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Ethnobotanical investigation and diversity of sweet potato (*Ipomea batatas* L.) landraces grown in Northern Benin

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Abstract

Sweet potato (*Ipomea batatas* L.) is a food plant which contributes significantly to food security and poverty reduction around the world. To document its production constraints, cultural practices, diversity, varietal preference criteria, landraces'performances and seed management, a survey was conducted in 28 villages of the northern Benin. A total of 9 constraints were identified among which, drought, insect attacks and low adaptability to soils were the most important. Subject to synonymy, 40 sweet potato landraces were identified. The number of landraces varies from 2 to 6, with an average of 3 per village. The analysis of the distribution and extent showed a high rate of landraces threaten of disappearance through villages. Landraces to be produced are selected on the basis of 15 preference criteria including the categories agronomic (55.82 %), culinary and technological (31.01 %) and economic (13.17 %). Among these preference criteria, the most important are easy of work, high productivity, high vegetative growth high market value, sweet taste, and size of tubers. The participatory evaluation revealed 17 landraces with good agronomic, technological and culinary characteristics. Some medical properties of sweet potato as to cure headaches (58.85 %) and sexual weakness (41.15 %) were identified. Establishment of an improvement varietal program considering the farmers' criteria preference is strongly recommended to promote sweet potato production in Northern Benin.

Keywords: Diversity, Sweet potato, farmers' preference criteria, Production constraints, Northern Benin.

Introduction

Sweet potato (*Ipomoea batatas* L.), of the family of Convolvulaceae, is a tuberous rooting plant which present great economic importance in tropical, and subtropical regions [1]. Both tubers and leaves of this crop are staple foods in the tropics where they take the place of the potato. The world production of this crop is estimated at 105 Mt in 2013, with 11.6 % of production in Africa [2]. Compared to other crops, it grows in varied agricultural conditions and adapts well to heat, drought, many diseases and pests, as well as poor and flooded soils. Sweet potato is one of the most cultivated root crops in West Africa, covering an area of 1.8 million hectares with an estimated production of 5.4 million tons in 2013 [2]. Its agronomic characteristics, such as broad adaptability, high productivity, short development cycle and high nutritional value, make it a particularly important crop for food security in countries under heavy human and environmental stress in climate change including Benin [3]. In Benin, sweet potatoes are grown in all regions from North to South with an estimated production of 58145 tons for yield of 5.88 t/ha [2]. Sweet potatoes are foods of high nutritional values filled with fibres, vitamins, minerals and protein [4]. It is an excellent source of beta carotene (vitamin A intake), an antioxidant that plays a leading role in eye health and would contribute to reduce the risk of cancer [5]. It also contains a lot of potassium which contribute to lower blood pressure [6]. The overlap between areas where sweet potato is already produced and areas of human malnutrition highlights the important opportunities which could be realized by boosting the production and utilization of more nutritious sweet potato varieties [7].

Given its relatively easy production methods and its high nutritional value, an increase of its production and use in sub-Saharan Africa can be seen as a major priority for poverty reduction, income generation, food and nutrition security, and preservation of a sustainable ecosystem. This involves the identification of high-yielding landraces or with traits of interest which can be involved in breeding programs [8]. Recent studies revealed the existence of high diversity of sweet potatoes in Southern and Central Benin [9]. However, in Northern Benin, no data is available on sweet potatoes diversity and production constraints, whereas this information remains a prerequisite for effective implementation of on-farm conservation strategies and for development of new varieties [10]. Documentation and identification of high-performance landraces based on farmer's varietal preference criteria will provide strategies to overcome constraints affecting the crop production in the Northern Benin. Hence, the objective of this study was fourfold:

i) Prioritize constraints associated with sweet potatoes production;
ii) Assess the diversity, distribution and extent of cultivated landraces;
iii) Identify farmers' landrace preference criteria for use in breeding programs;
iv) Assess, in participatory way, existing landraces for their agronomic, culinary and technological characteristics.

Materials and Methods

Study area and site selection

The study was carried out in the Northern region of Benin Republic. Northern Benin is semi-arid, presented one dry season and one rainy season and characterized by unpredictable and irregular rainfall oscillating between 800 and 950 mm/year [11]. The annual mean temperature is 27.5 °C while the annual relative humidity averages 58 % [11]. This region is divided into 4 departments (Alibori, Atacora, Borgou, and Donga), inhabited by 14 sociolinguistic groups (Ani, Biali, Nateni, Yom, Nagot, Mokole, Bariba, Boko, Dendi, Ditamari, Kotokoli, Lokpa, Peulh, Wama). Based on a preliminary survey carried out among agents responsible for agricultural development in management centres and Town halls, 28 villages were selected through Northern Benin according to sweet potato production and also in aim to cover the study area for an exhaustive inventory of existing diversity (Fig.1).

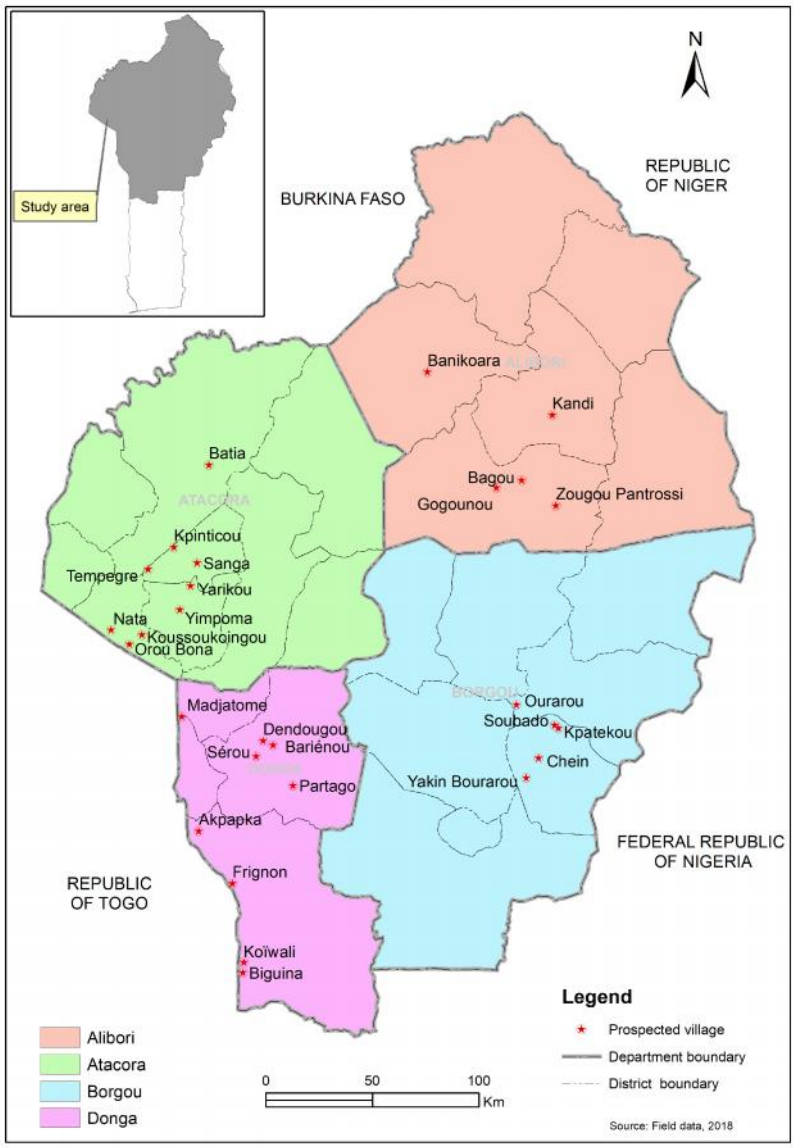

Fig. 1: Map of the study area showing the villages and departments surveyed

Data collection

Data were collected through an ethnobotanical investigation in the different selected villages using participatory research techniques and tools, such as direct field observation, group discussions, individual interviews, and field visits as reported by [12]. In each village, interviews were conducted with the help of a local translator to facilitate discussions and exchanges with farmers [13]. Interviewees were identified and gathered with the help of the village leaders and person in charge of farmers' association involved in the study to facilitate the organization of the meetings and the collection of data [14]. A total of 193 farmers of sweet potato were surveyed in the study area. They are distributed in the production areas according to the importance of sweet potato production.

During the group discussions, the production constraints and criteria preference were documented and prioritized by the method of identification and progressive elimination of the most important constraint described by Dansi et al. [13]. In this approach, farmers are directed to identify within the constraints listed, the one who is the most important and for which an urgent solution must be found.

Thus, the most important constraint identified and ranked first was removed from the list. The process was repeated until the last constraint was ranked and the results were immediately given to the farmers for approval [13]. The varietal diversity of sweet potato was inventoried by village and their distribution and extent were evaluated according to four-square analysis method [14]. This method helps to identify elite landraces (produced by many households and over large areas) and those produced by few households on small areas to assess the rate of varietal diversity loss or eventual abandonment. According to Kombo et al. [15], the agronomic, technologic and culinary characteristics of each sweet potato landrace identified were assessed with the group of farmers using the form prepared with two modalities (Good / Bad). The considered parameters were productivity, duration of the production cycle, tolerance to diseases and pests, tolerance to abiotic stresses (soil moisture, drought, soil poverty), soil selectivity, culinary qualities (taste, use of leaves as a vegetable) and organoleptic. Group discussions were followed by individual surveys conducted in households randomly selected in the village using the transect method described by Adjatin et al. [12]. In each village, 5 to 10 producers of sweet potato of both sexes were randomly selected for individual surveys. In each household, respondent was selected using method described by Gbaguidi et al. [14]. The socio-demographic data, the diversity of sweet potato landraces maintained per household, the mode and frequency of consumption and the criteria of consumer preference constitute the information collected. Then, free discussions were conducted with farmers to understand the reasons for growing each landrace by many or few households and on large or small areas. The names of the landraces which completely disappeared were also recorded and the reasons for their abandonment documented.

Statistical analysis

The obtained data were analyzed using descriptive statistics and the results are presented in the form of tables or figures. At the level of the study area, the constraints were ranked according to Gbaguidi et al. [14] based on the average of three key parameters such as the total number of villages in which the constraint is cited (TNV); the number of villages in which the constraint was ranked among the principal constraints or among the first Five (PCO) and the number of villages where the constraint is major, or ranked first (MAC). For these three parameters, higher is the number, greater is the constraint. The importance of a constraint (IMC) was determined by the formula: IMC = (NTV + PCO + MAC) / 3.

The same approach was used to classify and prioritize varietal preference criteria among producers and consumers. The rate of diversity loss (RDL) at each village level was determined, according to Kombo et al. [15], using the formula: RDL = (n - k) / N x 100 where n is the number of endangered landraces (cultivated by few households on small areas); k is the number of newly introduced landraces; and N is the total number of landraces identified in the village. A dendrogram was constructed using Statistica software to allow grouping of sweet potato landraces according to their preference criteria.

Results and Discussion

Socio-demographic characteristics of respondents and importance given to sweet potatoes in the study area

A total of 193 farmers of sweet potato were investigated through the 28 selected villages. Among them, majority (79.27 %) are men (Table 1). These results are similar to those of Sanoussi et al. [9]. Otherwise, it has been reported that females have a relatively greatest interest for sweet potato production in western Tanzania [16] and Kenya [17]. Most of respondents (53.32 %) have received formal education and distributed according to their level of education such as 18.88 % for primary, 32.22 % for secondary and 2.22 % for university. So, illiterate respondents represented 46.68 % of surveyed farmers (Table 1). These results are similar to those reported by Kwach et al. [17] in Kenya and contrary to those reported by Sanoussi et al. [9] in southern and central Benin. In addition, most of farmers (78.90 %) are young with between 20 and 40 years old for an average of 30 years. Experience for 77.78 % sweet potato' producers are between 1 and 10 years old (Table 1). Several ethnic groups were represented by Bariba (30.90 %), Lokpa (29.02 %), Waama (13.34 %), Dendi (12.23 %), Ditamari (4.45 %), Natimba (4.45 %), Ani (3.36 %) and Otamari (2.24 %). Compared to the area sown, 73.33 % of farmers give a relatively important place of their farm to the production of the sweet potato while 26.67% cultivate it only on piece of lands or small plots.

Table 1: Socio-demographic characteristic of surveyed farmers in the study area

Characteristics	Modalities	Percentages (%)
Gender	Male	79.27
	Female	20.72
Education	Primary	18.88
	Secondary	32.22
	University	2.22
	Illiterate	46.68
Age	[20-40[	78.90
	[40-60[	14.44
	[60-80[	6.66
Experience in potato production	[1-10[	77.78
	[20-30[	21.11
	[30-40[	1.11

The reasons justifying its production in study area were self-consumption (55.55 % of surveyed farmers) and marketing (45.45 %). Surveyed farmers sell sweet potato on the local and sometimes regional markets. In the study area, the majority of farmers (73.33 %) believe that sweet potato production in their locality has increased; and for 20 % of farmers, this production remained constant while only few farmers (6.67 %) think that sweet potato production decreased.

Constraints related to sweet potato production in the study area

The sweet potato production was subject to nine (9) constraints in Northern Benin (Table 2). Among them, drought (14.66 % of responses), insect attacks (11.66 % of responses), low adaptability to poor soils (10 % of responses) and lack of seed (8.33 % of responses) were the most important (Table 2). It should be noted that these constraints can be raised by the efforts of scientific research. The scarcity of rain or drought which was reported by farmers as constraint in many crops in Benin such as yam [10], cassava [18], and maize [19] was also reported in this study. It is then important to identify drought tolerant landraces in order to their distribution to farmers for the population happiness. Besides the drought, other constraints quoted by farmers, could be considered by scientist research through selection and use of resistant landraces as suggested by Agre et al. [18] and Doussoh et al. [20]. According to other authors, a combination between drought tolerance and insects' resistance with earliness and high yield is priority for sweet potato breeding [21, 9].

Table 2: Hierarchical constraints on sweet potato production

Constraints	TNV	PCO	MAC	IMC
Drought	18	8	18	14.66
Insect attacks (*Cylas* sp.)	13	9	13	11.66
Low adaptability to poor soils	15	3	12	10
Low yield	14	0	11	8.33
Lack of seeds	8	3	8	6,33
Conservation post-harvest	9	0	9	6
Lack of specific inputs	8	0	6	4.66
Lack of planting technique	8	0	7	3
Ignorance of the importance	6	0	2	2.66

Seed management

Plants material of the sweet potato used are cuttings of stems or vine. Then the plant material availability was not seen as a major problem in the rural areas surveyed because the plant can easily produce vine under farmers' conditions as reported for sweet potato at Center and Southern Benin [9] and for another crops as Crassocephalum ssp [12]. Thus in the study area, most of surveyed farmers (71.84 %) use their own seed. Sometimes, in lack of seed, some farmers (21.36 %) buy their seed in local or regional market at Southern Benin or rather in neighbouring countries like Nigeria. While few farmers (6.8 %) use seed from exchange with others farmers. Among farmers who use their own seed, Most of farmers (87.75%) selected healthy cuttings and kept them in box gardens for later use and only 12.25 % store the cuttings in the darkness at farm. The results showed that sweet potato seed system in northern Benin is purely traditional contrary to those of other African countries such as Burkina-Faso, Rwanda and Uganda. In these countries, it has been observed the presence of specialized structures in the production and distribution of improved sweet potato seed [22]. Farmers estimate the cheaper or even almost free cost of seed but don't know that seeds obtained by traditional method are low phytosanitary quality and causes many viral and bacterial diseases [23]. Vitro culture techniques could be used to improve the quality and the availability of sweet potato seed like other root and tuber crops in Benin [24].

Cultural practices

As reported by Luan et al. [25], sweet potato is considered as recalcitrant species regarding plant regeneration. Thus, for most of surveyed farmers (62.27 %), sweet potato sprouts seven days after planting. But, for 25.57 % and 12.16 % of farmers, regeneration takes place respectively 10 days and 14 days after planting. Otherwise, according to most of surveyed farmers (68.89 %), the first tubers appear one month after germination of the cuttings while for 17.89 % and 13.22 % of farmers, these immature tubers occur respectively 1.5 and 2 months after planting. For most farmers, the maturity cycle varies from 2 to 3 months for the early varieties and from 4 to 6 months for the later ones.

In the study area, most surveyed farmers (85 %) estimate that a distance of 1 m between different rows promotes a good yield as reported by Stathers et al. [26] (Table 3). Most of farmers (86.67 %) use hills for growing sweet potato because hills are more effective to give more large tubers compared to ridges (Table 3). They are usually several meters long, about 1 m wide, and less than 1 m high [27]. According to all surveyed farmers (100%), no seed treatment was done before planting. Seeds of the sweet potato being vine, two planting techniques are then practiced in the study area. So, used by some farmers (14.44 %), the first technique allows to reach a large area in record time but decreases the plant's productivity. It consists to cut and to bury in the soil 2/3 of the cutting. The second technique, used by most of farmers (85.56 %), consists in folding in disc or rolls and burying in the soil 2/3 of the cutting (Table 3). This last proves to be more efficient and advantageous. It allows cutting to take its base and spread to other places effectively. In addition to these two methods, Needunchezhiyan et al. [28] reported that sweet potato cutting can also be planted horizontally to the soil surface with 5 or 6 nodes. The use of this technic allows better development of the root system than other methods though it is laborious [29]. Otherwise, most of surveyed farmers (85.56 %) don't use agricultural inputs (fertilizers or pesticides) for the growth, the development and the protection of their crop. Sweet potato crop in the study area was grown in pure culture by some farmers (29.56 %) as reported on other crop such as sorghum [30] and maize [31]; while, similar to Bashaasha et al. [27], most farmers (70.44 %) grow sweet potato associated with other crops such as yam, leguminous and cereals such as millet, sorghum and maize (Table 3).

Table 3: Cultural practices used for sweet potato production through the study area.

Cultural practices	Modality	Percentages of responses
Distance between line/hill	1 m	85
	0.5 m	13
	2 m	2
Culture mode	Plank	13.33
	Hill	86.67
Seed treatment	None	100
Planting technics	Cut and put 2/3 of cuttings in ground	14.44
	Fold in disc and put 2/3 in ground	85.56
Inputs applications	Fertilizers or pesticides	14.44
	none	85.56
Culture association	Pure culture	29.56%
	Association with other crops	70.44%

Folk taxonomy and local nomenclature of sweet potato landraces

Thirteen (13) names of sweet potato landraces were recorded in the study area (Table 4). The meanings given to sweet potato varies following the sociolinguistic group. It has been then found that the meanings are expressions of sweetness, security and food relief. Farmers used essentially three parts of the plant such as stem (35.77 % of responses), leaves (37.68 % of responses), and tubers (26.55 % of responses) to recognize the various sweet potato landraces (Table 5). Three criteria remain unavoidable for farmers' recognition of sweet potato landraces in the study area. This is the leaves shape (25.5 % of responses), the colour of stems (17.52 % of responses) and skin colour of tubers (15.08 % of responses). These recognition criteria used in traditional taxonomy are all among sweet potato descriptors recommended by Huaman [32] and used by many authors in morphological characterization of sweet potato genetic material [33, 9]. In summary, farmers have a good knowledge of the morphological traits of sweet potato genetic resources. However, based on these criteria, name given by farmers can lead to repetition or reduction of varietal diversity. Then, genetically distinct varieties can be identified with the same local names, as several authors have reported on sweet potato [34, 9] and cassava [18].

Table 4: Vernacular nomenclature of sweet potato and meanings in different ethnic groups.

Generic name	Ethnic group	Meanings
Denkaï	Bariba	-
Doundou you	Dendi	Honeyed yam
Ekokonon	Ditamari	Single' tubers
Froun-houn	Waama	-
Kokofouna	Ditamari	Sweet yam
Koroudagou	Bariba	-
Koudagou	Dendi	-
Santi	Natimba	-
Téchayanran	Ditamari	Tuber raising water after it consumption
Tomba	AniFourou	Purple tubers
Tomba Kissêm	Lokpa	Eat and dance
Yékoko	Otamari	Sweet tubers
Yêtchagninra	Otamari	-

Table 5 : Morphological Traits recognition of sweet potato

Organs	Parameters	Responses (%)
Stem (35.77 %)	Stem colour	17.52
	Stem size	4.15
	Stem length	6.4
	Number of nodes	4.8
	Nodes' colour	2.9
Leaf (37.68 %)	Leaves shape	25.5
	Colour of leaves	5.73
	Colour of young leaves	2.6
	Colour of petiole	1.3
	Thickness of the leaves	2.55
Tuber (26.55 %)	Skin colour	15.08
	Length	2.55
	Size	5.1
	Form	3.82

Sweet potato diversity

Subject to synonymy, 40 sweet potato landraces were recorded across the 28 prospected villages. Among the 40 sweet potato landraces recorded, 26 were listed as early landraces (65 %) and 14 as late landraces (35 %). The number of landraces per village varied from 2 to 6 with an average of 3 landraces per village (Table 6). Villages like Bagou, Gogounou, Banikoara, Yakibourarou, Tempegre and Patargo are those with largest number of landraces. More than 75 % of these villages are located in the Alibori department. Likewise, the small number of accessions was observed in the departments of Donga and Borgou where more than 70 % of these villages produce only 2 landraces, while in the department of Atacora, 3 to 4 landraces are recorded per village. However, according to surveyed farmers average one landrace was introduced in the study area and this landrace would be of Nigerian origin. Also, only one landrace in average was abandoned because it does not meet farmers' needs. It is the purple sweet potato which they don't mastered the cultural practices and whose seeds are rare. There are many villages (57.14 %) where all identified landraces are well preserved. Otherwise, some villages such as Mandjatome, Yakibourarou, Bagou and Tempegre showed a high rate of varietal diversity loss (more than 50%). Several reasons explained the abandonment of some sweet potato landraces (Fig. 2). Among which, the most important were low productivity (17.83 % of responses), taboos (13.71 % of responses) and lack of seed (12 % of responses) (Fig. 2).

Most of farmers were interested in agronomic, morphological and culinary characteristics of elite landraces (produced in many households and over large areas) which are in average 2 in the study area (Table 6). In addition, the high productivity, taste and floury aspect of landraces maintained by farmers were some major characteristics of elite landraces and consequently, that lead to the abandonment of landraces with undesirables characteristics (Table 7). It requires involvement of scientific research which can lead to the creation of elite cultivars or the improvement of existing ones to meet the producers' requirements. For high rates of varietal diversity loss, it is desirable to develop strategies to maintain existing genetic diversity for present and future generations as reported on yam [10, 13], cassava [18] and sweet potato [35, 9].

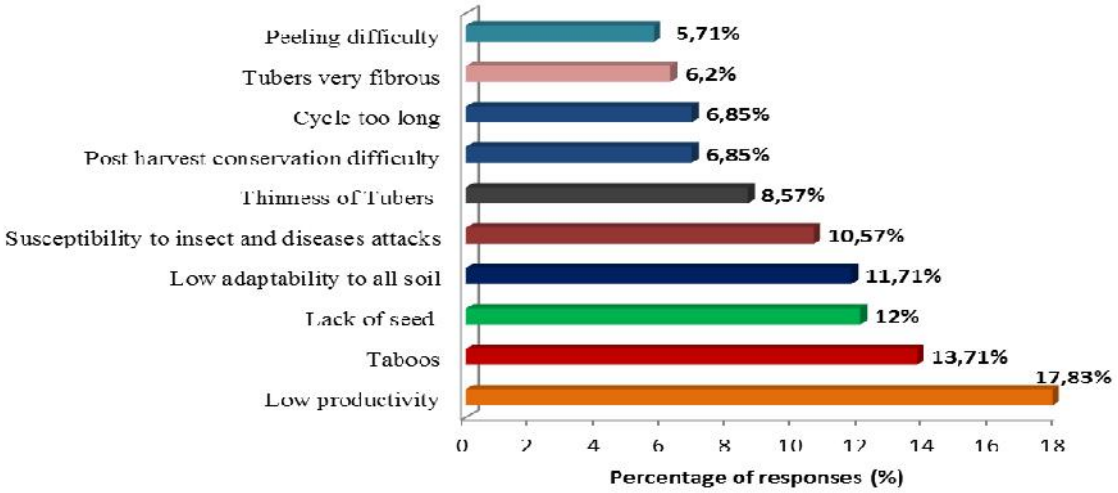

Fig. 2: Reasons of varietal diversity loss in study area

Table 6: Diversity, distribution and extent of the sweet potato in the study area

Villages	TNV	NIV	NAV	H+A+	H+A-	H-A+	H-A-	RDL (%)
Akpassa	3	1	0	2	1	0	0	n.a
Bagou	6	2	3	2	1	1	2	50
Banikoara	4	1	1	2	1	0	1	25
Barienou	3	0	0	1	1	0	1	n.a
Batia	4	1	1	2	1	0	1	25
Biguina	2	0	0	2	0	0	0	n.a
Chein	3	1	0	1	1	0	1	n.a
Dendougou	2	0	0	2	0	0	0	n.a
Frignon	2	0	0	1	1	0	0	n.a
Gogounou	5	2	3	2	2	0	1	60
Kandi	3	0	0	1	1	1	0	n.a
Koïwali	2	0	0	1	1	0	0	n.a
Koussoukoingou	4	1	1	2	0	1	1	25
Kpatékou	2	1	0	1	1	0	0	n.a
Kpinticou	2	0	0	1	1	0	0	n.a
Mandjatome	3	0	2	1	1	0	1	66.66
Nata	3	0	0	2	1	0	0	n.a
Oroubona	3	1	1	1	1	0	1	33.33
Ourarou	2	0	0	2	0	0	0	n.a
Patargo	5	2	0	2	1	1	1	n.a
Sérou	2	0	1	1	1	0	0	50
Soubado	3	1	1	2	1	0	0	33.33
Tempègrè	4	1	2	1	1	0	2	50
Toucountouna	3	1	0	2	0	0	1	n.a
Yakibourarou	5	2	3	1	2	1	1	60
Yarikou	2	0	0	1	1	0	0	n.a
Yimpuma	3	1	1	2	0	1	0	33.33
Zougou Pantrossi	2	0	0	2	0	0	0	n.a

M+S+ : landraces cultivated by many household on large area ; **M+S-** : l landraces cultivated by many household on small area ; **M-S+** : landraces cultivated by few household on large area ; **H-A-** : landraces cultivated by few household on small area ; **TNV** : total number of landraces ; **NIV** : Number of newly introduced landraces ; **NAV**: number of abandoned landraces ; **RDL**: rate of diversity loss.

Table 7: Reasons for the status of some varieties

Many household and large area (H+A+)	Many household and small area (H+A-)
High productivity	Average productivity
High adaptability to all type of soils	Good culinary qualities
Good vegetation cover	Low market value
Resistance to all king of pest	Difficulty of conservation
Good culinary quality	Long cycle
Short cycle	Tubber available
Less production constraints	Lack of seed
Harvest and conservation less restrictive	
Acceptable market value	
Seed available	
Precocity	
Few household and large area (H-A+)	**Few household and small area (H-A-)**
High productivity	Low productivity
Good market value	Soil selectivity
Suitable for certain types of soil	Very sweet
Rare	Sensitive to all kind of pest
	Very long cycle (6 months)
	Low market value
	Variety whose practices are very little mastered by the producers
	Newly introduced

Preference criteria of sweet potato landraces

Through the study area, 15 preference criteria were identified, including three categories: agronomic (55.82 % of responses), culinary and technological (31.01 % of responses) and economic (13.17 % responses) (Table 8). Among agronomic criteria, easy of cultural practices (17.12 % of responses), high productivity (10.25 % of responses), high vegetative growth (8.23 % of responses) and tuber size (7.69 % of responses) are the most important. The most important economic criteria are high market value (10.81% of responses). At the culinary and technological category, farmers were interested in five criteria among them the sweet taste (9.81 % of responses), the red colour of tubers (6.67 % of responses) and the floury aspect (6.65 % of responses) are the most important (table 8). These results are similar to those of Agre et al. [18] on cassava and Loko et al. [10] on yam. With regard to the constraints listed by farmers, the identified preference criteria and their relative importance were expected. This correlation between the two parameters proves the good knowledge of the crop by the surveyed farmers. These observations are similar to those of Odjo et al. [36] which showed that the farmers' variety preferences criteria are not only related to the intrinsic characteristics of the varieties but also to factors related to constraints of production and marketing. In addition, these different criteria hence identified and prioritized must be taken into account by breeders [37, 9].

Table 8: Preference criteria of sweet potato per category

Categories	Preference criteria	Percentage of responses (%)
Agronomic **55.82 %**	Ease for field work	17.12
	Size of tubers	7. 69
	Strong vegetative development	8.23
	Resistance to diseases and pests	5.31
	High productivity	10.25
	Good post-harvest storage	5.17
	Drought tolerance	4.23
	Accessibility of cutting	5.51
Economic **13.17 %**	Good market value	10.81
	Sale of all plant organs	2.36
Culinary and technological **31.01 %**	High content of dry matter	3.05
	Red epidermis	6.7
	Sweet taste	9.81
	Meaty tubers	6.65
	Ease to cook	4.8

Participatory evaluation

The use of fifteen preference of criteria considered as parameters of evaluation allowed to classify the 40 sweet potato landraces in 3 groups (Fig. 3). Each group had its characteristics that can be exploited by breeding programs as parents or by development projects through varietal exchanges, as is currently the case with yam [13]. Composed of 17 landraces, group 1 (G1) has very good agronomic characteristics. This group was characterized by high productivity with large tubers, good adaptability to any type of soil, and good vegetation cover. Despite their little fibres content, they have good culinary and technological qualities such as very sweet taste, skin aspect leading easiness in its processing but which causes the attack of storage insects. Fourteen landraces with good post-harvest storage, resistance to insects and diseases, adaptability to various soils, tolerance to drought were aggregated in group 2 (G2). These landraces aren't very productive and have small tubers but very farinaceous, very sweet with a thick skin. Group 3 (G3) constituted by 9 landraces was characterized by tubers and stems colour, unsuitability to any type of soil, difficulty of storage, sensitivity to insect pests. They had also low yielding but resistant to worms, less sweet and preferred by the aged farmers. The stems were red at the nodes and have short internodes.

Otherwise, Sanoussi et al. [9] reported the existence of eight groups from sweet potato landraces grown in Southern and Central Benin. Thus, categorization of landraces from these two regions into eight groups indicates that the diversity of the sweet potato is more important in these areas than that of northern Benin. It is necessary to search in the germplasm collected in Benin or other countries the landraces respondents at criteria preference in order to enrich sweet potato diversity in the study area as recommended by Loko et al. [10] on yam and Agre et al. [18] on cassava.

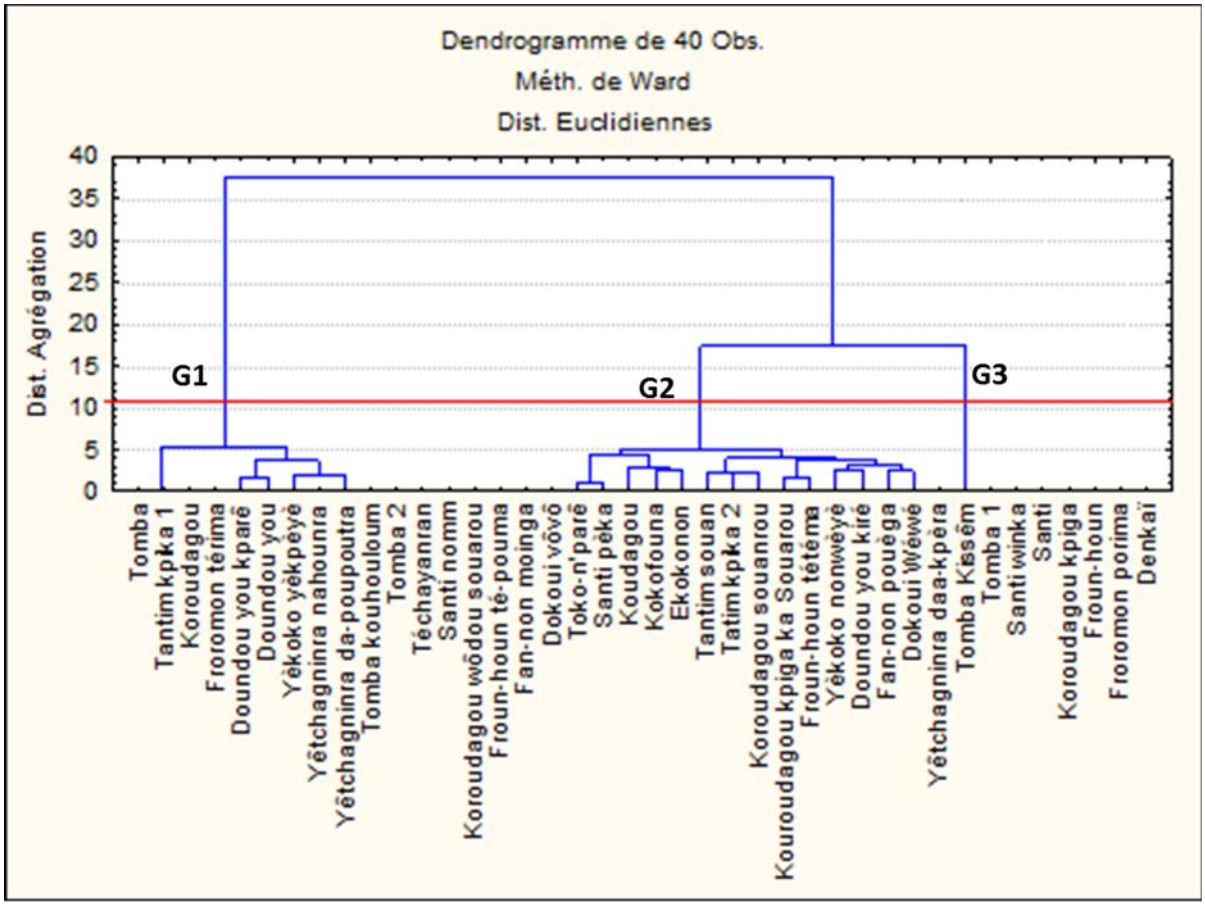

Fig. 3: Dendrogram showing the similarity between 40 landraces of potato

Diversity of uses of sweet potato landraces

The frequency of consumption of sweet potato varies largely according to surveyed farmers in study area. Thus, few farmers (8.89 %) consume it very frequently, while most of farmers (52.22 %) take it frequently, certain farmers (31.11 %) had moderate consumption, very few farmers consume it rarely (5.56 %) and very rarely (2.22 %). Similar to Sanoussi et al. [9], sweet potato was consumed as simple cooking (48.02 % of responses), frying (37 % of responses), and pounded (8.33 % of responses). Apart from those frequently consumption ways, some farmers (6.65 %) also mentioned its transformation into chips to make flour. According to them, the flour from the chips is very nutritional and constitutes good aliments supplements for children in the fight against food insecurity malnutrition mainly vitamin A deficiency as reported Amagloh et al. [38].

In addition to its nutritional importance, sweet potato was used by farmers to cure headaches (58.85 % of responses) and sexual weakness (41.15 % of responses). Regarding headaches, the leaves are used for the treatment whereas the uncooked tuber is used to cure the sexual weakness. These medicinal properties would be due to the presence of phytochemical element which will have to be analysed through phytochemical screening [39].

Otherwise, according to surveyed farmers, consumption of sweet potato causes diabetes (15.44 % of responses), blindness (18.86 % of responses), weakness and humans' sterility (53.6 % of responses) and confers small sizes to progenies (12.1 % of responses). It is also important to conduct biomedical analysis on tubers of sweet potato in order to invalidate or confirm these local perceptions which constituted a constraint for the valorization of this crop in northern Benin.

Conclusion

This study allows to inventory 40 sweet potato landraces subject to synonymy. Alibori and Atacora departments have been identified as an area of high production and diversity of sweet potato in Northern Benin and could be recommended as sites of *in situ* conservation. Several constraints of sweet potato production have been identified and could induce increasing of rates of varietal diversity loss if nothing is done. In the study area, the majority of sweet potato producers use a small number of high-performance or elite landraces for their production and selling. Farmers' preference criteria have been identified and will have to be involved in the improvement and varietal creation programs. Sweet potato is a crop which helps to avoids periods of food crisis and is a staple food during times of scarcities in Northern Benin. This crop is produced primarily for self-consumption in the form of boiled or fried tubers and rarely in crushed form. But based on these perceptions, its consumption may induce uneasiness which is obstacles to its promotion and valorisation and also justify its rudimentary state in Northern Benin.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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