

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

4 **ABSTRACT**

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

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

20 **1- Introduction**

21 The sweet potato (*Ipomoea batatas* L. Lam.) presents a great nutritional and economic  
22 importance in the tropical and moderate regions [1]. It is the sixth food crop most significant  
23 in world production after rice, wheat, potato, maize and cassava [2] with a world production  
24 estimated at ~~104 MT in 2013~~ [3]. Sweet potato is a source of income for producers and an  
25 important food especially in **period of welding**. Moreover, their agronomic capacities (good  
26 productivity, ~~cycle short~~, climatic changes and edaphic adaptation) constitute major assets to  
27 face the challenge of the food security in the context of the climatic changes in West Africa  
28 [4].

29 In spite of these importances, sweet potato ~~belongs of the~~ underused and neglected species as  
30 regards research in Benin [5]. But it is mainly cultivated by small producers within family  
31 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 nutriment 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.

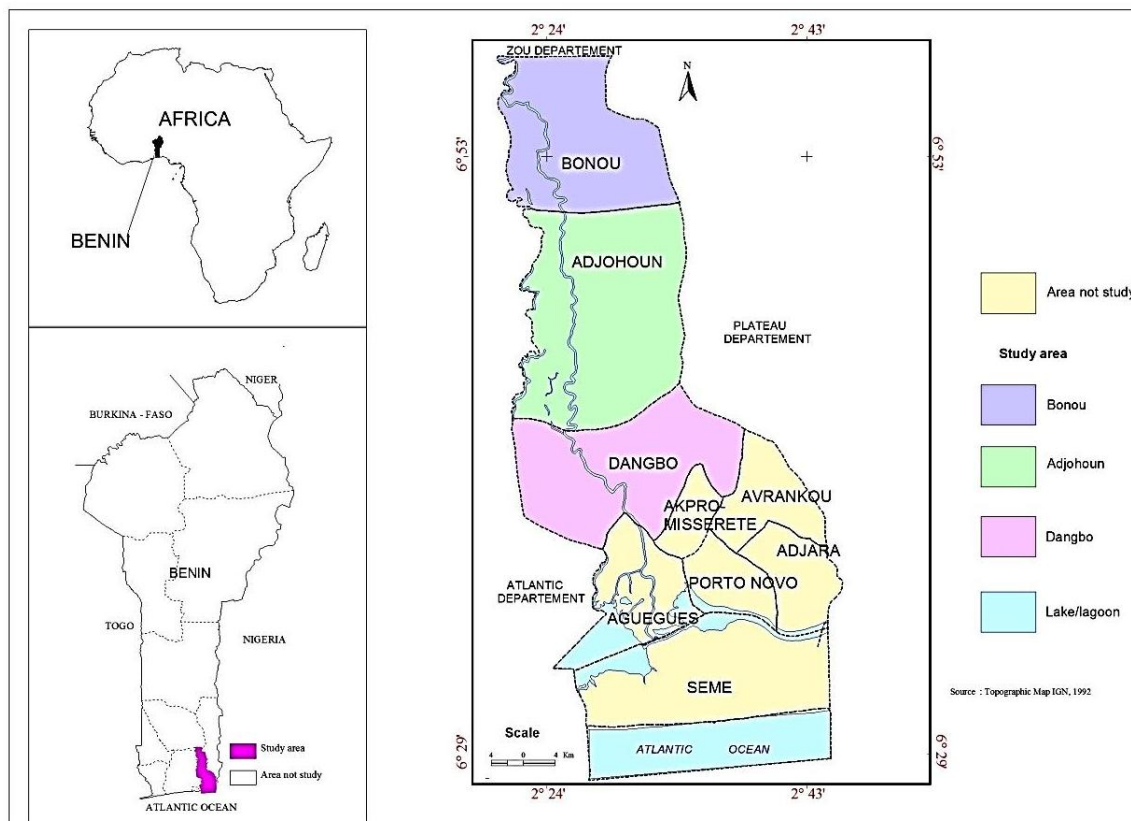
## 53 **2- Material and methods**

### 54 **2.1- Study area**

55 The study was carried out in three 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<sup>2</sup>, 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-Misséréfé, 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.



69  
 70 **Figure1:** Study area

71  
 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:

$$95 H = -\sum fi * \ln fi \text{ with } fi = ni/N$$

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):  $E = EqH / RC$ .

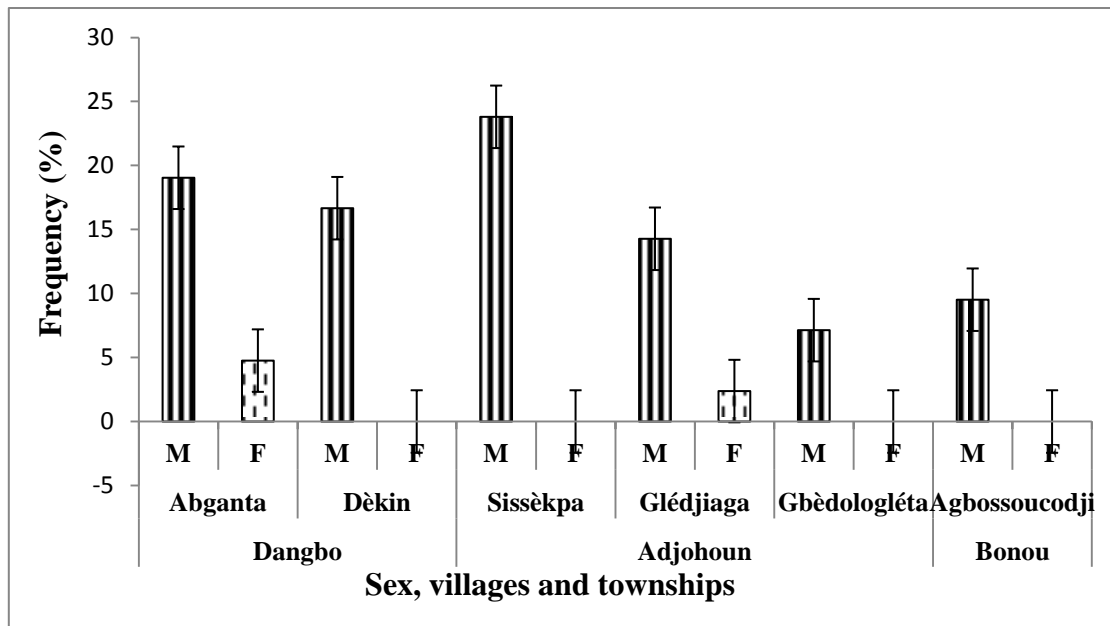
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## 103 **3- Results**

### 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 %).



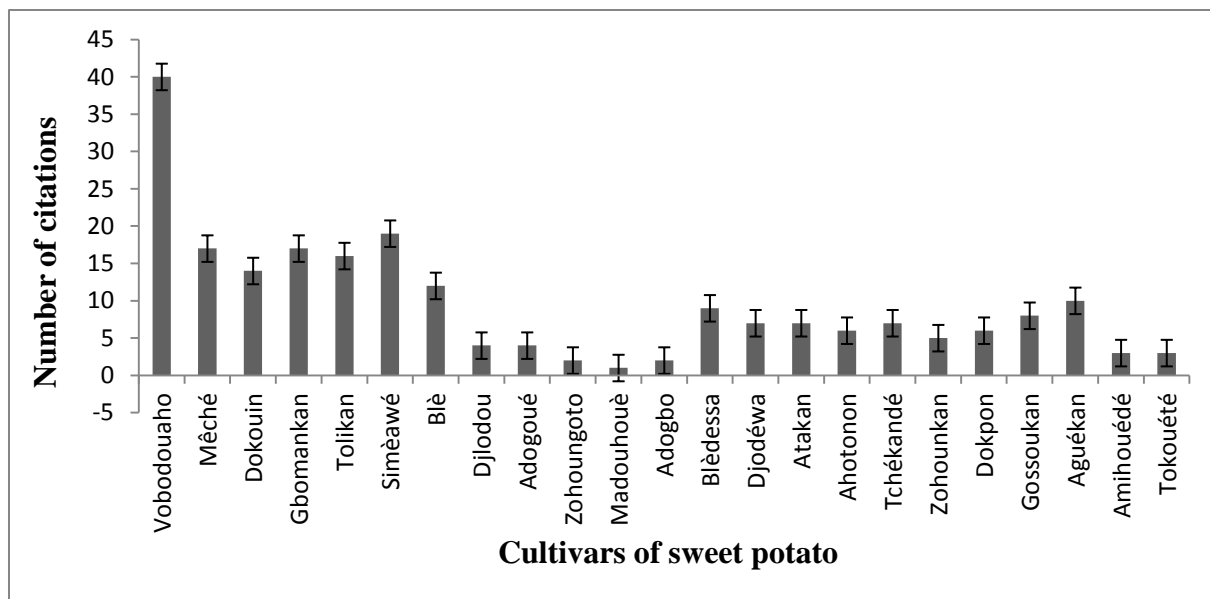
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113 *M: masculine F: feminine*

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

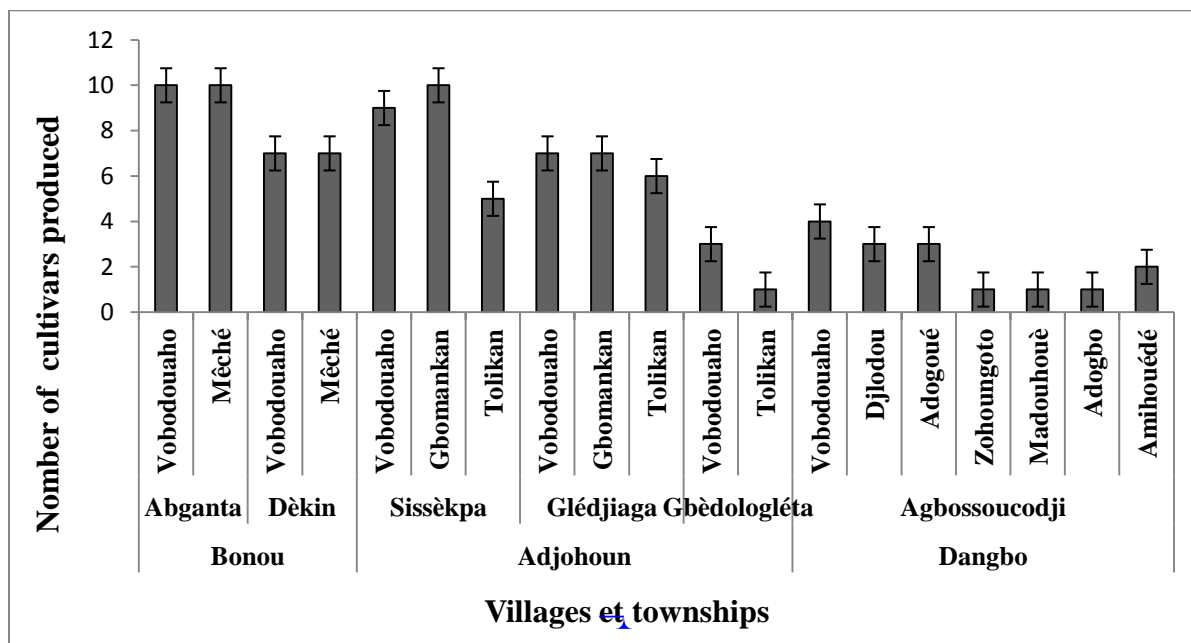
115 **3.2- Diversity of sweet potato cultivars in the department of Ouémé**

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).



127

128 **Figure 3: Local Sweet Potato Cultivars Cited by Producers**



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130 **Figure 4: Abundance of cultivars produced by villages and townships**

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132

133 *A: Djilodou; B: Amihouèdé; C: Adogoué; D: Zohoungogo; E: Madouhouè; F: Adogbo*

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

### 135 3.3- Diversity Index: Cumulative Wealth, Shannon Index, Equivalent Shannon Number 136 and Equitability

137 Table 1 indicates that the cumulative wealth of cultivars is higher in Sissikpa (18), Glédjiaga  
138 (15) and Agbossoucodji (15) but lower in Gbèdologléta (5). The index and the equivalent  
139 Shannon number of Agbossoucodji cultivars ( $H = 2.36$ ,  $Eq.H = 10.60$ ) were high. In  
140 comparison to the other five villages (Agbanta, Dčkin, Glédjiaga, Sissikpa and Gbèdologléta),  
141 the index and the equivalent number of Shannon of the cultivars were low. Thus, varietal  
142 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).

156

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

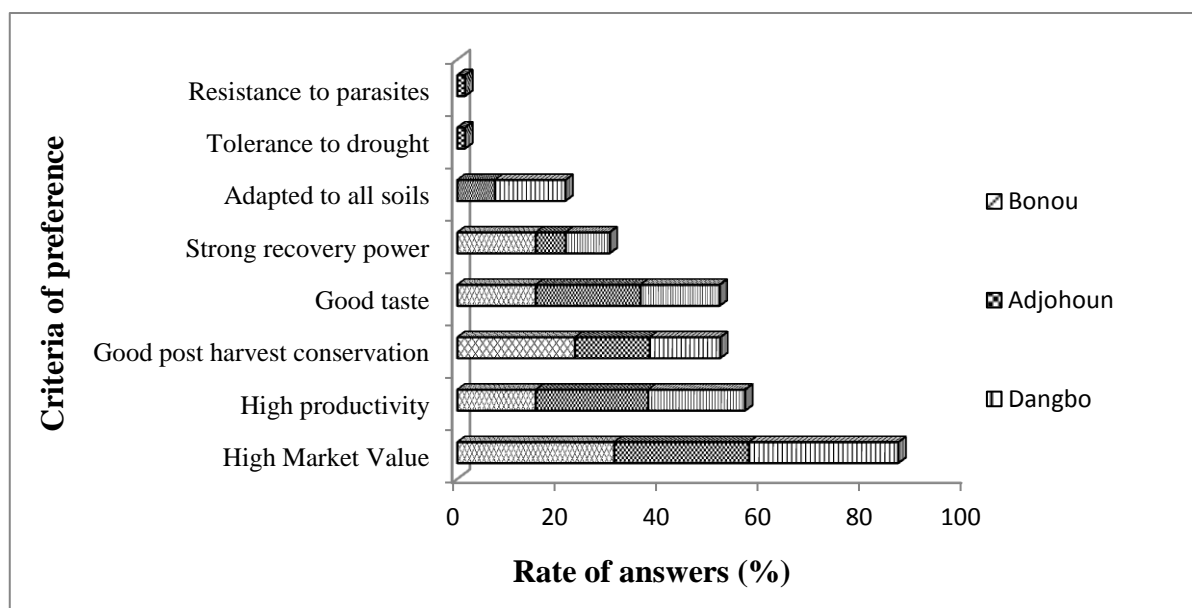
158 *RC: Cumulative wealth; H: Shannon diversity index; Eq.H: Equivalent number of.*  
 159 *Shannon; E: Varietal Equitability*

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  $\geq$  99.99%) from  
 169 one ethnic group to another (Figure 7). There is no dependence on age and sex.

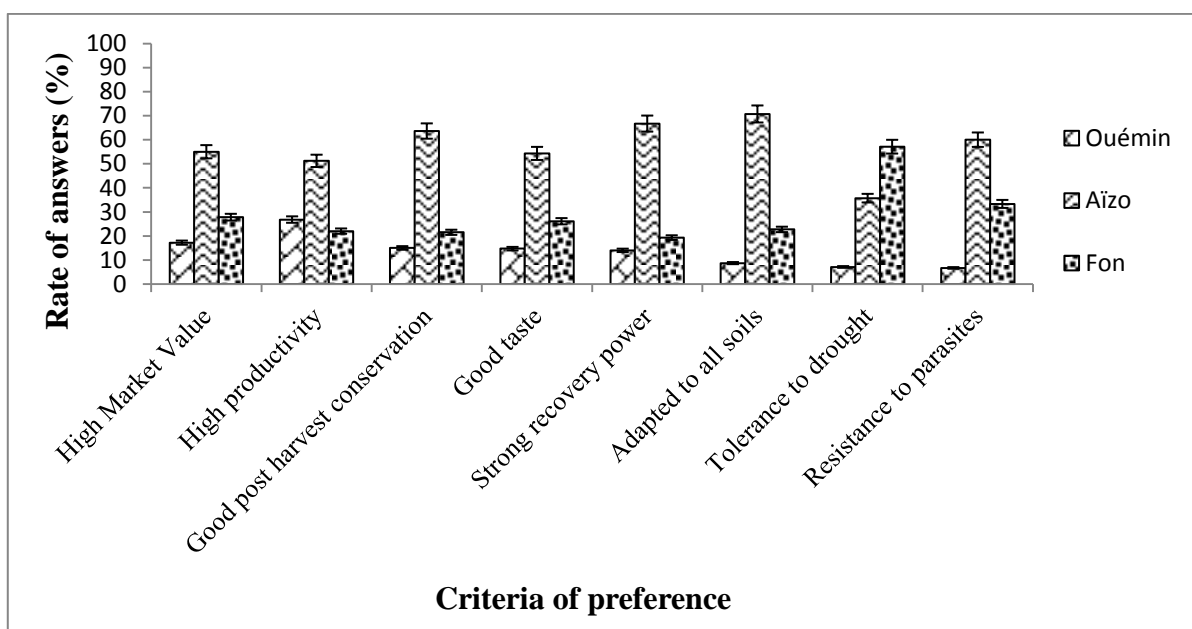
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172 **Figure 6: Preference criteria for local cultivars in the townships**



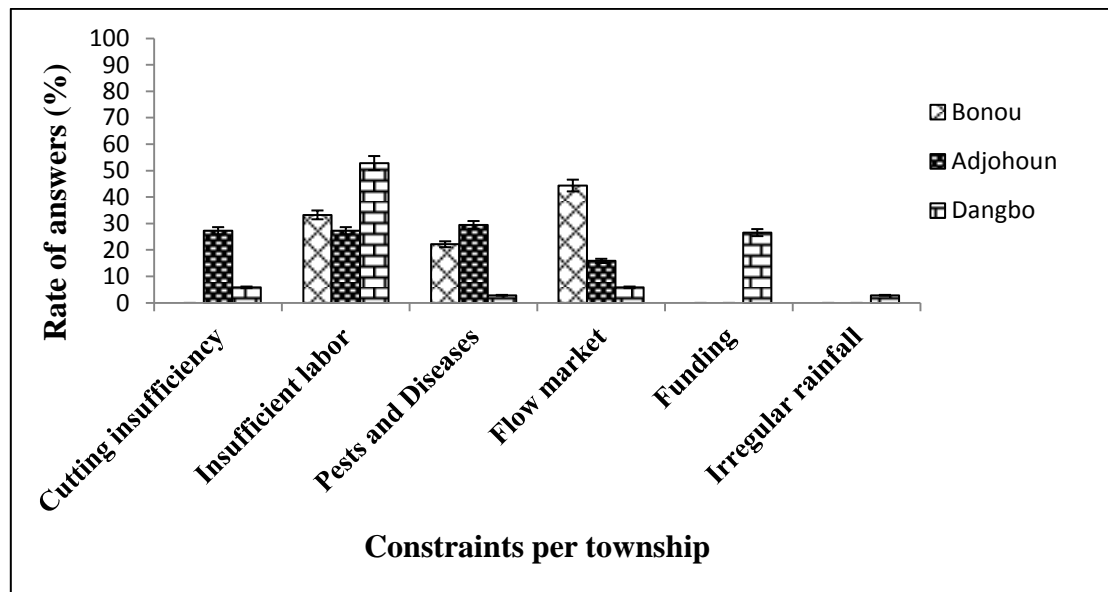
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174 **Figure 7: Preference criteria for local cultivars by ethnicity**

175 **3.5- Production constraints of sweet potato**

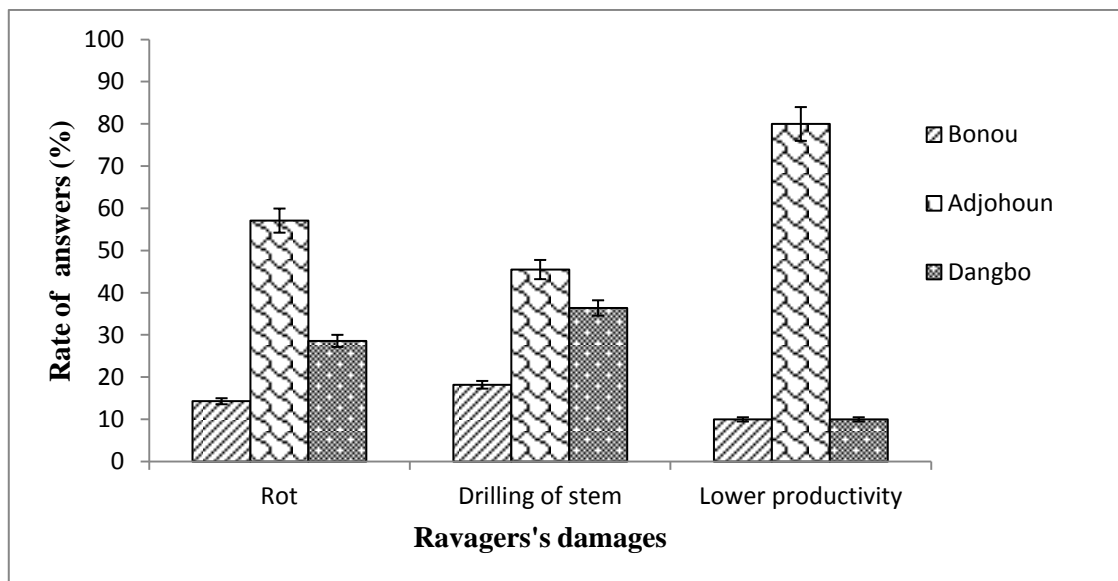
176 Sweet potato producers interviewed face some constraints such as insufficient cutting, labor  
 177 shortages, pest and disease attacks, irregular rainfall, funding and the flow market (figure8). It  
 178 should be noted that labor shortages, pest and disease attacks as well as the market for the sale  
 179 exist in the three townships. The constraint on seeds has been identified in the townships of  
 180 Dangbo and Adjohoun. The  $\chi^2$  test showed a very significant dependence ( $\chi^2 = 111.17$ ,  
 181  $df = 30$ ,  $1-p \Rightarrow 99.99\%$ ) between the constraints identified and the townships. Producers  
 182 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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187  
 188 **Figure 8: Production constraints of sweet potato in the three prospective townships**

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190  
 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 Madouhouè) 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.

250

## 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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