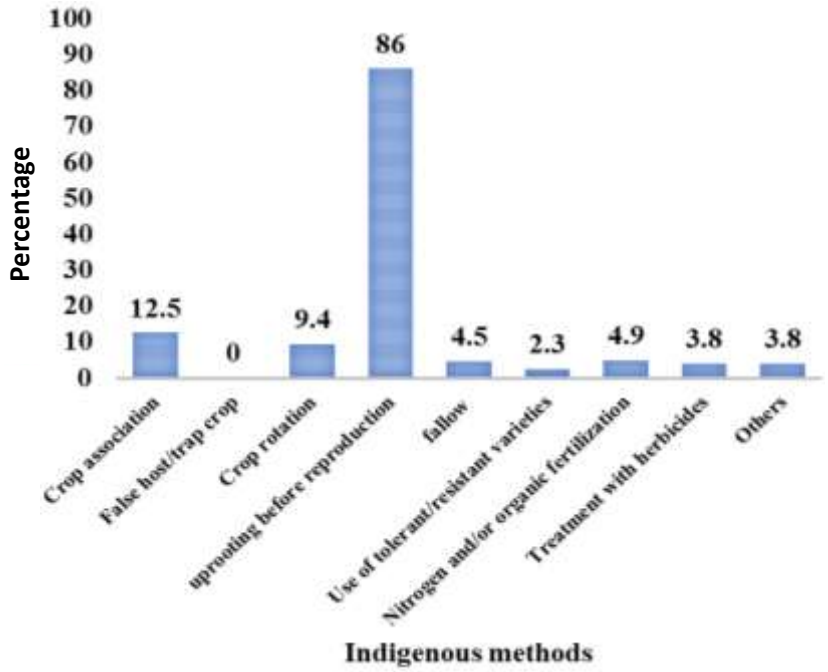

Figure 8. Indigenous control methods against *Striga gesnerioides*.

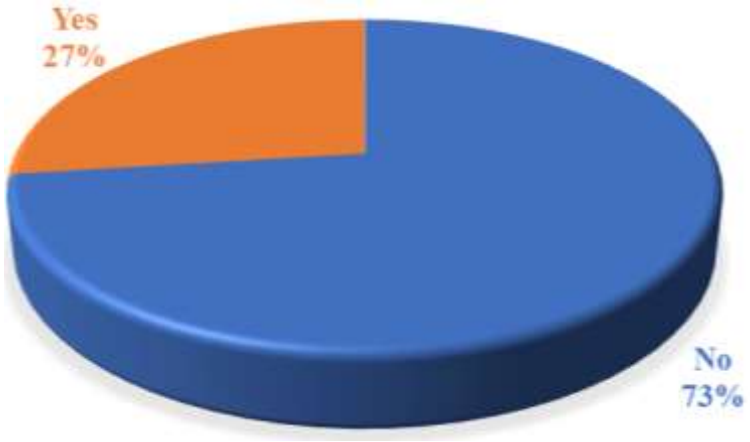

Figure 9. Use of *Striga* (Yes: useful for humans; No: not useful for humans).

through its mosquito repellent properties. It would also be used in wound dressings and wound healing. In addition, it would be used in children as a decoction to increase their appetite and to lower fever by purging them. Among other things, it would treat heartaches, earaches, bellyaches in children, diabetes, yellow fever, snake bites, etc. In terms of animal health, *Striga* is used to treat belly bloating and urinary problems in animals. Indeed, an infusion of *Striga* would facilitate and/or accelerate delivery after parturition in animals when the placenta is slow to be ejected. Finally, *S. gesnerioides* would intervene on the mystical level, in the preparation of certain magic potions to counter bad tongues (curses).

DISCUSSION

This investigation revealed that *S. gesnerioides* is well known by farmers since their identification criteria such as size, bushy habit, presence of large haustorium are specific to *S. gesnerioides* (Spallek et al., 2013). This large haustorium comparable to the tubers of broomrape

tubers, ensures its fixation on the host roots and serves for nutrients uptake (Dafaallah, 2019). Farmers' awareness of *S. gesnerioides* was also reflected through its local names which all refer to the symptoms and damages. In fact, farmers knew very well that *Striga* attack leads to cowpea plants stunting, leaf discoloration and drop off and plants death in heavily infested fields. Similar symptoms have been reported by Haruna et al. (2018). Tignegré (2010) and Dieni et al. (2019) reported that farmers in Burkina Faso are well aware of *Striga* and ranged it as one of the major constraints to cowpea production.

From farmers' opinion, cowpea yield losses due to *S. gesnerioides* ranged from 20 to 100% depending on the degree of infestation. Similar results have been reported in previous researches (Ibrahim et al., 2017; Runo and Kuria, 2018). The entire yield loss often leads farmers to abandon their fields and sometimes cowpea production as well (Haruna et al., 2018). However, farmers' awareness of *S. gesnerioides* varied from region to another. The weed was very well known in both Sahelian and north-Sudanian zones whilst in the south-Sudanian zone farmers were less aware of its effects. This can be explained by the low degree of *S. gesnerioides* infestation in this area as a result of relatively recent occurrence of the weed in this part of country. For example, the study revealed the presence of *S. gesnerioides* in cowpea fields in Niangoloko, which was free of *Striga* infestation, but the extent of the infestation is negligible yet. Several consecutive years cowpea production on less fertile soils, might have favoured this infestation since *Striga* preferable invades poor soils. These observations corroborate those of Sibhatu (2016).

As regard to management strategies, the surveys revealed that manual uprooting is the most widely used local method for controlling *Striga* across the country. This method appears to be the easiest and most accessible to farmers. As such, it has been reported as the main local strategies to control *Striga* in Ghana (Haruna et al., 2018).

Another cultural practice used to control *Striga* is fertilizer application. Both farmers and researches are aware of the importance of soil fertility as a factor limiting *S. gesnerioides* virulence on cowpea and it impact of yield (Omoigui et al., 2017). Knowing that the degree of *Striga* spp. infestation increases in low soil fertility conditions and vice versa (Larweh, 2016; Gebreslasie et al., 2018). In addition to these methods, farmers asserted that they leave highly infested fields to fallow for some years or practice crop rotation in order to reduce the intensity of the infestation. However, the success of these methods is conditioned by the availability of arable lands. The efficiency of fallow is limited by two factors: the ability of *Striga* seeds to remain viable in the soil for more than ten years (Sibhatu, 2016; Runo and Kuria, 2018) and the existence of its alternative hosts that contributes to maintaining the parasite in infested areas (Sawadogo et al., 2020). The use of resistant varieties was not very successful according to some farmers. However, this method is the most efficient and the most protective of the environment (Haruna et al., 2018). The issues encountered by farmers with this method can be explained by host-parasite specific resistance on one hand and on the other hand by the phenomenon dealing with breakdown of resistance. The over-use of generations of certified seeds of the resistant variety leading to decrease in varietal purity may also be another reason. It is therefore necessary to strengthen farmers' technical capacities for a proper use of this method which will facilitate the control of the weed.

Although *S. gesnerioides* is drastically affecting cowpea production, farmers recognized that it has some useful virtues. Medical use like cancer treatment of other parasitic weeds have been reported (Strüh et al., 2012). A biological insecticide property of *S. hermonthica* against storage insects of cowpea (*Callosobruchus maculatus* (Fab)) has been mentioned by Kiendrebeogo et al. (2006). Jansen (2005) has reported on the social utility of the weed. However, parasitic weeds like *S. gesnerioides* remain by far more noxious to human being than they can serve him. Therefore, appropriate control strategies should be developed for minimizing its damages on cowpea production.

Conclusion

Farmers in the different regions identified *S. gesnerioides* by its short height, bushy growth habit and haustorium. Their estimations of yield losses caused by *Striga* ranged between 20 and 100%. The widely indigenous control method used by farmers is hand weeding. In spite of its harmfulness to cowpeas, *S. gesnerioides* is still of considerable importance in the field of human and animal health. Thus, the vegetative and reproductive parts of the parasite are used in the treatment of several human and animal diseases. However, they show a feeling of helplessness towards this parasitic plant which is the cause of significant damage. To better counter the harmful effects of *Striga* on crops, the development of varieties with stable resistance seems to be the best solution adapted and accessible to the context of sub-Saharan Africa, which is characterized by family and subsistence agriculture.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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