Diversity of sweet potato cultivars (*Ipomoea batatas* L. Lam.) based on vernacular nominations and the constraints of their production in the Department of Ouémé in southern Benin

ABSTRACT

Sweet potato (*Ipomoea batatas* L. Lam.) is a neglected nutritional and food plant adapted to various environmental conditions of Benin. The objective of this study was to evaluate varietal diversity and production constraints of tree sweet potato in South Benin. Sampling "snowball" has been applied through three townships using the direct interviews with 42 producers identified in six villages. Statistical methods used to measure the varietal diversity include Shannon diversity indice, varietal richness and equitability (abundance). 23 local cultivars were listed including ten (10) regularly cultivated subject to synonymies. The results showed that Adjohoun township has cumulated average richness, index of Shannon and number equivalent most elevated (RC = 38; H = 2.49; Eq.E = 12.10). However, the most elevated equitability and more nearer to 1 (E= 0.71) is obtained in the township of Dangbo. The main constraints enumerated by the producers are absence of flow market, attacks of the devastating and illnesses and the non availability of the quality seeds. The establishment of conservation strategies is necessary to protect the genetic resources of sweet potato in Benin.

Key words: Local varieties Diversity, *Ipomoea batatas*, vernacular names, constraints, Southern Benin

1- Introduction

The sweet potato (*Ipomoea batatas* L. Lam.) presents a great nutritional and economic importance in the tropical and moderate regions [1]. It is the sixth food crop most significant in world production after rice, wheat, potato, maize and cassava [2] with a world production estimated at 104 MT in 2013 [3]. Sweet potato is a source of income for producers and an important food especially in period of welding. Moreover, their agronomic capacities (good productivity, cycle short, climatic changes and edaphic adaptation) constitute major assets to face the challenge of the food security in the context of the climatic changes in West Africa [4].

In spite of these importances, sweet potato belongs of the underused and neglected species as regards research in Benin [5]. But it is mainly cultivated by small producers within family small-scale farming where existing diversity is known and little valorized. Today, the cultures

32 are in an environment very changing under the effect of the climatic changes which affect

33 their development and their varietal diversity ([6]; [7]).

34 These threats which weigh on the species are likely to generate major difficulties for the

35 socio-economic life of the current populations and for future generations. They have serious

36 consequences such as species number reduction and their genetic diversity, disturbances of

37 biotic interactions and flows of nutriments and dynamic processes of ecosystems. However,

38 there is no centralized collection of sweet potato genotypes in Benin that would permit the

39 conservation and use of genetic material adapted to different ecological and agronomic

40 conditions. In the absence of collection, it is hardly conceivable to develop a breeding

41 program, the genetic improvement of sweet potato that can meet the needs of local

42 communities. Given the importance of sweet potatoes to rural communities, measures to

43 manage residual resources are urgently needed to ensure their sustainability. Indeed, the

44 sustainable management of speculation can not be a success without the inventory of the

45 existing and especially without the active participation of the local population. Srisuwan et al.

46 [8] revealed that the selection process is long and requires the use of a large number of

47 individuals. However, Sanoussi et al. [9] showed that some local varieties of sweet potato

48 disappear, leading to loss of diversity. Therefore, the inventory of existing local cultivars

49 would be a great asset not only to have a base of local varieties of sweet potato but also to

50 develop strategies for management and improvement of the species. The objective of this

51 work is to inventory the different sweet potato cultivars and the constraints of their production

52 in the department of Ouémé in South Benin.

53 ## 2- Material and methods

54 **2.1- Study area**

55 The study was carried out in tree townships Dangbo, Adjohoun and Bonou in Ouémé chosed

56 due to the high production of sweet potatoes in ouémé [10]. In addition, sweet potatoes

57 cultivation is dominant in the "valley" system [10], where the townships of Dangbo,

58 Adjohoun and Bonou are located.

59 The department of Ouémé located in Southeast of Benin has a total area of 1281 km^2, with a

60 population of 1096850 inhabitants in 2013 according to provisional results of the census

61 General of Population and Habitat. It is bounded on the south by Atlantic Ocean and the

62 Department of Littoral, North by the Department of Plateau, West by the Department of

63 Atlantic and East by the Federal Republic of Nigeria. It comprises nine townships: Adjarra,

64 Adjohoun, Aguégués, Akpro-Missérété, Avrankou, Bonou, Dangbo, Porto-Novo, Sèmè-

65 Kpodji. This department enjoys a subtropical climate with two rainy seasons: a large one from
66 April to July, a small one from September to November, and two dry seasons, a small one
67 from August to September, the big one from December to March. This favors the production
68 of sweet potato during both seasons both on the plateau and in the liable to flooding plain.
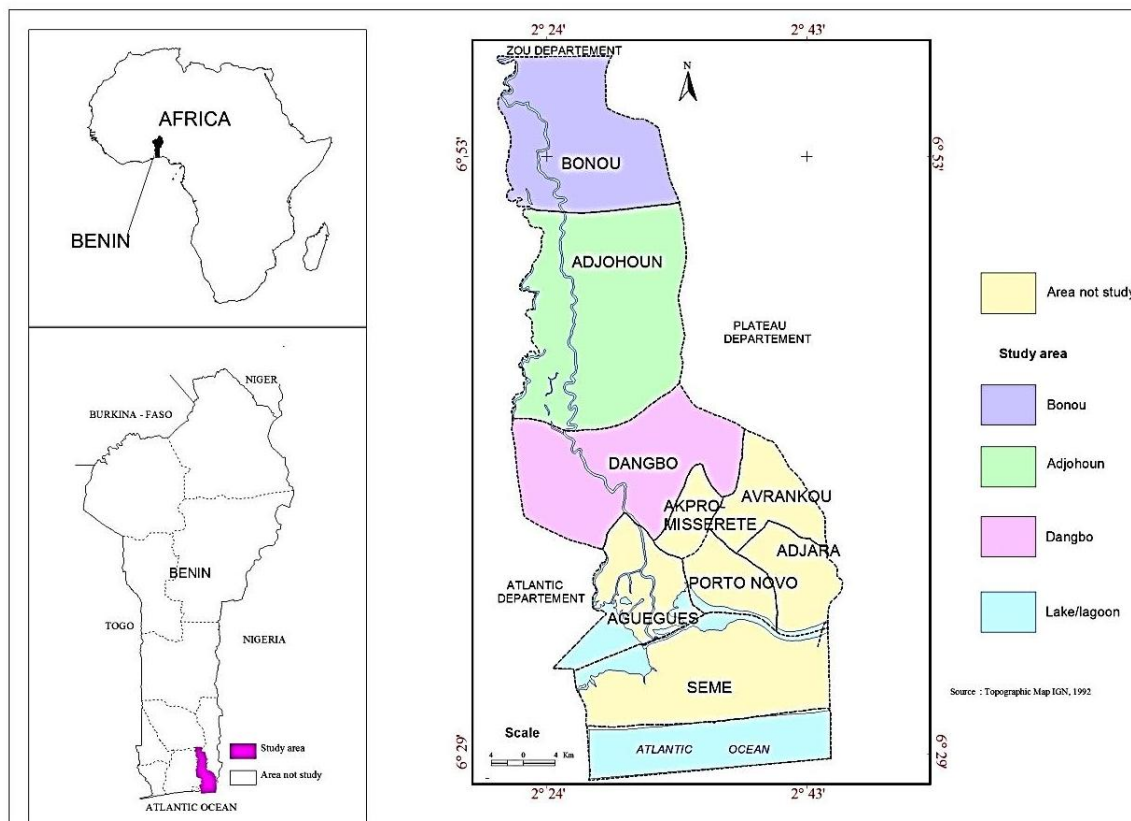
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70 **Figure1:** Study area

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72 **2.2- Data Collection**

73 The inventory of sweet potato cultivars was carried out in six villages known to be accessible
74 areas and producing sweet potato from the department of Ouémé. In each village, the varietal
75 inventory was done in a participatory manner according to Kombo et al. [11]. Producers are
76 identified using the snowball sampling method [12] . In the first instance, a random draw was
77 carried out among the producers targeted by the head of each of the six villages. Then, each of
78 the selected producers is asked to identify other sweet potato producers. The survey was
79 carried out through individual interviews on the basis of a semi-structured questionnaire.
80 After a brief presentation of survey objectives to producers, they were asked to list all local
81 varieties (vernacular names) grown or not grown in the village. In the field with the producer,
82 the samples were collected to ensure the actual presence of the different local varieties still

83 cultivated. Information on socio-demographic data (age, sex and ethnic group), criteria for
84 recognition of local cultivars by growers and their perceptions of this crop was identified.

85 **2.3- Data analysis**

86 The survey data were processed using the Sphinx software (Version 4.5) to determine the
87 abundance of different cultivars nominated by producers and the variability of the perceptions
88 relative to the constraints. The chi^2 test was calculated on the table of citations (marginal
89 numbers equal to the sum of the rows / columns).
90 To characterize the diversity of cultivars, three indices such as cumulative wealth, Shannon
91 diversity indices, and equitability were calculated at each village and township level.
92 Cumulative wealth is the number of times the cultivar was cited by producers and was
93 calculated from villages and township from inventories. The Shannon diversity index denoted
94 (H) is calculated by the following formula:
95 $H = -\sum fi*Lnfi$ with $fi = ni/N$
96 Where (fi) is the abundance of cultivar "i" in the study unit considered; ni is the number of
97 fields where the first variety, N is the total number of fields in the study unit; Ln is the basic
98 natural logarithm 2.
99 Equitability reflects differences in abundance between varieties. It is the ratio between the
100 equivalent number of Shannon and the accumulated wealth (RC): $E = EqH / RC$.
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103 # 3- Results

104 **3.1- Sociodemographic data of the respondents**
105 In the three townships, 42 sweet potato producers were interviewed, of whom 92.86% were
106 men compared with 7.14% women. The majority of respondents were between 30 and 50
107 years old (57.14%) and 35.71% were over 50 years of age (Figure 2). In total, three ethnic
108 groups were surveyed (Ouémin, Aïzo and Fon), of which the majority of the Ouémins were
109 women (72%). Moreover, independence test of Chi^2 shows that the distribution of
110 respondents according to sex, age and ethnicity is independent to villages and townships (Chi^2
111 = 23.32; 1-p = 38.57 %.).
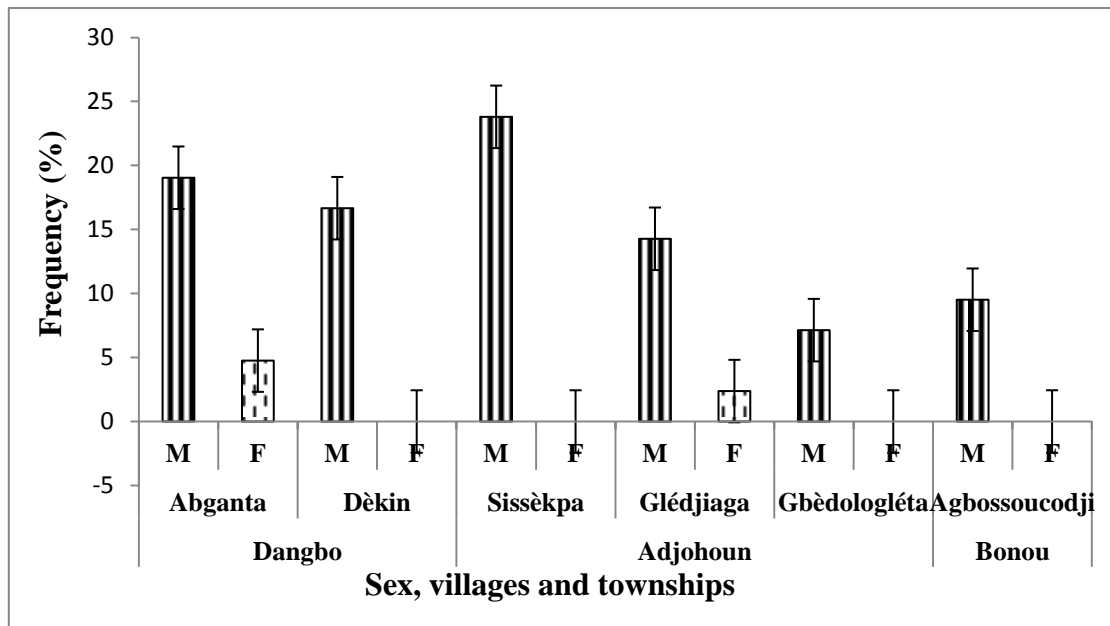
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113 *M: masculine F: feminine*

114 **Figure 2: Distribution of respondents by sex by township**

115 **3.2- Diversity of sweet potato cultivars in the department of Ouémé**

116 The results show that the producers listed 23 cultivars in the three townships subject to
117 synonymies (Figure 3). The diversity of cultivars based on vernacular nominations varies very
118 significantly from one village to another and from one township to another (chi^2 = 392.40, ddl
119 = 110, 1- p > 99.99%). However, the field visit with the growers revealed that in all six
120 villages, out of 23 sweet potato cultivars cited, 10 cultivars were produced (Figure 4).
121 Moreover, the distribution of these 10 cultivars depends very significantly from one village to
122 another (chi^2 = 128.62, ddl = 45, 1- p > 99.99%). The cultivar "Vobodouaho" is mainly
123 produced in all municipalities. The cultivars "Mêché" and "Tolican" were produced only in
124 Bonou and Adjohoun, respectively. On the other hand, cultivars such as "Djlodou",
125 "Adogoué", "Amihouédé", "Zohoungogo", "Adogbo" and "Madohouè" were only found in the
126 most diverse Dangbo (Figure 4&5).
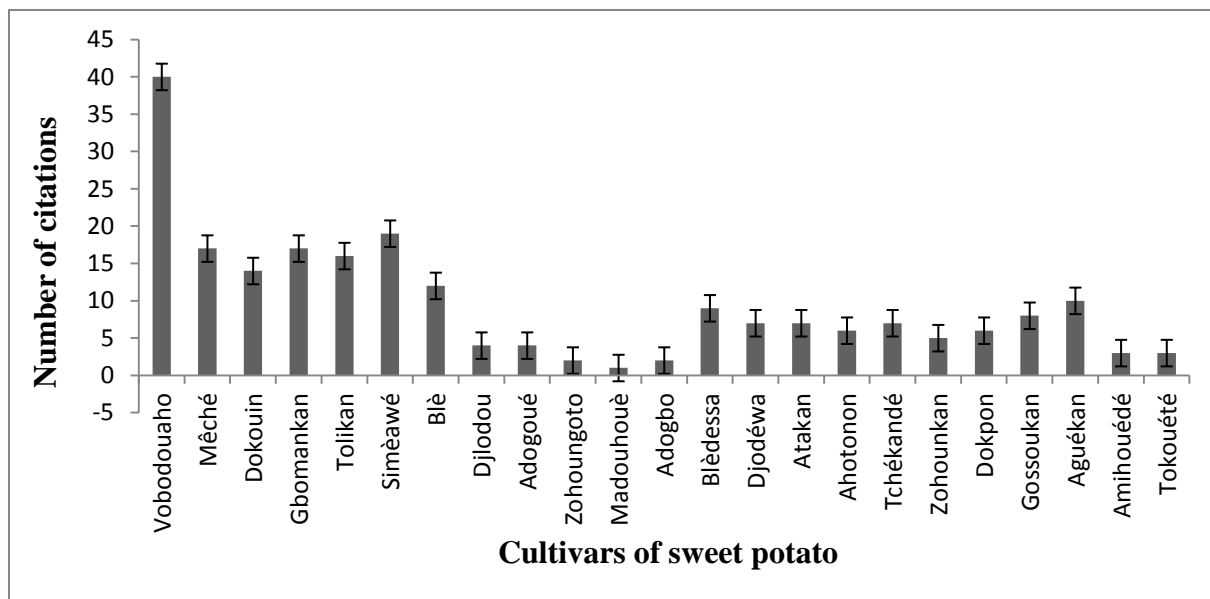
Figure 3: Local Sweet Potato Cultivars Cited by Producers
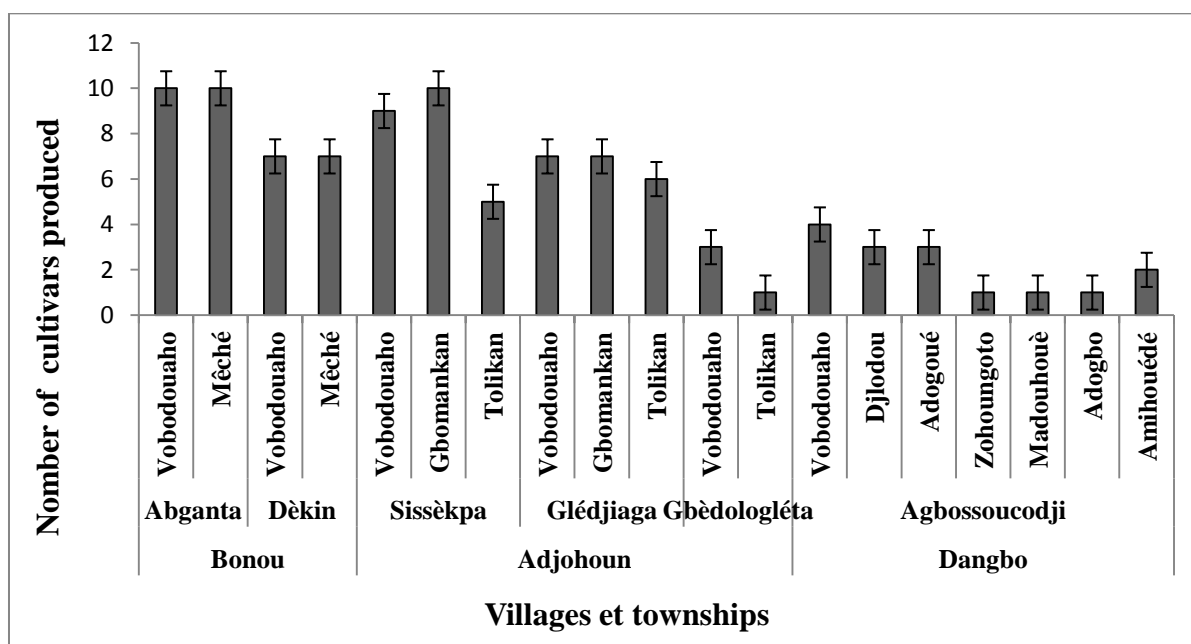
Figure 4: Abundance of cultivars produced by villages and townships

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A: Djlodou; B: Amihouèdé; C: Adogoué; D: Zohoungogo; E: Madouhouè; F: Adogbo

Figure 5: Rare and endemic local varieties listed in the prospection area

3.3- Diversity Index: Cumulative Wealth, Shannon Index, Equivalent Shannon Number and Equitability

Table 1 indicates that the cumulative wealth of cultivars is higher in Sissikpa (18), Glédjiaga (15) and Agbossoucodji (15) but lower in Gbèdologléta (5). The index and the equivalent Shannon number of Agbossoucodji cultivars (H = 2.36, Eq.H = 10.60) were high. In comparison to the other five villages (Agbanta, Dčkin, Glédjiaga, Sissikpa and Gbèdologléta), the index and the equivalent number of Shannon of the cultivars were low. Thus, varietal equitabilities are close to draw and differ little between these villages (Table 1).

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150 **Table 1: Equitable distribution of cultivars in villages**

Villages	RC	H	Eq.H	E
Agbanta	12	0.61299075	1.84594391	0.15382866
Dèkin	9	0.56011776	1.75087868	0.19454208
Glédjiaga	15	0.72101194	2.05651322	0.13710088
Sissikpa	18	0.86586121	2.37705236	0.13205846
Gbèdologléta	5	0.90682424	2.47644544	0.49528909
Agbossoucodji	15	2.36122185	10.6038999	0.70692666

151 *RC: Cumulative wealth; H: Shannon diversity index; Eq.H: Equivalent number of*
152 *Shannon; E: Varietal Equitability*

153 At the township level, Adjohoun has the average cumulative wealth, the Shannon index and
154 the highest equivalent number (RC = 38, H = 2.49, Eq.E = 12.10). On the other hand, the
155 highest and closest equitability of 1 (E = 0.71) is obtained in Dangbo township (Table 2).

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157 **Table 2: Equitable distribution of cultivars in townships**

Townships	RC	H	Eq.H	E
Bonou	21	1.17310851	3.23202382	0.1539059
Adjohoun	38	2.49369739	12.1059539	0.31857773
Dangbo	15	2.36122185	10.6038999	0.70692666

158 *RC: Cumulative wealth; H: Shannon diversity index; Eq.H: Equivalent number of.*
159 *Shannon; E: Varietal Equitability*

160 **3.4- Producer preferences**
161 Producers referred to eight preference criteria that allowed them to continue producing the 10
162 cultivars (Figure 6). These include criteria such as drought resistance, pest tolerance, high
163 recovery, good taste, adaptation to all soils, good post-harvest conservation, high productivity
164 and high market value. The chi^2 independence test reveals that the dependence is not
165 significant between the preference criteria and the townships (chi^2 = 50.64, ddl = 54, 1-p =
166 39.51%). However, the preference criteria for 'pest resistance', 'drought tolerance' and
167 'adaptation to all soils' are only cited in Dangbo and Adjohoun. Moreover, the results showed
168 that these criteria varied very significantly (chi^2 = 154.68, ddl = 66, 1 - p => 99.99%) from
169 one ethnic group to another (Figure 7). There is no dependence on age and sex.

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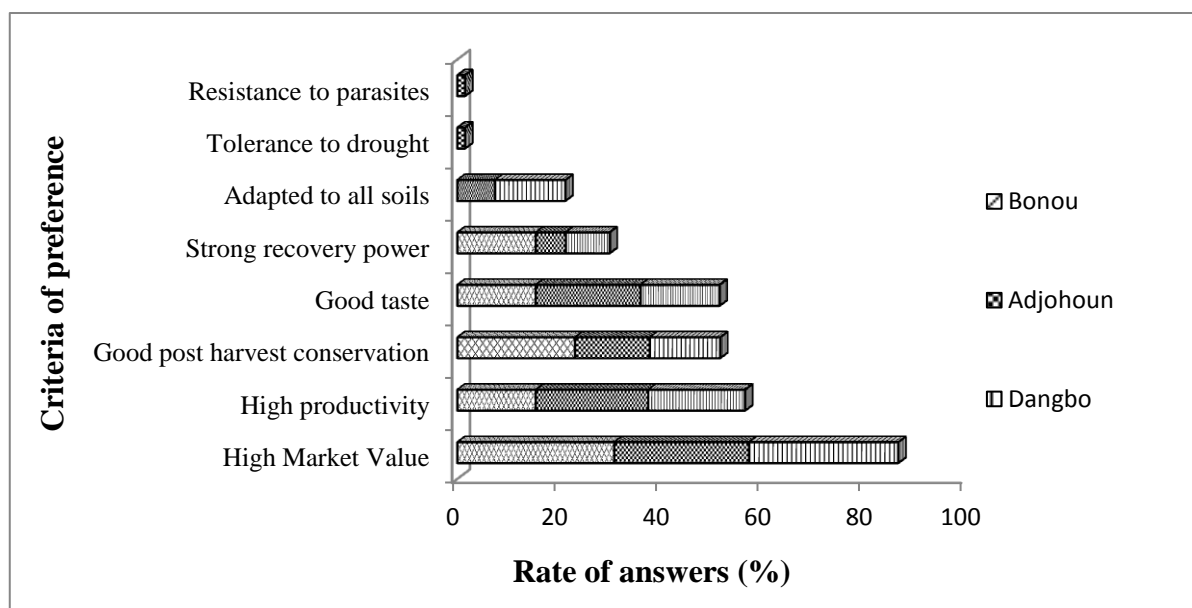
**Figure 6: Preference criteria for local cultivars in the townships**

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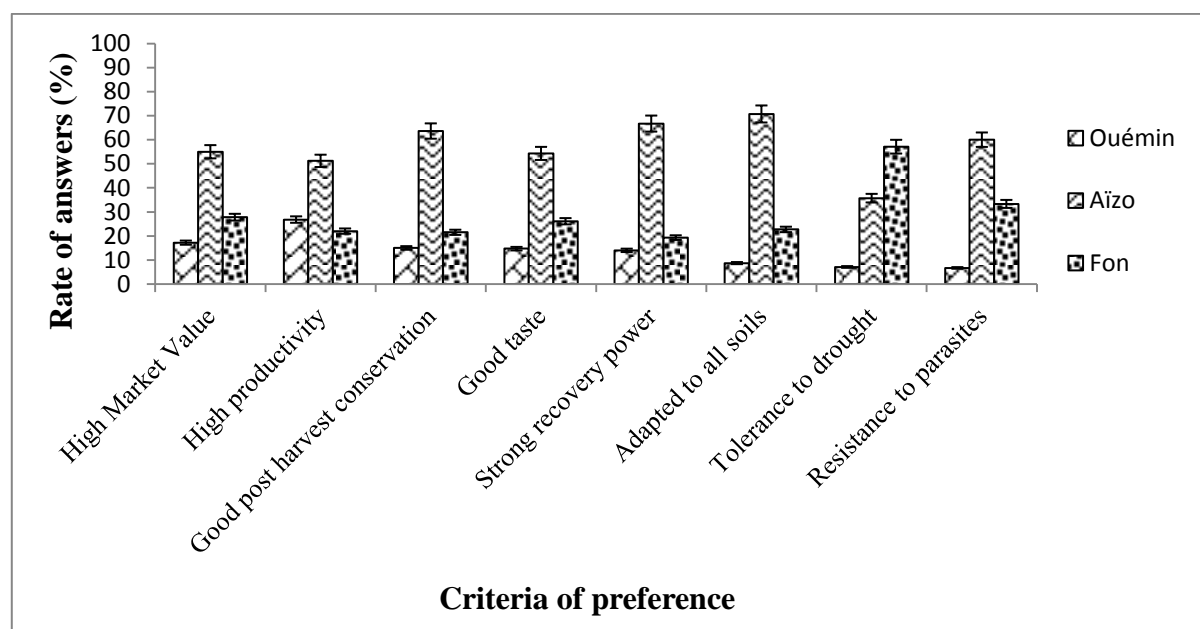
Figure 7: Preference criteria for local cultivars by ethnicity

3.5- Production constraints of sweet potato

Sweet potato producers interviewed face some constraints such as insufficient cutting, labor shortages, pest and disease attacks, irregular rainfall, funding and the flow market (figure8). It should be noted that labor shortages, pest and disease attacks as well as the market for the sale exist in the three townships. The constraint on seeds has been identified in the townships of Dangbo and Adjohoun. The Chi^2 test showed a very significant dependence (chi^2 = 111.17, dd1 = 30, 1-p => 99.99%) between the constraints identified and the townships. Producers have also suggested that pests cause enormous damage such as tuber rot and stem drilling

183   (Figure 9). According to the producers, this damage entails a significant loss of production.

184   The Chi^2 test revealed that pest damage was recorded in all townships without distinction

185   (chi^2 = 2.82, ddl = 4, 1- p = 41.10%).

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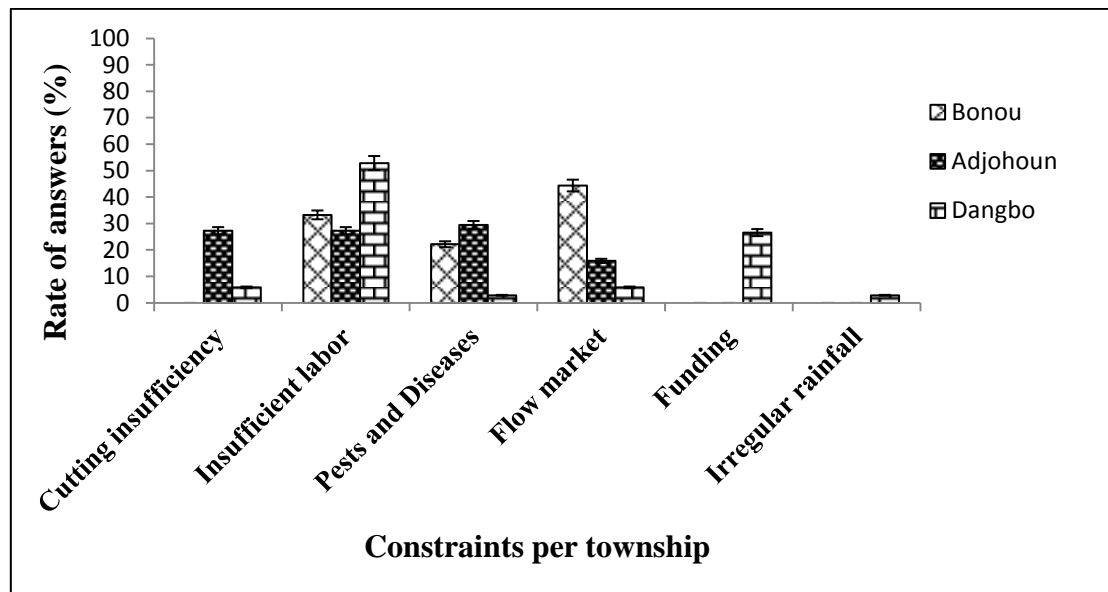
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188   **Figure 8: Production constraints of sweet potato in the three prospective townships**

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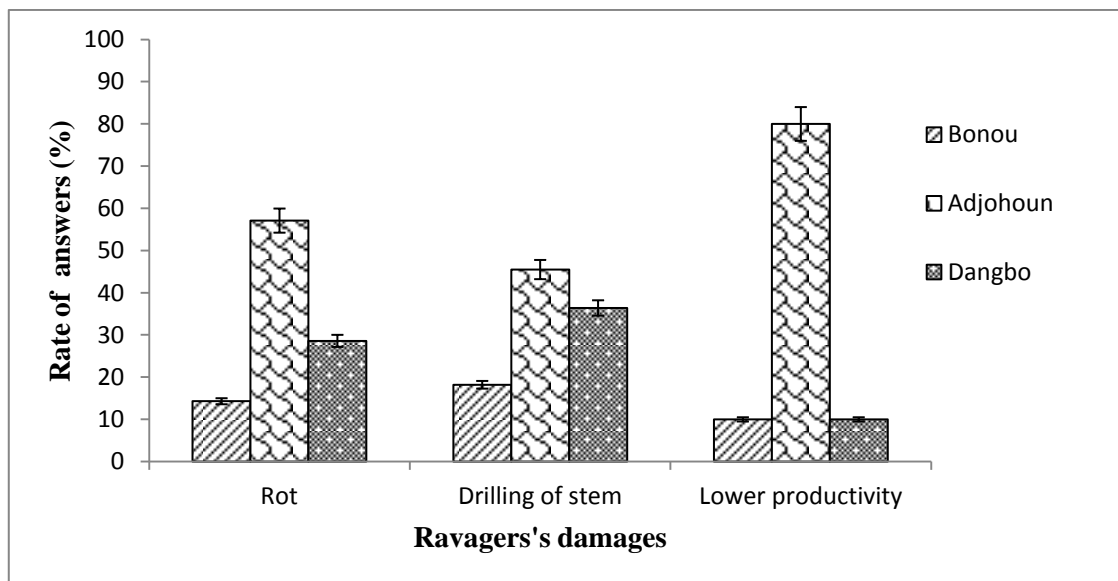
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191   **Figure 9: Damage due to sweet potato pests in the three prospective townships**

192   **4- Discussion**

193   The information obtained in this study on the diversity of sweet potato is collected based on

194   endogenous taxonomy and the random ethnobotanical survey method which are retrospective

195   survey methods. Indeed, these methods solicit the memory of the persons interviewed and

196   could induce biases related to the personal evaluation of the respondent [13]. According to

197   Dossou et al. [14]   the individuals interviewed implicitly take into account a personal

198   assessment often referring to their preference. Despite these few biases, these methods are

199   widely used in ethnobotanics. They have the privilege of highlighting conclusive results

200   because peasant representation based on variety names is an important entry point for the

201   study of varietal diversity [15] .

202   Thus, the results show that in the townships of Bonou, Adjohoun and Dangbo, the production

203   of sweet potato is mainly made by the men. Women are in small proportions and are not

204   represented in all the townships, notably Bonou. This means that this culture is an activity

205   reserved for men in these prospective townships. Adegbola [10]   showed that in the south-

206   valley system, this activity is reserved for men. The distribution of ages within the townships

207   has generally shown a small percentage of producers in the 20-30 age group. The majority of

208   these people are from 30 to 50 years old. This observation could be explained by the exodus

209   of young people to Nigeria and especially to the cities in search of work less laborious than

210   the work of the land.

211   Twenty-three (23) local names of sweet potato cultivars were identified. However, from one

212   township to another the same cultivar can be found fewer than two different names.

213   According to Mamba-Mbayi et al. [16]   and Robooni et al. [17] , in the vernacular

214   nomenclature of cultivars of cultivated plants, vernacular names generally vary from one

215   ethnic group to another, from one village to another within the same ethnic area and

216   sometimes from one household to another within the same village. In this context, the same

217   cultivar throughout the villages can be designated by different names and different cultivars

218   can sometimes be designated by the same name ([18] , [19]). Therefore, to avoid

219   overestimating or underestimating varietal diversity and to facilitate the efficient use of local

220   cultivars, these should be collected and characterized both on the basis of agro-morphological

221   and molecular markers ([20] , [21]). In addition, ten cultivars have been produced for

222   agronomic and financial reasons: good yield, adaptability to all soils, high market value and

223   good organoleptic quality are the most important.

224   The index and the equivalent number of Shannon of the Agbossoucodji cultivars are high and

225   the varietal equitability is close to 1 indicating that there are a high number of different

226   cultivars. In addition, these cultivars are produced by producers with almost the same

227   frequencies. On the other hand, the index and the equivalent number of Shannon of the

228   cultivars are low in the villages of Dèkin, Agbanta, Glédjiaga, Sissikpa and Gbèdologléta.

229   Thus, varietal equitabilities are close to zero and differ little between these villages, showing

230   that there are a small number of cultivars in which a small proportion is frequent and the
231   majority of these cultivars are very rare. Moreover, the results show that there are one or two
232   dominant cultivars which are found in almost all the villages because of their agronomic
233   performances (productivity), in particular the cultivar "Vobodouaho". These differences
234   observed in terms of varietal richness, equitability and abundance of cultivars between
235   villages and between townships can be explained by the preferences of producers, especially
236   those linked to the agronomic performance of varieties (productivity and adaptability to all
237   Soil types). Indeed, farmers tend to cultivate only those cultivars that they consider to be more
238   productive and to leave other cultivars, which reduce varietal diversity. According to Otabo et
239   al. [22] , the agronomic performance of varieties is factors that negatively influence varietal
240   diversity. Dansi et al. [23]   also showed on yams that agronomic performance (productivity)
241   is the most sought after for all crops by producers and influences varietal diversity. Although
242   the diversity of sweet potato cultivars is low and some cultivars (Meche, Tolican, Djlodou,
243   Adogoué, Amihouédé, Zohoungogo, Adogbo and Madohouè) are endemic, it faces several
244   constraints, Pests and diseases. The study showed that these pests and diseases have serious
245   consequences on the productivity of cultivars even those recognized to be more productive.
246   At this pace, the few rare cultivars existing in these townships will disappear which could
247   significantly affect food security if nothing is done. The establishment of a participatory
248   selection and decentralized conservation program is essential and will enable sweet potato
249   producers to maintain varietal diversity at the village level.

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251   **5- Conclusion**

252   Based on vernacular nominations, this work revealed a diversity of sweet potato cultivars in
253   Dangbo, Adjohoun and Bonou townships. Some cultivars such as Mêché, Tolican, Djlodou,
254   Adogoué, Amihouédé, Zohoungogo, Adogbo and Madouhouè are endemic, but are subject to
255   several constraints, in particular those related to pests and diseases, which have a serious
256   impact on the productivity of cultivars, even those be more productive.

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