

RESEARCH ARTICLE

Yield stability of water yam (*Dioscorea alata* L) landraces compared to improved varieties across multiple environments and their culinary qualities in the Republic of Benin

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Abstract

Background: In the Republic of Benin, the fresh yam market has two key periods: a time of high availability from August to February, followed by a scarcity from March to July. Fortunately, when *Dioscorea rotundata* fresh tubers become scarce and expensive, *Dioscorea alata* (commonly known as Agaabidjan/ Florido) pervades the market and provides a substitute, ensuring income for all value chain actors. Despite its importance, the gene pool of water yam is low and vulnerable in the growing areas.

Results: To assess the yield stability of water yam landraces grown in the traditional Beninese agriculture and identify elite genotypes, a genotype main effect and genotype-by-environment (GGE) interaction biplot analysis was conducted together with sensorial evaluation based on yam consumers preferences. Thirteen local and three improved varieties were assessed for fresh tuber yield and pounded yam quality across three locations over two consecutive seasons (2022 and 2023). Our findings showed that the accessions of three landraces Sakata Kpeguelehoun, Sakata Metchessa, Sakata Sossohoun) and two improved varieties (TDa0000194, TDa1510043) outperformed Florido in terms of yield, and three other landraces (Possoposso, Kpatampia, Lèssèlèssè) have similar yields.

Conclusion: Our results revealed that the most productive water yam accessions do not necessarily present a more stable yield across different environments. Sakata Metchessa stood out as a strong candidate for the national water yam-breeding program with good culinary features and high and stable yield in various environments. All landraces collected have their particularity, which highlights the importance of farmers in selection.

KEYWORDS

genotype-by-environment interaction, multilocal trials, yam, yield stability

INTRODUCTION

Yam value chain sustains livelihoods of around 5 million people, including rural farming households, traders, transporters, and

processors.¹ In Benin, yam as an important crop greatly contributes to poverty reduction, food security, and economic development. The *Dioscorea rotundata* – *cayenensis* complex is the basis for around 90% of its production, due to their organoleptic characteristics.² Fresh yam

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is available throughout all the year in Benin but is highlighted by two specific periods: August to February (high availability) and March to July (scarcity).³ Different varieties of preferred yam, *Dioscorea rotundata*, are not available all along the year. However, when its fresh tubers become scarce and expensive, they are replaced in the market by Florido (*Dioscorea alata*) and provide a substitute, ensuring income for all value chain actors. In fact, throughout the year, yam price varies significantly (a range of price from 42 \$ to more than 167 \$ for 50 kg has been reported by sellers at Market in 2023) with a particular increment up to multiple units for the most appreciated ones.⁴ Despite its poor organoleptic properties, *D. alata* is the most popular choice for many consumers who want to maintain the value chain from producers to consumers during scarcity period.^{3,5} It has a crucial importance in food security; in spite of this, its production is only 10.9% of total yam production in the Republic of Benin.^{5,6} Moreover, the preservation of its gene pool is under threat because the cultivation is largely centered on a single variety called 'Florido'.⁵ There is a paucity of knowledge about water yam varieties grown in Beninese agriculture, with only a few farmers cultivating the few known varieties in small areas.² These local water yam landraces have high agronomic and culinary performances comparatively to some improved yam varieties developed by the International Institute of Tropical Agriculture.⁷ However, the absence of conservation and utilization strategies could lead to significant genetic erosion of the Beninese water yam germplasm. Therefore, it becomes crucial to assess the agronomic performance of landraces to identify stable and superior genotypes for farmers to release.^{8,9} It is known that the agronomic attributes and consumer acceptance of water yam varieties are the key factors in their success.¹⁰ Indeed, the culinary attributes of tubers are the most important criteria for consumers' adoption of yam varieties and influence their market value.¹¹ While water yam tubers often remain underutilized due to consumer biases towards the low quality of the pounded yam preparations.¹² The pounded yam dish that is made from water yam tubers is characterized by its softness, non-stretchability, stickiness, and non-cohesiveness.¹³ This study aimed to evaluate the agronomic and culinary performance of water yam landraces grown in traditional Beninese agriculture and the three best improved genotypes being introduced from IITA,⁷ in order to determine which ones are suitable for vulgarization.

METHODOLOGY

Plant material and accessions identification

Sixteen water yam accessions, including three improved varieties and thirteen local varieties, were used for agronomic and culinary evaluation (Table 1). The seeds of the three improved water yam varieties were obtained from the International Institute of Tropical Agriculture (IITA) and identified as having the best agronomic performance (yield ≥ 40 t/ha) in some yam-growing areas in Benin.⁷ The seeds of local varieties were collected from farmers in different regions of the Republic of Benin (Table 1).

TABLE 1 Plant material used for performances evaluation.

	Accession	Type	Provenance
01	Daglidja	Local	Savalou
02	Florido / Aga abidjan	Local	Glazoué (Control)
03	Alagban	Local	Nigeria
04	Kpatampia	Local	Djougou
05	Lèssèlèssè	Local	Bassila
06	Matapei	Local	Toucountouna
07	Possoposso	Local	Bassila
08	Sakata Kpeguèlehoun	Local	Tallou
09	Sakata Metchessa	Local	Tallou
10	Sakata Sossouhoun	Local	Tallou
11	Houto	Local	Djidja
12	Sounou pompéi	Local	Matéri
13	Tiyonougaoité	Local	Boucoubmé
14	TDa 0000194	Improved	IITA
15	TDa 1510043	Improved	IITA
16	TDa 1520050	Improved	IITA

Experimental sites

Field trials were carried out at three distinct locations, including Dassa, Tchetti, and Tallou.⁷ Dassa and Tchetti are located in central Benin, which has a transitional climate between the Sudanese and Guinean climates, with an average rainfall of 1200 mm/year. Tallou village in northern Benin is characterized by a tropical climate with an average rainfall of 1100–1200 mm/year, and a temperature range of 27–35°C. The humidity of the air fluctuates between 18% during the Harmattan period and 99% during the rainy season in August.¹⁴ Dassa and Tchetti are characterized by ferruginous soils with natural vegetation composed of savannas, while at Tallou, they are Hydromorphic, ferrallitic soils and lithosols with a vegetation consisting of gallery forests and savannahs.

Experimental design and data collection

The trial was established in a lattice design with two repetitions across all three locations, in accordance with the protocol developed for yam variety performance.¹⁵ The design involves four blocks per replicate, with a 2-m spacing between blocks and repetitions (Figure 1). There are four rows per block, each row comprising one accession with 10 mounds. There is 1 m between rows and between mounds. Yam seeds have been sown in March (Dassa (04th 2022; 14th 2023), Tchetti (06th 2022; 16th 2023), Tallou (07th 2022; 18th 2023)) and harvested at the end of December. Tuber setts were sown directly in the mounds (60–80 cm high) at a spacing of 1 × 1 m. No fertilizer or chemical pesticides were applied. Manually controlling weeds and staking all mounds were done. The average weight per plant (Kg/mound) of yam was calculated by mound to calculate yield.

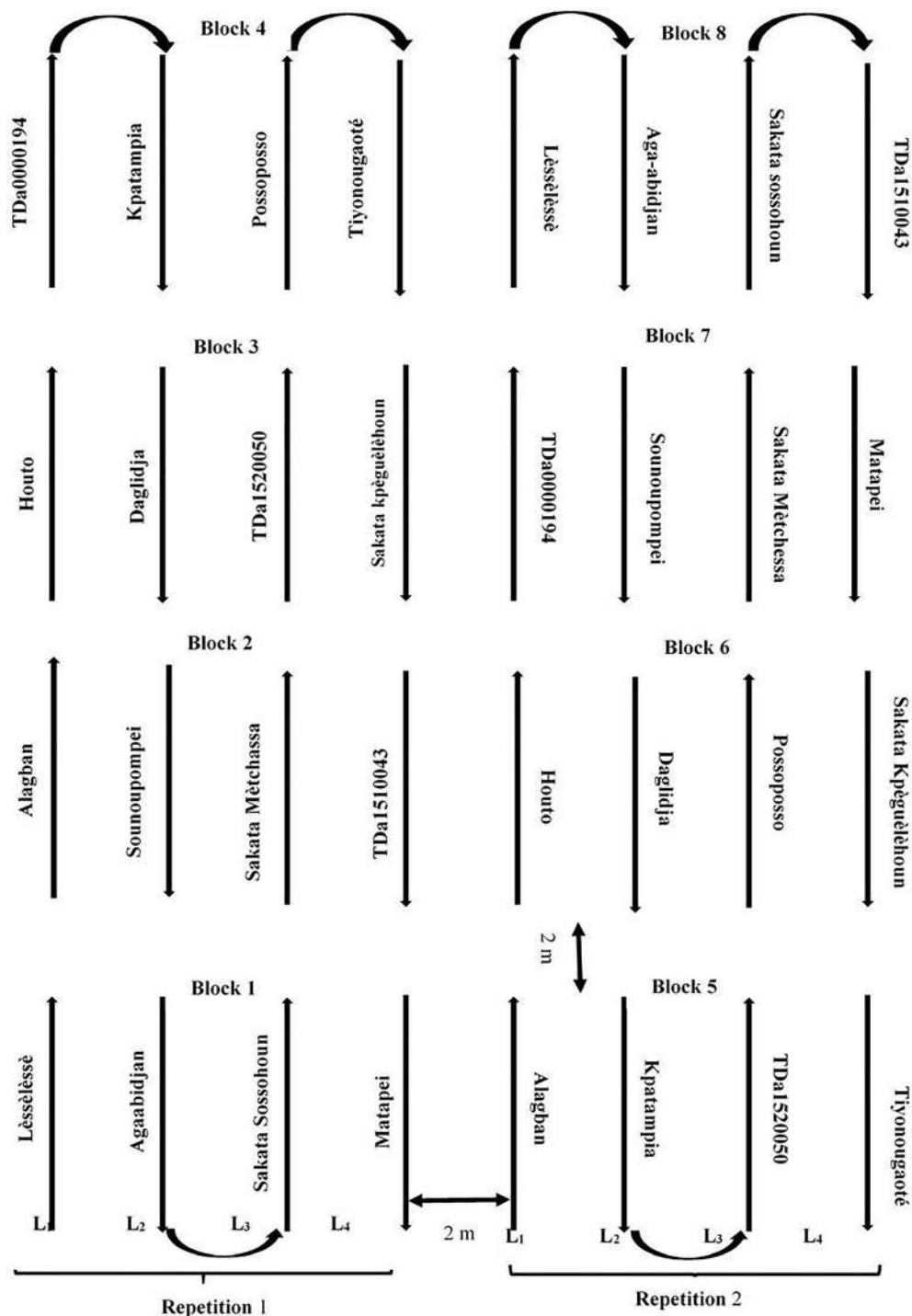


FIGURE 1 Experimental design.

Organoleptic test

For the hedonic test, sixty (60) panelists were selected among students from the National High School of Applied Biosciences and Biotechnologies (ENSBBA) who voluntarily agreed to participate in the tests. Fresh tubers were cleaned with water after being hand-peeled and cut into slices of 5 cm.¹⁶ For each yam accession, 2 kg of yam tuber slices were cooked at a temperature of 100°C with 200 mL of

water for various times.⁷ Qasa yam pounding machine (Model QYP-6000) was used.¹⁷ Before the tasting, a short training was provided to the tasters to harmonize their method of scoring or appreciation, filling in the scoring sheet, and especially assigning scores to each sensory character (appearance, color, mouldability, stretchability, mealiness, texture, aroma, elasticity, and taste). A combination of samples was given to each taster, and they were given the opportunity to score them on a 5-level hedonic scale on an evaluation sheet. After

consuming two batches of pounded yam, testers were given a glass of water to rinse their mouths to avoid mixing the flavors.

Data analysis

Field data

Data from three locations, including Dassa, Tchetti, and Tallou, were used to define six studied environments in the two experimental seasons (2022 and 2023). These include E1 (Dassa 2022), E2 (Dassa 2023), E3 (Tallou 2022), E4 (Tallou 2023), E5 (Tchetti 2022) and E6 (Tchetti 2023). Analysis of variance (ANOVA) was conducted using a mixed linear model using the *lmer* function in the R “*lmerTest*” package, where genotypes were considered fixed, and other factors, such as environment and trial components, were considered random effects. The adjusted means or best linear unbiased estimate (BLUE) yield values were then extracted using the R *emmeans* package. The BLUE yield values were used to compare the performance of the varieties in each environment using the *mutlcomp* R package. To calculate the broad-sense heritability of yield traits across all trials, a second mixed linear model was constructed, where all factors, including genotype, were taken as random to enable estimation of genetic variances. Broad-sense heritability (H^2) was calculated according to the following formula¹⁸:

$$H^2 = \frac{V_g}{V_g + \left(\frac{V_{ge}}{e}\right) + \left(\frac{V_e}{er}\right)}$$

Where V_g is genotypic variance, V_{ge} is the variance for variety by the environment, V_e denotes the error variance, e is the number of environments, and r represents the number of replicate numbers.

Similarities and differences among the studied genotypes were elucidated using the Euclidian distance method to plot a dendrogram

using the ‘*factoextra*’ R package.¹⁹ For the high and stability yield evaluation, GGE biplot analysis^{20,21} was performed using the *GGEbiplots* R package and the two first principal components (PC1 and PC2) scores.

Culinary data

We performed a classical ANOVA using the *Agricolae* package²² and the *aov* function to discover sources of variation and examine significant differences between genotypes and trial components. To compare the genotypes, we fitted a linear mixed model taking into account the genotypes as fixed and replicates (consumers) as a random effect. Thereafter, a multiple comparison test was performed using the *cld* function in the *Multcomp* package. We used the *ggbiplot* package for the Principal Component Analysis (PCA)²³ in order to understand the link between yam genotype and the sensory attributes for pounded yam. The R 4.2.2 software²⁴ environment was used for all analyses and graphs.

RESULTS

Yield evaluation

The ANOVA test reveals that varieties had a very significant impact on yield, more than the environment where yield can greatly vary significantly (Table 2). There is a significant link between parameter variety and environment. This is explained by the different yield in different environments, with the high values obtained at Tallou (Table 3). The best linear unbiased estimation of yield value of each genotype in each environment showed that varieties TDa 1510043, TDa 0000194, Sakata Kpeguelehoun, TDa 1520050, Sakata Sossouhoun, Sakata Metchessa, Lesselesse, Houto, Kpatampia, Agaabidjan,

TABLE 2 Anova table for yield evaluation.

	Sum Sq	Mean Sq	NumDF	DenDF	Pr(>F)
Variety	55.52	3.70	15	73.47	1.88E-17***
Env	14.40	2.88	5	6	0.003817**
Variety: Env	28.38	0.38	75	51.44	0.027826*

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; ns $p > 0.05$.

TABLE 3 Summary statistics by environments.

Trials sites	Env	Yield (kg/mound)	Vyield	Sdyield	Nvar	Nobs
Dassa	E1 (2022)	2.52	0.54	0.73	16	32
	E2 (2023)	3.07	0.38	0.61	16	32
Tallou	E3 (2022)	2.92	0.85	0.92	16	32
	E4 (2023)	3.13	0.80	0.89	16	32
Tchetti	E5 (2022)	2.39	0.57	0.75	16	32
	E6 (2023)	2.73	0.35	0.59	16	32

Sounoupompei, Possoposso, Matapei have at least a yield of 3 kg/mound (Figure 2a).

Cluster analysis constructed to search for similarities and dissimilarities among the studied genotypes revealed two categories, each with two groups (Figure 2b). The first category consisted of varieties that had a high yield of marketable tubers, ranging from 4 kg / mound to more, regardless of the environment in which they were grown. There are two groups in this category: the group G1 (TDa0000194, Sakata Kpeguelehoun, and Sakata Metchessa) has always yielded more than 4 kg per mound, and the group G2 (Sataka Sossou, TDa 1510043, TDa 1520050, and Houto) has yielded and can oscillate around 4 kg per mound. The second category included water yam accessions, which yield can vary from one environment to another, and can increase or decrease up to 3 kg/mound. The group G3 included water yam accessions (Lesselesse, Kpatampia, Agaabidjan/ Florido, Possoposso, Matapei, Sounoupompei, and Daglidja), which can have a high yield. The group G4 included water yam accessions (Tiyonougaoite and Alagban) with a medium yield (between 2 and 3 kg per mound).

Yield stability through genotype-environment analysis

Identification of mega-environments and winning genotypes

The total variation of the yield of fresh yam tuber was 85.04%, composed of PC1 which explained 71%, and PC2 which explained 14.04%. The 'which-won-where' polygon view obtained from GGE biplot is formed by vertex genotypes that are Sakata Metchessa, TDa 0000194, Sakata Kpéguéléhoun, TDa 1510043, Sounoupompei, and Alagban. The six environments were divided into three sectors or mega-environments. E4 was in the first mega-environment, E2 and E6 were the second mega-environments, and the third mega-environment was formed by E1, E5 and E3 (Figure 3a). The improved variety TDa0000194 was the winner (have the optimum yield) in the first mega-environment, while Sakata Metchessa was the winner in the second mega-environment. Sakata Kpeguelehoun and TDa1510043 were the winners in the third mega-environments. Sounoupompei and Alagban showed a poor yield in all the environments.

Discrimination and representativeness of the studied environments

The AEC abscissa axis and the AEC coordinate were revealed in Figure 3b. Figure 3c indicates that there are two types of environments: Type 1 environments (E2 and E6) with short vectors, and Type 2 environments (E1, E3, E4 and E5) with long vectors. Among them, E3 and E4 have presented longer vectors and small angles with the AEC abscissa, which are ideal for selecting superior genotypes. E2 and E6 were more representative of other environments, whereas E3 is the most discriminating but nonrepresentative (Figure 3c). E3 was

more informative to select genotypes with specific adaptability. E1 and E5 were both discriminating and representative; therefore, they constitute good testing environments to identify and select varieties that have broad adaptability to the studied environments. As a result, TDa1510043 and Sakata Kpeguelehoun exhibited a wide range of adaptability in different environments.

Ranking of genotypes, mean performance, and yield stability analysis

Ranking genotypes allowed us to classify genotypes into two categories. The first genotype was high yielding and positively correlated with PC1, while genotypes with medium and low yielding were also included. From Figure 3d, the ranking was as follows: Sakata Metchessa > TDa0000194 > Sakata Kpéguéléhoun > TDa1510043 > Houto > TDa1520050 > Sakata Sossouhoun > Mean > Agaabidjan = Lesselesse = Possoposso > Matapei > Kpatampia > Sounoupompei > Tiyonougaoite > Daglidja > Alagban. As far as genotype yield stability is concerned, based on Figure 3e, the more stable genotypes were Kpatampia, Agaabidjan, Sakata Metchessa, Houto, Lesselesse, and Daglidja. By ranking mean performance and yield stability, the analysis has revealed two best varieties (Sakata Metchessa and TDa 0000194) with similar mean yields, but Sakata Metchessa was more stable.

Sensory evaluation

The ANOVA test revealed that sensory attributes varied greatly depending on the panelist and the different varieties. We noticed a significant difference between different parameters in Table 4. The multiple comparison test showed that pounded yam from TDa0000194 and TDa1510043 were more appreciated than some local varieties, even though some local varieties such as Sakata Kpéguéléhoun, Sakata sossouhoun, Possoposso, and lesselesse were also liked (Table 5).

The first two components (PC1 and PC2) explained 75.8% of the variability (Figure 4). Taste and aroma were negatively correlated with the two axes. Referring only to the first component, the pounded yam from accessions TDa0000194, TDa1510043, Lesselesse, Sakata Metchessa, Agaabidjan, Tiyonougaoite, Sakata Kpeguelehoun, Katampia, Possoposso, and Sakata Sossouhoun have all the sensory attributes except a good texture. TDa 1520050, Sakata Kpeguelehoun, Sakata Sossouhoun, Kpatampia, and Possoposso were correlated with taste, aroma, and texture, in opposition to other traits such as color, moldability, and elasticity.

Projection of different varieties on the two components revealed that they have two most important groups of water yam accessions. The first group included TDa0000194, TDa1510043, Lesselesse, Sakata Metchessa, Agaabidjan, and Tiyonougaoite, whose pounded yam had high color, moldability, and elasticity scores. The second group included Sakata Kpeguelehoun, Katampia, Possoposso, and Sakata Sossouhoun, whose pounded yam has two additional sensory

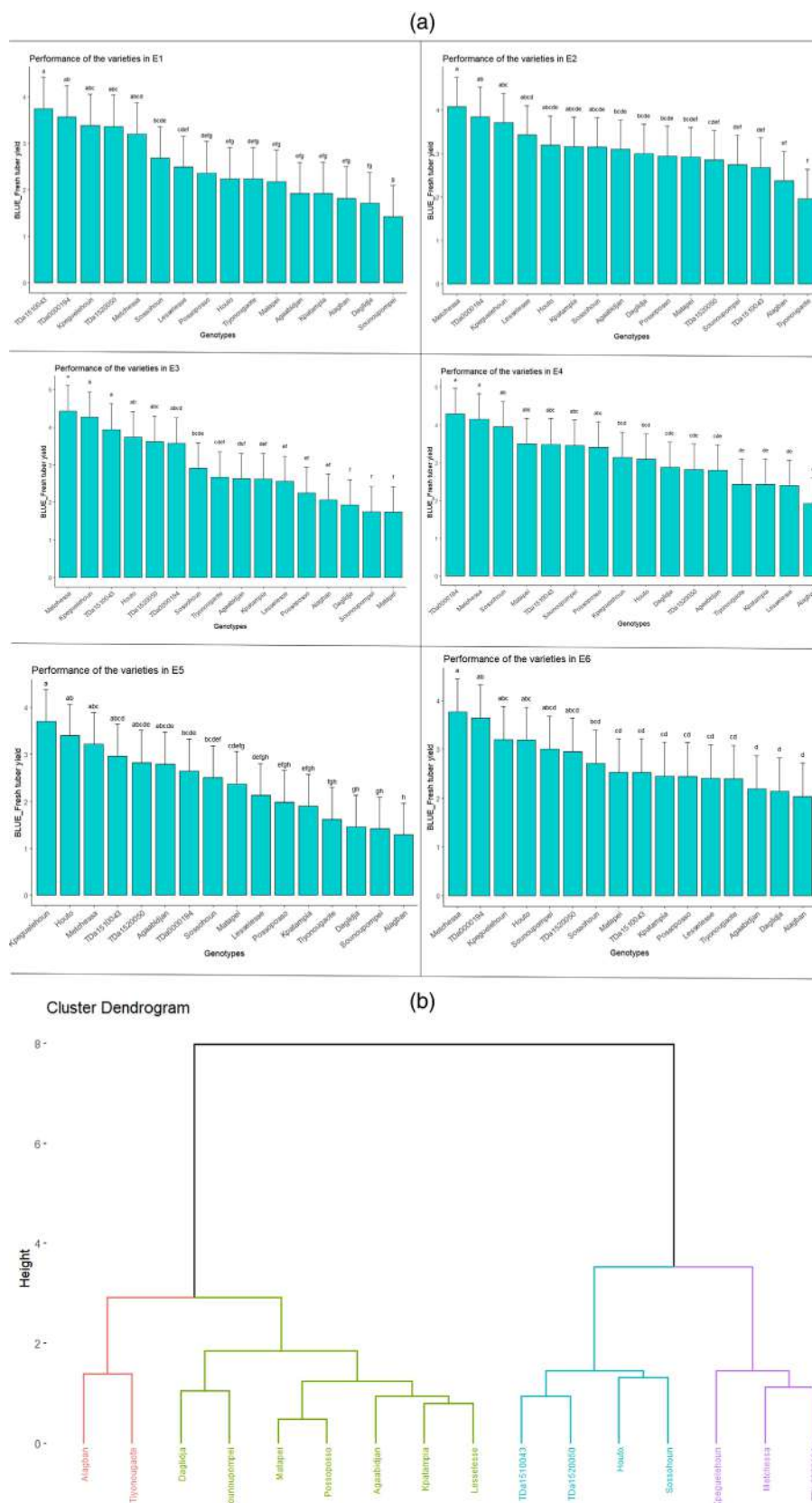


FIGURE 2 Best linear unbiased Estimation yield value of each genotype in each environment and Cluster dendrogram.

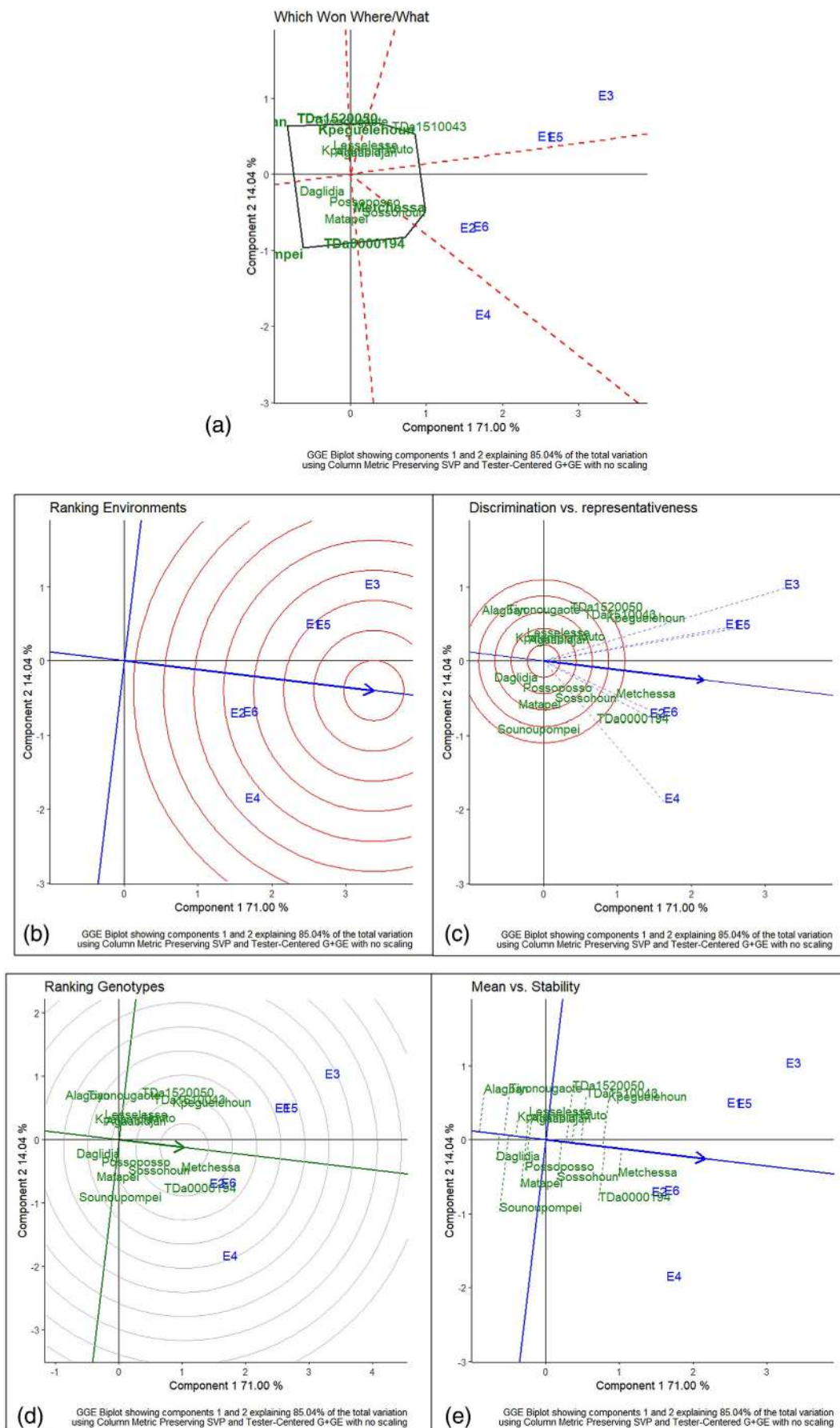


FIGURE 3 GGE Biplots analysis graphics.

TABLE 4 Anova test of the studied traits.

Source of variation	Df	Mean square						
		Arome	Color	Elasticity	Mouldability	Stretchability	Taste	Texture
Accession	15	23.36***	31.89***	29.01***	30.10***	23.36***	16.81***	20.30***
Rep	14	0.46***	0.88***	0.71**	0.67**	0.46*	0.72**	1.13***
Residuals	210	0.26	0.26	0.27	0.27	0.26	0.28	0.37

Note: Significant level: * (0.01 < $p \leq 0.05$), ** (0.001 < $p \leq 0.01$), *** ($p \leq 0.001$).

TABLE 5 Multiple comparison.

Parameters accessions	Taste	Elasticity	Color	Mouldability	Stretchability	Texture	Aroma
Agaabidjan	4.46 ^d	4.66 ^c	5.00 ^a	3.85 ^c	3.99 ^{cd}	3.26 ^g	3.26 ^g
Alagban	3.06 ^f	3.06 ^e	3.33 ^d	1.26 ^{gh}	2.26 ^f	3.53 ^{fg}	3.53 ^{fg}
Daglidja	2.66 ^g	1.80 ^g	1.53 ^f	1.60 ^g	1.60 ^h	3.86 ^{ef}	3.86 ^{ef}
Houto	3.73 ^e	3.80 ^d	3.73 ^c	3.73 ^{cd}	3.40 ^e	3.60 ^{efg}	3.6 ^{efg}
Kpatampia	5.00 ^{ab}	2.66 ^f	4.93 ^b	2.66 ^f	2.40 ^f	2.20 ^{ij}	2.20 ^{ij}
Lèssèlèssè	4.80 ^{cd}	4.73 ^c	5.00 ^a	3.53 ^{cd}	4.26 ^{bc}	2.66 ^h	2.66 ^h
Matapei	2.60 ^g	2.46 ^f	2.80 ^e	2.53 ^{ef}	1.80 ^{gh}	4.53 ^c	4.53 ^c
Possoposso	5.00 ^{bc}	5.00 ^{bc}	3.66 ^{cd}	3.66 ^{cd}	1.73 ^{gh}	5.00 ^a	5.00 ^a
Sakata Kpegùlehoun	5.00 ^{ab}	5.00 ^a	3.53 ^{cd}	5.00 ^b	1.80 ^{gh}	5.00 ^a	5.00 ^a
Sakata Metchessa	4.53 ^d	3.93 ^d	5.00 ^a	3.46 ^d	3.66 ^{de}	2.60 ^{hi}	2.6 ^{hi}
Sakata Sossohoun	5.00 ^a	5.00 ^{ab}	4.60 ^b	5.00 ^a	3.66 ^{de}	4.00 ^{de}	4.00 ^{de}
Sounoupompéi	2.46 ^g	1.73 ^g	2.66 ^e	2.66 ^e	2.06 ^{fg}	4.33 ^{cd}	4.33 ^{cd}
Tiyonougatô	4.66 ^d	4.66 ^c	4.73 ^b	3.53 ^{cd}	3.46 ^e	2.66 ^h	2.66 ^h
TDa 0000194	3.66 ^e	5.00 ^a	5.00 ^a	5.00 ^a	5.00 ^a	2.13 ^j	2.13 ^j
TDa 1510043	4.60 ^d	5.00 ^a	5.00 ^a	4.66 ^b	4.60 ^b	1.93 ^j	1.93 ^j
TDa 1520050	5.00 ^a	2.33 ^f	1.00 ^g	1.00 ^h	1.60 ^h	5.00 ^b	5.00 ^b

Note: The means of different letters in a column are significantly different at the 5% level. The values that are highlighted in bold are considered to be high (> 4).

attributes, such as taste and aroma, which correlate with the first component.

Agronomic and sensory performances of water yam accessions

A cross-sectional analysis of sensory evaluation, yield performance, and GGE biplot analysis through genotype ranking revealed four groups of water yam accessions (Figure 5). The group included TDa0000194, Sakata Kpegùlehoun, Sakata Metchessa, Sakata Sossohoun, and TDa 1510043. They have a high, stable yield and at least 80% sensory attributes. The second group included accessions that had at least 80% sensory attributes, but their yield can fluctuate due to the environment and can drop to 20 kg/t. This second group included Possoposso, Kpatampia, Lèssèlèssè, and Agaabidjan accessions. The third group comprised TDa1520050, which were Houto accessions with stable yields but only about half of their sensory qualities. The remaining accessions in the fourth group have weak yield and sensory attributes without Tiyonougatô (weak yield but very high sensory attributes).

DISCUSSION

Yield varied significantly from one environment to another, which can be explained by edaphic and climatic differences.^{17,25,26} The highest yields were found in Tallou village, which was the best environment ideal for selecting superior genotypes. This result could be justified by the climate effect, which is less arid in Tallou than in Dassa and Tchetté. Indeed, the annual average rainfall in Tallou is between 1200 and 1300 mm.²⁷ This average made this region the most humid in Benin and most adapted to yam for its water requirements. In addition to the climate, the soils are made up of very old crystalline formations with a granite-gneissic parent rock that is favorable for crops.²⁷

The minimum yield for yam varieties to be adopted by Beninese farmers, defined by Loko et al.¹⁷ can be reached by some assessed water yam landrace accessions, which can reach a yield of 4.16 kg/mound. The yield of evaluated local water yam accessions was twice the yield found on farm by Adifon et al.²⁸ in Benin and by Bakayoko et al.²⁹ in Côte d'Ivoire. The cluster analysis classified Florido (Agaabidjan) in the second category, and revealed that the majority of local varieties and all the improved ones are better than that accession. From 2010 to present,

cross-border migration traffic introduced several varieties of water yam, which are more performant than Florido.³⁰ Neighboring countries such as Togo, Nigeria, Côte d'Ivoire, and national research institutions such as

INRAB contributed to increasing the varietal richness of *D. alata*.³¹ The fact that improved varieties are in the first category indicates they can perform better than some local varieties, which demonstrates the importance of breeding and selection in sustainable agriculture.

Identification of the most promising genotypes across multilocal sites that demonstrate yield potential and yield stability is vital for selection and variety release.^{32–34} The evaluation of genotype-by-environment (GE) and genotype-by-environment (G) main effect, interaction (G + GE) is crucial for selecting the performant water yam accessions with the interaction of the environment. Many breeders used it to select elite' genotypes.³³ GGE Biplot analysis helped us identify the genotype ranking, which is a more discriminative and representative environment, in order to choose among the most performant accessions, rather than the national elite Florido. Our results revealed that the most productive water yam accessions were not necessarily those that were more stable across environments, and enhanced the importance of GGE Biplot use for selecting elite varieties. Studies have shown that location, season, and environment are necessary parameters for evaluating genotype yield and its yield stability^{35,36}; Similar results were found for pea and peanut lines, where the genotypes with higher yields were not the most stable across environments.^{32,34,37} The improved varieties TDa0000194, TDa1510043, and TDa1520050 were less stable than local accessions. This could be explained by the fact

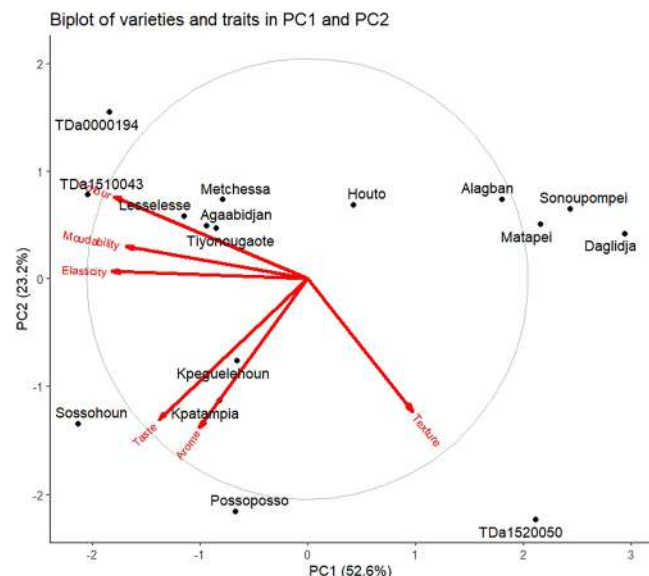


FIGURE 4 PCA analysis for sensory evaluation.

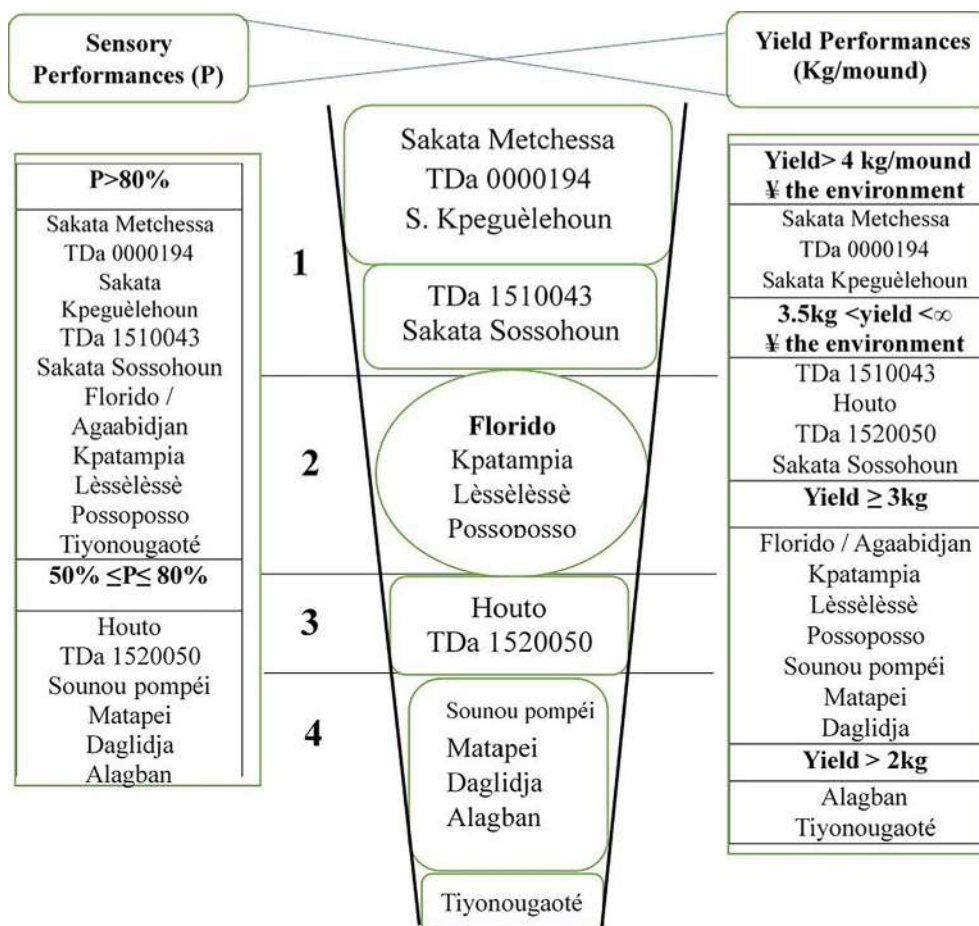


FIGURE 5 Crossing analysis based on Yield and sensory performances.

that local accessions have a high capacity to tolerate biotic and abiotic stress, resulting in a high yield stability.³⁸ Sakata Metchessa and TDa0000194 were the most productive accessions, but the yield of Sakata Metchessa was the most stable. Pounded yam of TDa0000194, TDa1510043, Lesselesse, Sakata Metchessa, Agaabidjan, Tiyonougaote, Sakata Kpeguelehoun, Katampia, Possoposo, and Sakata Sossouhoun accessions presented all sensory attributes necessary to be released to farmers. The remaining varieties presented at the same time fewer attributes than they did; the presence of TDa1520050 among the accessions presenting the least sensorial attributes confirms results of.⁷

All the accessions except Sounou pompéi, Matapéi, Daglidja and Alagban, can be used for varieties release and landrace from two first group (Figure 5) can be considered as parent for open pollinization. Despite the relatively low yield of Tiyonougaoté, it presents at least 80% of sensory attributes. This explains and confirm the high importance of sensory attributes for farmers. It is like Laboko most loved yam accession⁵ whose production is too constraining but with a one of the best sensory attributes. TDa1520050 and Houto presented a high and stable yield but only 50% of sensory attributes. It is comparable to variety “Gnidou” or “Ala” of *Dioscorea rotundata-cayenensis* complex which have not a very interesting sensitive attributes but a good yield. Landraces is highly important for sustainable agriculture because of their capacity of local adaptation, stress tolerance, yield stability and seed nutrition.³⁹ The Eight landraces (Sakata Kpeguelehoun, Sakata Metchessa, Sakata Sossouhoun, Possoposo, Kpatampia, Lèssèlèssè, Houto, and Tiyonougaoté) identified from farmers will enhance yam genetic variability, reduce genetic erosion and biodiversity loss for food safety in Benin.

CONCLUSION

Our results showed that five water yam accessions (TDa0000194, Sakata Kpeguelehoun, Sakata Metchessa, Sakata Sossouhoun and TDa1510043) were better than the most common water yam variety produced in Benin, ‘Agaabidjan/Florida’, and three (Possoposo, Kpatampia, Lèssèlèssè) had the same attributes. High yield stability was achieved by the local water yam accession, Sakata Metchessa. These findings provide a useful basis for improving national water yam-breeding strategies.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author.

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