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Research Paper

Major Constraints to Maize Production in the Sudano-Sahelian Zone of Cameroon and Different Control Techniques Against *Striga hermonthica* Adopted by Maize Producers

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Abstract. In the Sudano-Sahelian zone of Cameroon, *Striga hermonthica* constitutes a major threat to maize production. Maize producers have many practices or techniques to control *S. hermonthica* but these practices or techniques have not yet been documented. The objective of this study was to do an inventory the practices used by the farmers to control *S. hermonthica* in the Sudano-Sahelian zone of Cameroon. The present study was carried out in six (6) localities including Bocklé, Gaschiga, Pitoa, Meskine, Gazawa and Bogo in the North and far-North regions of Cameroon. Nine hundred (900) maize producers i.e. hundred and fifty (150) per locality were randomly chosen and surveyed. According to the sociocultural characteristics of the respondents, maize was more cultivated by the males (61.2%). Many producers (54.2%) were youths and most of them (78.4%) were educated. Majority (86.6%) of the respondents were married. Majority of those surveyed were Christians (59.1%) followed by Muslims (33.8%). A good number (33%) of the respondents had some experience in maize production ranging from 5 to 10 years. Many of the farmers preferred to use local seeds (77%). To prepare their farms, many (48.7%) of the farmers often used animals for ploughing. A good number (34.7%) of those surveyed were cotton producers while the others (65.3%) produced only food crops. The most important constraints included: the parasitic weed *Striga hermonthica*, the loss of soil fertility, the unfavorable climatic conditions, the weak access to the credit, the intermittent dryness, the low price of the agricultural products, the high cost of farm inputs, irregular rainfall, the lack of labour, the damage due to the fall armyworm, heavy rainfall, crop diseases (striation, coal,…), poor accessibility of the high production zones, and ignorance of appropriate agronomic techniques by producers. According to maize producers of the study sites, the symptoms of *S. hermonthica* were: maize stunting (84%), bad formation of ears (93.2%), seedling deaths (87.7%) and poor yield (96.9%). To face this threat, the maize producers used seventeen techniques of which the most used included: the chemical fertilization (99.1%), roguing (95.3%), use of post-emergence herbicides (87.9%), crops rotation (78.6%) and fallowing (66.8%).

Keywords: *Striga hermonthica*, *Zea mays* L., control techniques, Sudano-Sahelian zone of Cameroon.

INTRODUCTION

Maize (*Zea mays* L.) is an allogamous plant belonging to the family of Poaceae. It is one of the most cultivated crops in the world and may be the first cereal produced before the wheat (Tahir *et al.*, 2009; Missihoun *et al.*, 2012). It is

the main basic food crop which supports the food safety of the households in the Sub-Saharan African countries (Badu-Apraku *et al*., 2020). Maize is cultivated in the five agro-ecological zones of Cameroon including Sudano-Sahelian, high Guinean savannas, western highlands, and humid forests with monomodal as well as bimodal rainfall zones (Mafouasson *et al*., 2017). Maize grain contributes more than 150 billion FCFA of the gross domestic product in Cameroon (MINADER, 2010; Ngomeni *et al*., 2014).

In spite of the high potential and crucial role of maize in Cameroon, its production level and yield per hectare is still low compared to the world's average production (Mageto *et al*., 2017). Maize production and its productivity are threatened by drought, poor soil fertility and *Striga hermonthica* infestation (Das *et al*., 2019).

In the far-North region of Cameroon, maize production dropped by 15% over the period from 2018 (299,488 tons) to 2019 (254,081 tons). The same tendency was observed on the surface area of production with 138,176 ha for the year 2018 and 127,521 ha for the year 2019. This decrease was particularly observed in Mayo-Tsanaga division (-12%) which remains the first maize production basin of the region, followed by Logone-Chari division (-32.6 %) (MINADER, 2020).

Maize production in the North region of Cameroon remained stable over the same period, with approximately 601,000 tons of production in 232,777 ha and mainly produced in Benoue and Mayo-Rey divisions (MINADER, 2020). Due to the loss of soil fertility, expensive nature of chemical fertilizers, disturbances of rainfall pattern due to climate change and *Striga hermonthica* infestation, a considerable reduction of maize production has been witnessed (Naitormbaidé *et al*., 2015). Studies undertaken on the interaction of the stress factors showed that in the West and Central Africa, maize grain yield reduction has increased from 42 to 65% due to *S. hermonthica* infestation (Badu-Apraku *et al*., 2004; 2010). During its entire underground phase, *S. hermonthica* depends entirely on the host plant (Traoré, 1999) and its severe infestation can involve a loss of production from 50 to 100% (Doggett, 1988; Watson *et al*., 2007; Sunda *et al*., 2012). In Cameroon, the partial or total losses due to *S. hermonthica* are mainly observed in the Sudano-Sahelian Savannas.

Losses caused by *S. hermonthica* are estimated around 40% on average, but total losses can occur in the zones of high infestation (Ayongwa *et al.*, 2010). *S. hermonthica* is a major problem which affects the production and the quality of cereals in the savanna conditions. Several methods, including changes in agricultural practices, were adopted to solve this problem. In Sub-Saharan Africa, the methods to control *S. hermonthica* usually include the manual weeding, chemical control and intercalated cultures with trap cultures (Gloria *et al*., 2021). Dugje *et al.* (2010) described several measures of *S. hermonthica* control strategies such as roguing, the use of trap cultures, application of nitrogenous fertilizers, the use of the post-emergence herbicides, intercropping of cereals and legumes, crop rotation and host plant resistance.

In the Sudano-Sahelian zone of Cameroon, the maize producers have a wide range of methods to control *S. hermonthica* but these methods have not yet been documented. The present study was then carried out to evaluate the local techniques adopted by the farmers to control *S. hermonthica* in order to reduce maize yield losses caused by this parasitic plant and thus improve maize production with the aim of reducing hunger and poverty in the North and far-North regions of Cameroon.

Materials and Methods

Study Sites

The present study was carried out in two regions which constitute the Sudano-Sahelian zone of Cameroon covering the North and far-North regions. These two regions are among the most important maize production basins of Cameroon. In each region, three localities were selected including Bocklé, Gaschiga and Pitoa in the North region and Meskine, Gazawa and Bogo in the far-North region. These localities are close to the large cities Maroua and Garoua where the demand for dry and fresh maize is very high.

Data Collection

Primary data were collected by taking into consideration the following criteria: level of maize production in the area, respondents' experience in maize production, *S. hermonthica* control and level of *S. hermonthica* infestation. The choice of the localities was done with the help of the Heads of Investigation units and Agricultural Statistics of the Regional Delegation for Agriculture and the Rural Development of North and Far-North Regions and their collaborators who were used as facilitators throughout the study. A participatory rural appraisal approach was conducted through focus group discussions and individual questionnaires were administered to the maize producers while taking into account the subdivisions and villages they came from. Two facilitators chosen according to their knowledge of the zone and the local language were taken to facilitate the communication. Information obtained from the Sub Divisional Delegation for Agriculture and Rural Development facilitated the selection of *S. hermonthica* infested maize fields in the various neighborhood.

At the level of each neighborhood, an interview in a focus group was carried out with a group made up of the neighborhood head and maize producers chosen according to their knowledge in maize production and good reputation within the community. These groups were established with men and women of different ages and

social classes. A total of 36 neighborhood were surveyed with six per locality. Information collected were related to maize production and constraints, *S. hermonthica* species in their farms, as well as the symptoms of *S. hermonthica* attack on maize and the techniques of control adopted by the producers against the parasite. Individual questionnaires were administered to twenty-five potential producers identified during the focus group discussion of each neighborhood. A total of 900 producers were surveyed with 150 maize producers per locality. The information collected at the individual level were related to: socio-cultural characteristics of the producers (sex, age, educational level, marital status, religion and ethnic groups), the cropping system practiced in the Sudano-Sahelian zone of Cameroon (experience in maize production, surface of maize farms, land preparation methods, preferred season of maize production, type of varieties used, difficulties encountered in the acquisition of the improved seeds, and characteristics of the local varieties); density and impacts of *S. hermonthica* on maize; indigenous techniques to control *S. hermonthica* and the type of assistance offered by the Cameroon government and non-governmental organizations in maize production and control of *S. hermonthica* in the Sudano-Sahelian zone of Cameroon.

Secondary data was collected in each subdivision by interviewing and administering individual questionnaires to the Sub-divisional Delegate for Agriculture and Rural Development and by the use of annual reports of the respective Delegate for Agriculture and Rural Development.

Statistical Analyses

Data collected at the time of the investigation were typed and organized using Microsoft Excel 2013 software. The statistical analysis software, SPSS (Statistical Package for Social Science) version 20.0, was used to make cross dynamic tables on the qualitative parameters and relationships between the sociocultural factors and the seasons and the varieties used by the producers, the density of *S. hermonthica* and the impacts of *S. hermonthica* on maize production in the six localities. Chi-square test was considered significant at a probability level of $P<0.05$.

Results

Primary Data

Distribution of Maize Producers in the Study Sites

Table 1 presents the distribution of the maize producers in Bocklé, Pitoa and Gashiga in the North region and Meskine, Gazawa and Bogo in the far-North region according to their sociocultural characteristics. Generally, maize production was mostly carried out by men (61.2%) as compared to women (38.8%). However, no significant difference ($P=0.059$) was noticed between the six localities regarding the proportion of men implied in maize production in the six localities with 62.0% in Meskine, 66.0% in Gazawa, 68.7% in Bogo, 61.3% in Bocklé, 53.3% in Pitoa and 56% in Gashiga. A similar observation was recorded with women representing 38.0% in Meskine, 34.0% in Gazawa, 31.3% in Bogo, 38.7% in Bocklé, 46.7% in Pitoa and 44.0% in Gashiga.

The majority (54.2%) of maize producers were youths in which 30.4% were aged from 25-35 years old and 23.8% aged from 35-45 years old. Few peasants represented age ranged from 65 to 75 years old (2.9%). However, no significant ($P=0.203$) difference was noticed between age ranges and localities studied.

Regarding educational level of the maize producers, it varied significantly ($P=0.003$) from one locality to another. The majority (78.4%) were at least educated with 39.8% who ended their studies at the primary level, 34.4% reached secondary level and 4.2% attained post-secondary level, while 21.6% were illiterates.

With regard to the marital status of the maize producers in the six sites studied, the majority (70.2%) were married, 12.2% widowed, 4.2% divorced and 13.4% single. According to religion, the majority of surveyed maize producers were Christians (59.1%), 33.8% were Muslims and 7% for the other religions. Chi-square test showed a significant variation ($P=0.000$) among the different religions in the six sites studied.

Distribution of Respondents Based on Their Years of Experience in the Production of Maize

The distribution of the respondents according to their experience in maize production was gathered as follows: 33% had experience ranging from 5 to 10 years, 23.3% ranged from 15 to 20 years, 22.1% from 10 to 15 years, 14.9% from 1 to 5 years and 6.7% had more than 20 years of experience (Figure 1).

Distribution of Respondents Based on the Varieties Cultivated in the Study Sites

Approximately, 9% of the surveyed farmers used the improved maize seed varieties during the 2020 cropping season due to the unavailability and the high cost of the seeds at the time of sowing (Figure 2). The farmers preferred to use local seeds (77%) for various reasons among which are the low cost of this seed, its availability, and its capacity to be recycled.

Distribution of Respondents in Relation to the Methods of Land Preparation before Planting

Figure 3 shows that the majority (48.7%) of the respondents used animals for ploughing their farms while

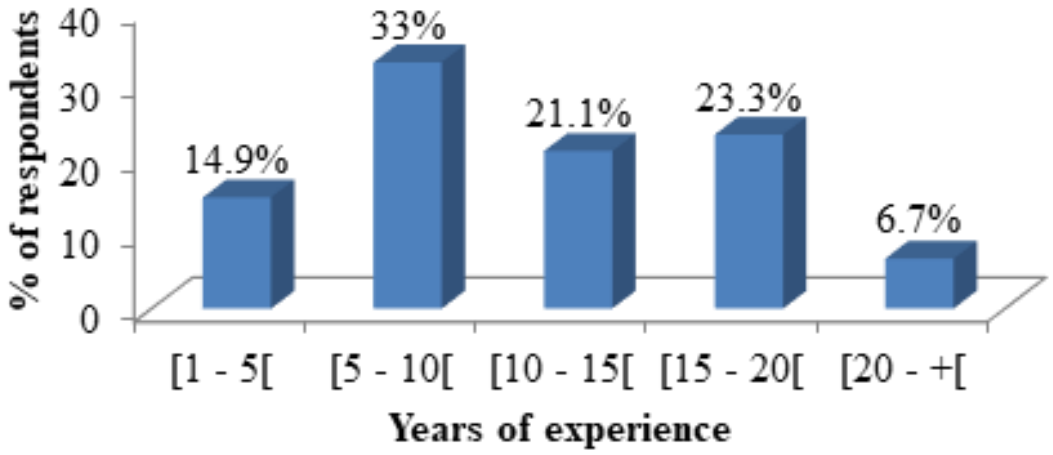

Figure 1. Distribution of Respondents Based on Their Years of Experience in Maize Production.

Table 1. Distribution of the respondents according to socio-demographic characteristics.

Parameters	Far North Region			North Region			Total	P-Value
	Meskine	Gazawa	Bogo	Bocklé	Pitoa	Gaschiga		
Sex								
Male	62	66	68.7	61.3	53.3	56	61.2	P=0.059
Female	38	34	31.3	38.7	46.7	44	38.7	
Age ranges								
15-25	4	8.7	4	14.7	10.7	8	6	
25-35	25.3	32	32.7	31.3	32	30.4	29.3	
35-45	28	25.3	23.3	18.7	25.3	23.8	24	P=0.203
45-55	25.3	18	20.7	16.7	16	20.1	24	
55-65	16	12.7	16	16	13.3	14.8	14.7	
65-75	1.3	3.3	3.3	2.7	2.7	2.9	4	
Educational level								
None	29.3	15.3	17.3	19.3	14	33.3	21.6	
Primary	36.7	37.3	46	40	46	33.3	39.8	P=0.003*
Secondary	30.7	40.7	33.3	35.3	36	30.7	34.4	
Post-secondary	3.3	6.7	3.3	5.3	4	2.7	4.2	
Matrimonial status								
Married	75.3	67.3	60.7	76	65.3	76.7	70.2	
Single	7.3	17.3	19.3	9.3	18	8	13.4	P=0.046*
Widowed	14	10.7	14	11.3	12.7	11.3	12.2	
Divorced	3.3	4.7	6	3.3	4	4	4.2	
Religion								
Christian	58	45.3	63.3	65.3	5.3	47.3	59.1	
Muslim	34	49.3	32	25.3	18	44.7	33.8	P=0.000*
None	8	5.3	4.7	9.3	6.7	8	7	
Christian	58	45.3	63.3	65.3	5.3	47.3	59.1	

(26.8%) used zero tillage and the application of post-emergence herbicides; 17.4% had access to mechanization and used the tractor for the preparation of their lands, 4.3% used non-selective and 2.8% made a direct seedling (Figure 3).

Distribution of the Respondents According to Crops Grown in the Study Sites

With regard to the crops grown in the study sites, 34.7% of those surveyed were cotton producers while the others

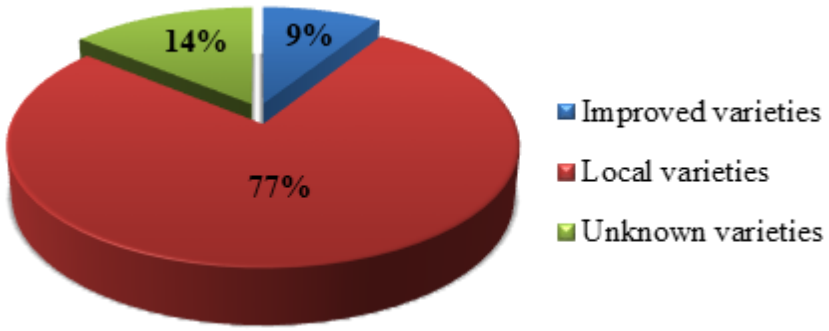

Figure 2. Distribution of Respondents Based on the Varieties Cultivated in the Study Sites.

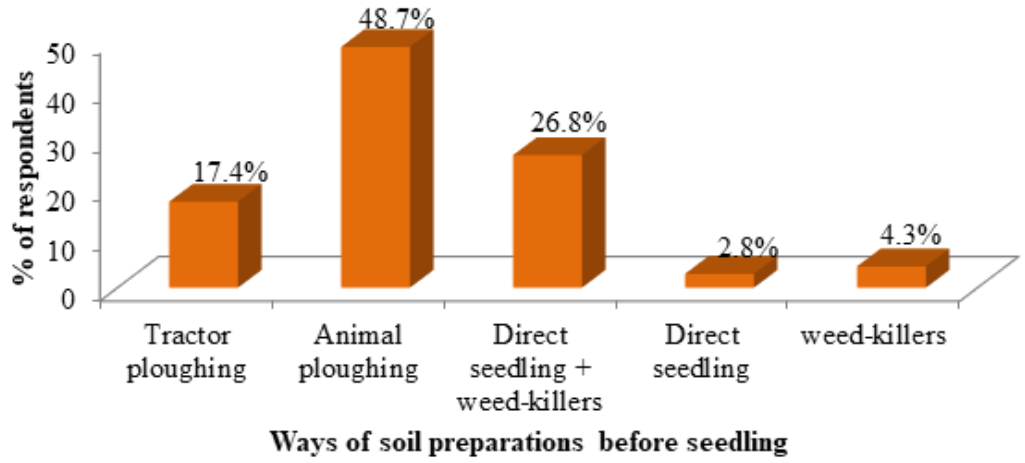

Figure 3. Distribution of Respondents in Relation with the Ways of Soil Preparation before Seedling.

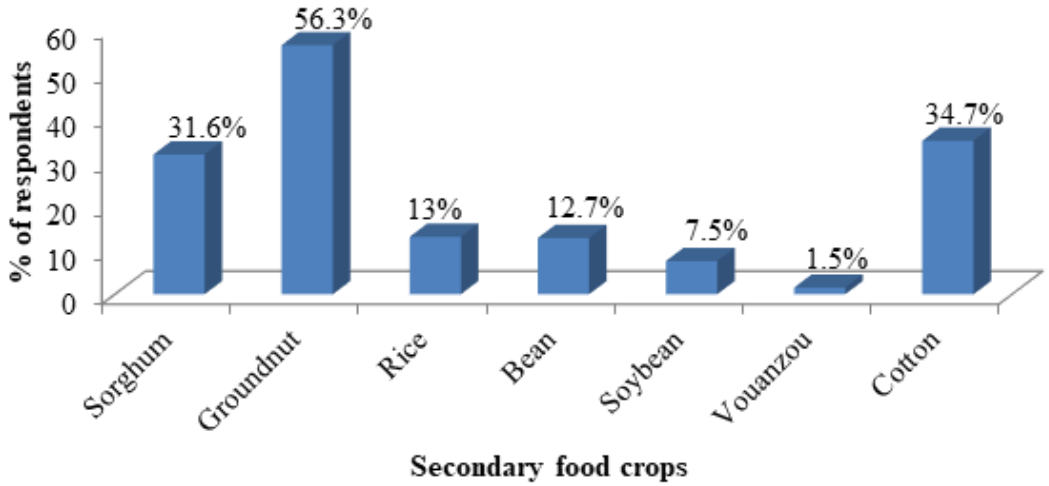

Figure 4: Distribution of Respondents in Relation to Secondary Food Crop Production

(65.3%) produced only the food crops (Figure 4). As for the food crops, 100% of those surveyed cultivated were maize alongside other crops like groundnut (56.3%), sorghum (31.6%), bean (12.7%), Bambara groundnut (1.5%), rice (13%) and soybean (7.5%) as also shown in Figure 4. These food crops are intended for family consumption;

Table 2. Distribution of Respondents in Relation to the *Striga* Density in the Six Study Sites.

Density of *Striga*	Far-North Region			North Region			Total	P-value
	Meskine	Gazawa	Bogo	Bocklé	Pitoa	Gaschiga		
Weak	14	23.3	12.7	14	8	10	13.7	
Average	50.7	52	50.7	48.7	26.7	44	45.4	P<0.0001*
High	35.3	24.7	36.7	37.3	65.3	46	40.9	

Table 3. Distribution of Respondents in Relation to the Impacts of *Striga* on Maize in the Six Study Sites.

Impact of *Striga* on maize	Far-North Region			North Region			Total	P-value
	Meskine	Gazawa	Bogo	Bocklé	Pitoa	Gaschiga		
Maize stunting	80.7	86.7	84	86.7	87.3	78.7	84	P=0.203
Bad cob formation	87.3	92.7	93.3	94.7	96	95.3	93.2	P=0.039*
Maize plant death	82	88.7	92	84	93.3	86	87.7	P=0.016*
Reduction of the yield	98	98	100	85.3	100	100	96.9	P=0.000*
Abandon of the farm	32	24.7	34.7	34.7	62.7	46.7	39.2	P=0.000*

only the surplus is sold at the market. The proximity of the markets as well as the existence of farm-to-market roads constituted significant factors for the production of food crops. The incomes were used for the primary needs (soap, oil, construction and improvement of the habitat, education of the children…).

Constraints on Maize Production in the Sudano-Sahelian Zone of Cameroon

The constraint to maize production in the Sudano-Sahelian Zone of Cameroon were multiple according to the respondents. The major constraints included: the parasitic weed *Striga hermonthica*, the loss of the soil fertility, the unfavorable climatic conditions, the weak access to the credit, the intermittent dryness, the low price of the agricultural products, the high cost of farm inputs, irregular rainfall, the lack of labour, the damage due to the fall armyworm, heavy rainfall, crop diseases (striation, coal,…), poor accessibility of the high production zones, and ignorance of appropriate agronomic techniques by producers. The parasitic weed *Striga hermonthica* was ranked as by % of farmers in all the localities. *S. hermontica* was present in the field of more than 97.7 % of farmers.

Distribution of the Respondents According to the Density of *S. hermonthica* in the Fields of the Maize Producers

From the analysis in Table 2, the density of Striga in the maize farms of the producers in the six study sites revealed that 45.4% of the respondents had their farms with an average level infestation of Striga, 40.9% of the respondents with high infestation level and 13.7% of these surveyed with weak infestation of Striga in their farms. However, a high significant difference (P=0.000) was noted between the six localities with regard to the various levels of infestation of Striga in the maize fields of the producers.

Distribution of Respondents in Relation to the Impacts of Striga on the Maize in the Six Study Sites

From this study, *S. hermonthica* negatively impacts the maize production in the agro-ecological zone studied. Eighty-four percent (84%) of the respondents attested that *S. hermonthica* induces the stunting of the maize plant (Table 3). However, there was no significant difference between the six study sites concerning the stunting of the maize plants. The bad formation of ears was due to *S. hermonthica* as reported by 93.2% of the respondents. There was a significant difference (P=0.039) between the various study sites for this attribution. With regard to the death of the maize seedlings, 87.7% of the respondents attested to the implication of *S. hermonthica*, with a high significant (P=0.016) difference noted between the six localities. The reduction of yield due to the parasite was reported by 96.9% of the respondents. The Chi-square test showed a significant variation (P=0.000) between the six study sites. A strong density of *S. hermonthica* pushes the farmers to abandon their maize farms. Within the framework of this study, 39.2% of the respondents were ready to abandon their farms because of *S. hermonthica*. There is a significant difference (P=0.000) between the six study sites for this willingness to abandon their farms.

Distribution of the Respondents According to the Control Methods of *S. hermonthica* in the Study Sites

Seventeen (17) indigenous techniques were used to control *S. hermonthica* in the Sudano-Sahelian zone of Cameroon (Table 4). The totality of the surveyed peasants (100%) estimated that the appearance of *S. hermonthica*

Table 4: Distribution of the Respondents According to the Control Methods of *S. hermonthica* in the Study Sites.

Types of control	Control strategy	Far-North Region			North Region				
		Meskine	Gazawa	Bogo	Bocklé	Pitoa	Gaschiga	Total	P-value
Cultural	Organic fertilisation	49.3	51.3	62.7	46.7	38.7	43.3	48.7	P=0.001*
	Chemical fertilisation	98	100	100	96.7	100	100	99.1	P=0.003*
	Crop rotation	78	76	86	92	69.3	70	78.6	P=0.000*
	Mixed cropping	21.3	16.7	16.7	19.3	17.3	32.7	20.7	P=0.004*
	Crop rotation	70	56	71.3	57.3	71.3	74.7	66.8	P=0.001*
	Manual cleaning	88.7	86.7	100	96.7	100	100	95.3	P=0.000*
	Pastured fallow	12.7	10	10	13.3	22.7	35.3	17.3	P=0.000*
	Simple fallow	12.7	10.7	8.7	2.7	7.3	9.3	8.6	P=0.049*
	Ash	46.7	28	22	20.7	15.3	14.7	24.6	P=0.000*
	Natron	14.7	16.7	0	0	12	7.3	8.4	P=0.000*
	Fertilisation chimique+Natron	30.7	22	20.7	15.3	21.3	18	21.3	P=0.034*
	Zero tillage	32.7	51.3	39.3	44.7	42.7	42.7	42.2	P=0.040*
	Burning of *Striga*	18	22	14	16.7	10	17.3	16.3	P=0.111
	Manual weeding	26.7	26	17.3	28.7	14.7	21.3	22.4	P=0.019*
Chemical	Pre-emergence of *Striga* seed-killers	0	0	0	1.3	4	0	0.9	
	Post-emergence of *Striga* seed-killers	87.3	93.3	93.3	80	85.3	88	87.9	P=0.000*
	The both	12.7	6.7	6.7	18.7	10.7	12	11.2	
Genetic	Previous crop varieties	6.7	7.3	8.7	3.3	10	13.3	8.2	P=0.047*
	No hybrids, resistants or previous crop varieties	93.3	92.7	91.3	96.7	90	86.7	91.8	

is due to the impoverishment of the soils in organic matter. Various techniques were used according to their effectiveness and the ways of implementation. In general, the peasants associated several techniques to control *S. hermonthica* provided they are less expensive.

The indigenous techniques to control *S. hermonthica* practiced by the peasants included: the organic fertilization (48.7%) by using the compost or manure (dung of cow or goats or chicken); the chemical fertilization (99.1%) by using the direct spraying of a manure solution (NPK) and/or urea on the seedling of *S. hermonthica*, thus allowing to reduce the production of seeds by burning the aerial parts of the parasitic plant; the rotation of crops (78.6%) by using false hosts (groundnut, cotton, bean, soybean, and Bambara groundnut) which are plants causing the germination of Striga seeds without being parasitized (germination commits suicide); mixed cropping (20.7%) by using species resistant to Striga and which have the ability to fix nitrogen (groundnut, bean, soybean…) or trap species to face Striga; the rotation (66.8%) of crops in a certain order by dividing the arable lands into great portions; fallow grazing (17.3%) by allowing animals to graze and deposit their dungs on a previously cultivated land, thereby improving its soil fertility; simple fallowing (8.6%) by allowing the degraded land during a certain period to restore its fertility; rogueing (95.3%) by manually pulling off of *S. hermonthica* emerged; manual weeding (22.4%) which is done with the hand by removing any foreign plant in the field including the parasitic weed; the use of potassium or sodium carbonate (8.4%) by amending the soil after having returned out of powder; the use of ash (24.6%) by pouring it on the seedlings with Striga; chemical+natron fertilization (21.3%) by mixing urea with the natron and spreading; the zero tillage (42.2%) while sowing without plowing with the animal haulage or the tractor but while using or not using weed-killers of contact; the burning of Striga 16.3%) by burning Striga with the crop waste products, bad grasses and the dead leaves of the farm; the use of pre-emergence (0.9%) weed-killers by using weed-killers containing (2,4-dichlorophenoxyacetic) applied on the surface of the soil after sowing, but before the emergence of the crop; the use of post-emergence herbicides (87.9%) by using products containing 2,4-D, of Paraquat, Glyphosate or Atrazine; the use of a combination of pre-emergence and of post-emergence (11.2%) by using them in a combination of 2,4-D+Paraquat, 2,4- D+Glyphosate and 2,4- D+Atrazine, in foliar application, after the emergence of Striga; and the use of the early maturing open pollination varieties acquired at the Institute of Agricultural Research for Development (IRAD) or in the regional services of the Ministry of Agriculture and the Rural Development. All the respondents (100%) did not use the high-yielding, early maturing maize hybrid resistant to *S. hermonthica*.

DISCUSSION

Most of interviewed maize farmers were mainly males (61.2%) as compared to women (38.8%). The majority of the questioned farmers were in the age range of 25-65 years old. In addition, the majority of the farmers had a primary level as their highest level of education (39.8%). The majority of those surveyed were Christians (59.1%);

33.8% were Muslims and 7% belonged to other religions. Oumarou *et al.* (2017) also reported that the distribution of the surveyed sample of study in the Sudano-Sahelian zone were mainly dominated by the males at Guirvidig and were entirely directed by the men in Mindif and Laf localities. Most of these men were married. The average age of men was beyond 45 years implying a level of maturity in the management of the farms. However, this experience was not accompanied by a good educational level in Guirvidig, contrary to Mindif and Laf where the majority of the family heads reached at least a level of primary study. With regard to the years of experience in maize production, the majority of those surveyed (52.1%) had more than 10 years of experience in the production of maize. These results are similar to those of Miti *et al*. (2007) who showed that in Zambia, the farmers who cultivated maize during more than 10 years in the local zone had yields more raised than the new farmers because they had acquired much experience in the production of maize.

The majority of the maize producers of the study sites (77%) used the local varieties. Epée Missé (2019) in the same agro-ecological zone had already shown that apart from cotton seeds provided to the farmers by SODECOTON, seeds of other food crops were bought from the local market and were of lower quality than the improved varieties. In the Sudano-Sahelian zone, cotton and food crops (maize, groundnut, sorghum, black eye bean, rice and soybean) are the main cash crops. Kenga *et al.* (2005) had already reported the principal food crops in North-Cameroon to include maize, Sorghum, groundnut and bean whereas the minor food crops were sesame, Bambara groundnut and vegetables. In the study zone, three approaches were used to control of Striga, namely the cultural , chemical and were practiced by the farmers. Seventeen techniques or practical approaches were used by the populations of the Sudano-Sahelian zone to control this parasite. Several of these techniques were among those identified in the Western zones of Kenya by Atera *et al.* (2013) and Oswald (2005) and in the East zone of Kenya by Lagoke and Isah (2010). Several control methods exist which can help to manage Striga infestations in the study sites. These include intercropping, crop rotation, manual weeding, improvement of the of soil fertility with inorganic or organic manure, fallowing, genetic resistance to the parasite, genetic resistance to the selective herbicides, seeds treatment, trap crops, road repair, "push-pull" technology, herbicides and biological control.

The cereals and cash crops are cultivated either in rotation or in intercropping. In the North and far-North regions of Cameroon, all the local population use the (pre-emergence. post-emergence and both) in the control of *Striga hermonthica*. These results are in accordance with those of Philippe *et al.* (2014) in which the chemical control involved treating the soil and the crops using weed-killers. According to these authors, chemical control remains the easiest and most economic method to use. The constraints other than *S. hermonthica* in the production of maize in the Sudano-Sahelian zone were multiple according to the respondents. They included the loss of soil fertility, the unfavorable climatic conditions, the low access to the credit, the intermittent dryness, the low price of the agricultural products, the high cost of farm inputs, irregular rainfall, the lack of labour, the fall armyworm attack, high rain, crop diseases, poor accessibility of the production zones, and the lack of technical follow-up. Epée Missé (2019) had earlier reported that the North and the far-North Regions of Cameroon were exposed to food insecurity as a result of unfavorable climatic conditions, poor soil fertility, attacks of Striga and cropping systems.

CONCLUSION

Striga hermonthica is a parasitic plant which hinders maize production in the Sudano-Sahelian Zone of Cameroon. Five significant effects of this parasitic plant exist which could reduce maize yields. They are: maize plant stunting, poor formation of ears, the death of the plant, the decrease of yield, and the abandonment of the farms. Seventeen (17) techniques for controlling *S. hermonthica* were used by the various maize producers of the Sudano-Sahelian Zone. These include the use of organic and chemical fertilizers; crop rotation; mixed cropping; grazed fallowing; simple fallowing; rogueing; manual weeding; the use of natron or sodium carbonate; ash, chemical and natron application; zero tillage; the burning of Striga; pre-emergence herbicides; Striga post-emergence herbicide application ; and the application of pre- and post-emergence weed killers previous crop varieties. Unfortunately, the producers do not use high-yielding early maturing and striga resistant hybrid varieties because these varieties are not available in this zone. Therefore, it is important to develop and make available such varieties. The use by farmers of these high-yielding early maturing and striga resistant hybrid varieties will certainly boost maize production in the Sudano-Sahelian zone where famine, malnutrition and poverty are high among the population. This will also lead to increase maize production in Cameroon in general.

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