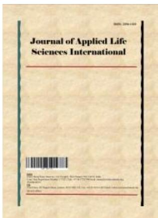

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Phenotypic Characterization of *Dioscorea burkilliana* J. Miège (Dioscoreaceae) Genetic Resources

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Authors' contributions

This work was carried out in collaboration among all authors. Authors ITG and MA designed the study. Authors ITG and OJO wrote the protocol, managed the literature search and interpreted the data analysis. All the authors read and approved the final manuscript.

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ABSTRACT

Aims: This study investigated morphological characterization of eighty accessions of *Dioscorea burkilliana* obtained from the Genetic Resources Center of International Institute of Tropical Agriculture (IITA) Ibadan, Nigeria.
Study Design and Methods: The experimental field was laid out in a complete randomized design with three replicates on plots of 10 meters length spaced at one meter between rows and one meter within rows (10 m x 1 m x 1 m).
Results: The evaluation of nine qualitative and six quantitative traits revealed phenotypic variations in *D. burkilliana* accessions using IPGRI's descriptors. The mature stem colour of spot at spine base (MSCSSB) had the highest mean of 61.73 cm, while young stem with absence or presence of scale leaves (YSA/PSL) had least value of 0.37 cm. The principal component analysis (PCA) produced the highest eigenvector of 3.122 for Prin 1 with highest proportion of 20.81%, while Prin 15 had the least (0.11%). Also, in Prin 1, the mature leaf petiole at base (MLP A), mature leaf petiole at middle (MLP B) and mature leaf petiole at top (MLP C) were closely related compared to matured leaf measurement MLM-Breadth A, MLM-Breadth B and MSA-PCS. There was positive

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and strong relationship between mature leaf petiole at base (MLP-A) with mature leaf petiole at middle (MLP-B) (r = 0.84, p< 0.005) and mature leaf petiole at top (MLP-C) (r = 0.75). The dendrogram was delineated into seven cluster groups in which cluster V had 18 accessions which was the highest, while cluster VI had the least with one accession (DbB 222).

Conclusion: The strong positive associations among MLP-A, MLP-B and MLP-C as well as MSS SAB and MSA/PCS suggested the consideration of these traits for future breedings. Accessions DbB 83, DbB 140 and DbB 254 could be recommended as parent material for the improvement of *Discorea burkilliana.*

Keywords: Dioscorea burkilliana; accessions; morphological character; phenotypic variation; dendrogram.

1. INTRODUCTION

Yams (*Dioscorea* sp.) belong to the Dioscoreaceae family, and are important staple food for over 300 million people in the tropics and subtropics [1]. It is a multi-species class of root tuber crop distributed worldwide, particularly important in the Nigerian and West African diet [2]. Apart from being a staple food, yam has medicinal values. As an example, Akubue [3] reported the presence of a hypoglycaemic agent in *Dioscorea dumetorum* (Kunth) Pax extract. Tubers of yam species are used in spasmodic asthma, vomiting and hepatic congestion [4]. Yam is dioecious with vines which store starchy reserves in aerial or underground tubers. They are however highly perishable commodities which require much attention due to pest infestation and physiological processes as a result of their high moisture content (50-80%) and high respiration rates [5]. *Dioscorea burkilliana* is one of the wild yams of the forest commonly found in Benin Republic [6], Gabon and in Central Africa Republic [7]. The cultivated and wild types are mostly grown for their starchy tubers, and also have medicinal properties [8]. Cultivated yams are propagated vegetatively, whereas wild yam that are sexually propagated and comprise of both diploid and polyploid species [9]. The characterization of germplasm with respect to phenotypic diversity is carried out with the aid of descriptors [10]. Assessment of phenotypic diversity involves measurement of quantitative and qualitative characters of the accessions and analysis of dissimilarities between a pair of accession based on some of the characters [11]. The characters which are highly heritable throughout their life span are responsible for dissimilarities [12]. The relative contributions of the various accessions and their characters accounted for total variability in the germplasm [12,13]. Wild yams carry potentially important traits, and there is need to breed more new productive strains. Despite the agricultural and medicinal importance of yams, little is known about their origin, phylogeny, diversity and genetics. As there is scarcity of information on accessions of *D. burkilliana* in literature, this study investigated phenotypic variation on some qualitative and quantitative traits of *D. burkilliana*.

2. MATERIALS AND METHODS

2.1 Source of Germplasm

Eighty tubers of *Dioscorea burkilliana* (Table 1) were obtained from Genetic Resources Centre (GRC) of the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. The samples were collected by IITA from diverse geographical locations of Benin Republic. Furthermore, all experiments were carried out using available facilities in IITA.

2.2 Land Preparation, Experimental Design and Planting Method

The accessions were planted at IITA nursery (Plate 1A) from 17th of July 2014 to 23th May 2015. The land was mechanically prepared by ploughing, harrowing and ridging. The experiment was laid out in a complete randomized design (CRD) with three replicates, and arranged in rows of 10 meters each spaced at 1 meter between rows and 1 meter within rows (10m x 1m x 1m).Yam is propagated by means of yam sett ranging from 150-300 g in tuber weight.

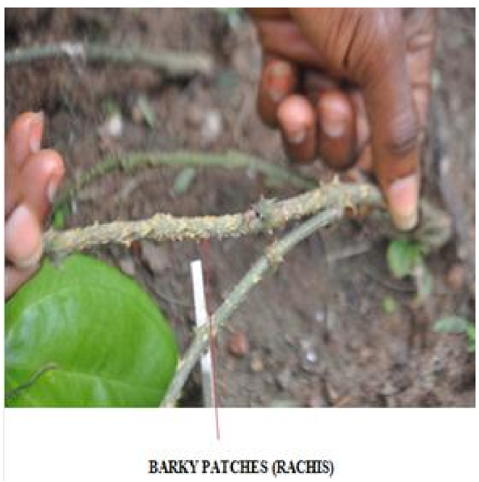
When yams are about 1m tall, they are staked in order to provide support on which to twine. Also, staking keeps the shoots away from the soil surface which may be hot early in the season and moist later on. The tubers were sown on a single row plot of 10 meters, and planted at 1 meter apart on the ridges, while manual weeding was done regularly.

2.3 Phenotypic Characterization of *Dioscorea burkilliana*

Measurements of nine qualitative and six quantitative characters were made on eighty accessions of *D. burkilliana.* Quantitative characters were determined by measuring and counting, while the qualitative characters were determined visually, feeling or touching and scored by nominal codes [barky patches, young stem, presence or absence of scale leaves, mature stem spine on stem base, mature stem-color of spot at spine base, etc]. A Descriptor List for *Dioscorea* spp. IPGRI / IITA [14] was used as guide for phenotypic characterizations.

2.4 Statistical Analysis

Means and standard deviations were estimated using the formula described by Gomez and Gomez [15], Analysis of variance (ANOVA) was used to test for significant differences Duncan Multiple Range Test (DMRT) was used separate the means at significance level of p<0.05. Dendrogram was constructed to show the cluster pattern of accessions with similar characteristic. Principal component analysis (PCA) and correlation coefficient were also determined to establish the relationships between the characters and accessions.



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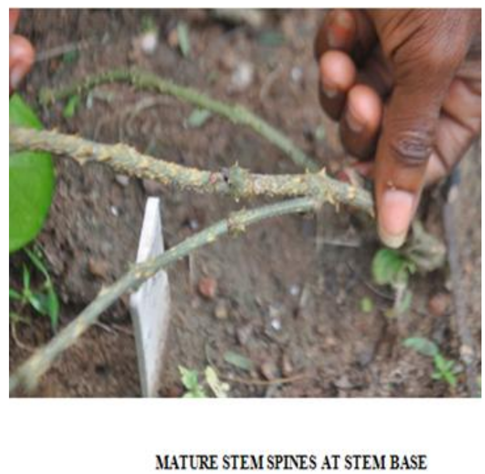

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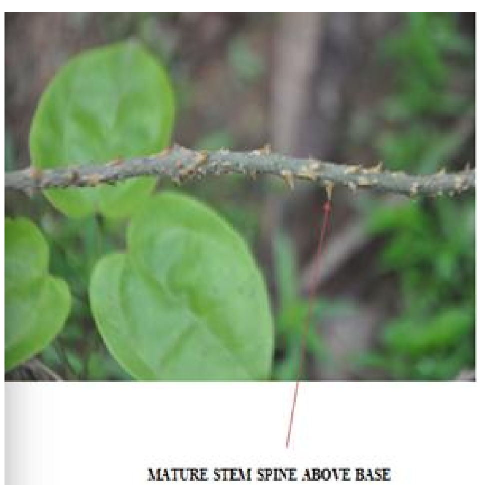

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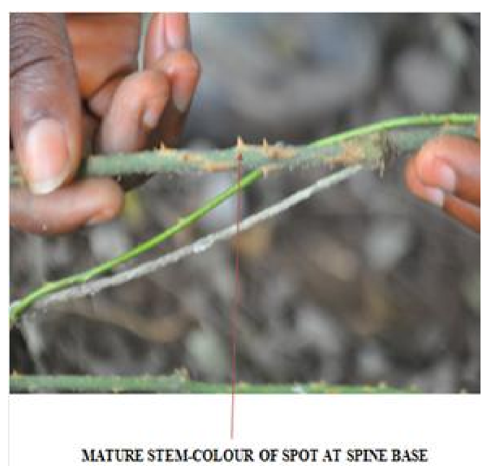

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Plate 1. Phenotypic descriptors of *Dioscorea* spp., 1A- Barky patches, 1B- Mature stem spines at stem base, 1C- Mature stem spine above base, 1D- Mature stem of coalescent spine, 1E- Mature stem color of spot at spine base

Table 1. *Dioscorea burkilliana* accessions from different geographical locations in Republic of Benin

Accessions	Longitude	Latitude
DbB 01	$4^0$053’20’’E	$7^0$046’05’’N
DbB 03	$4^0$049’47’’E	$7^0$046’37’’N
DbB 06	$4^0$054’36’’E	$7^0$046’54’’N
DbB 11	$4^0$054’30’’E	$7^0$046’59’’N
DbB 15	$4^0$054’32’’E	$7^0$046’60’’N
DbB 19	$4^0$049’97’’E	$7^0$046’68’’N
DbB 22	$4^0$054’02’’E	$7^0$046’71’’N
DbB 23	$4^0$052’08’’E	$7^0$046’71’’N
DbB 26	$4^0$054’35’’E	$7^0$046’74’’N
DbB 28	$4^0$054’32’’E	$7^0$046’75’’N
DbB 33	$4^0$054’11’’E	$7^0$046’82’’N
DbB 35	$4^0$058’23’’E	$7^0$046’86’’N
DbB 39	$4^0$054’05’’E	$7^0$046’90’’N
DbB 41	$4^0$054’05’’E	$7^0$046’93’’N
DbB 51	$4^0$054’11’’E	$7^0$047’06’’N
DbB 53	$4^0$054’11’’E	$7^0$047’07’’N
DbB 56	$4^0$054’09’’E	$7^0$047’08’’N
DbB 60	$4^0$054’01’’E	$7^0$047’10’’N
DbB 69	$4^0$053’79’’E	$7^0$047’15’’N
DbB 72	$4^0$053’94’’E	$7^0$047’15’’N
DbB 76	$4^0$054’02’’E	$7^0$047’17’’N
DbB 83	$4^0$053’97’’E	$7^0$047’19’’N
DbB 85	$4^0$053’93’’E	$7^0$047’20’’N
DbB 91	$4^0$054’13’’E	$7^0$047’23’’N
DbB 93	$4^0$053’77’’E	$7^0$047’24’’N
DbB 95	$4^0$053’80’’E	$7^0$047’24’’N
DbB 96	$4^0$053’98’’E	$7^0$047’24’’N
DbB 102	$4^0$054’09’’E	$7^0$047’29’’N
DbB 103	$4^0$054’16’’E	$7^0$047’30’’N
DbB 104	$4^0$054’16’’E	$7^0$047’34’’N
DbB 105	$4^0$053’96’’E	$7^0$047’36’’N

Accessions	Longitude	Latitude
DbB 106	$4^0$053’98’’E	$7^0$047’37’’N
DbB 108	$4^0$053’96’’E	$7^0$047’39’’N
DbB 110	$4^0$054’08’’E	$7^0$047’44’’N
DbB 117	$4^0$053’22’’E	$7^0$047’78’’N
DbB 119	$4^0$053’23’’E	$7^0$047’79’’N
DbB 124	$4^0$067’51’’E	$7^0$049’79’’N
DbB 125	$4^0$070’23’’E	$7^0$050’76’’N
DbB 126	$4^0$054’03’’E	$7^0$051’03’’N
DbB 128	$4^0$072’86’’E	$7^0$051’60’’N
DbB 132	$4^0$088’03’’E	$7^0$054’55’’N
DbB 135	$4^0$069’37’’E	$7^0$055’43’’N
DbB 137	$4^0$069’68’’E	$7^0$055’60’’N
DbB 140	$4^0$069’62’’E	$7^0$055’67’’N
DbB 141	$4^0$068’58’’E	$7^0$055’68’’N
DbB 148	$4^0$069’61’’E	$7^0$055’23’’N
DbB 149	$4^0$069’94’’E	$7^0$055’73’’N
DbB 156	$4^0$069’85’’E	$7^0$055’76’’N
DbB 161	$4^0$069’38’’E	$7^0$055’78’’N
DbB 165	$4^0$069’47’’E	$7^0$055’81’’N
DbB 166	$4^0$069’75’’E	$7^0$055’81’’N
DbB 174	$4^0$069’42’’E	$7^0$055’85’’N
DbB 175	$4^0$069’61’’E	$7^0$055’85’’N
DbB 177	$4^0$069’60’’E	$7^0$055’86’’N
DbB 181	$4^0$069’34’’E	$7^0$055’88’’N
DbB 183	$4^0$069’48’’E	$7^0$055’93’’N
DbB 189	$4^0$069’34’’E	$7^0$056’08’’N
DbB 190	$4^0$069’37’’E	$7^0$046’09’’N
DbB 193	$4^0$074’85’’E	$7^0$056’10’’N
DbB 195	$4^0$074’78’’E	$7^0$056’18’’N
DbB 216	$4^0$074’82’’E	$7^0$056’38’’N
DbB 217	$4^0$074’81’’E	$7^0$056’39’’N
DbB 222	$4^0$074’52’’E	$7^0$056’43’’N
DbB 227	$4^0$074’69’’E	$7^0$056’48’’N
DbB 229	$4^0$074’66’’E	$7^0$056’49’’N
DbB 240	$4^0$073’04’’E	$7^0$057’20’’N
DbB 253	$4^0$060’40’’E	$7^0$047’90’’N
DbB 254	$4^0$061’00’’E	$7^0$048’20’’N
DbB 256	$4^0$060’00’’E	$7^0$051’25’’N
DbB 257	$4^0$060’15’’E	$7^0$052’00’’N
DbB 261	$4^0$062’00’’E	$7^0$055’80’’N
DBB 265	$4^0$063’50’’E	$7^0$052’60’’N
DbB 270	$4^0$067’00’’E	$7^0$050’70’’N
DbB 276	$4^0$064’40’’E	$7^0$056’30’’N
DbB 280	$4^0$065’60’’E	$7^0$058’00’’N
DbB 286	$4^0$071’30’’E	$7^0$054’90’’N
DbB 293	$4^0$073’14’’E	$7^0$057’29’’N
DbB 300	$4^0$069’17’’E	$7^0$059’41’’N

3. RESULTS

Phenotypic characterization of qualitative and quantitative traits in 80 accessions of *Dioscorea burkilliana* is shown in Table 2. The general mean performance of the accessions and their characters showed morphological variation that distinguished the accessions. The morphological variation were barky patches (Plate 1A), matured stem spine on stem base (Plate 1B), matured stem spine above base (Plate 1C), matured stem present of coalescent spines (Plate 1D) and mature stem color of spot at spine base (Plate 1E). The highest mean value for phenotypic qualitative trait was 61.727 with standard deviation of 47.678 in MLM breadth A, while the least mean value for YSA/PSL was 0.371 at standard deviation of 0.484.DbB 72 had the shortest leaf measurement of 3.1 cm while DbB 01 (4.8cm) had the highest leaf measurement at maturity. The mature stem color of spot at spine base of DbB 28 was purple in some accessions, red in others (Table 2).

The variation in morphological qualitative characters of *D. burkilliana* is presented in Table 3. The accessions showed variation on morphological characters, the barky patches (BP) character was observed in 46 out of 80 accessions whereas 34 accessions did not have barky patches. Also, 32 accessions had young stem scale leaves, whereas 48 accessions did not have young stem scale leaves. The result in Table 3 also showed that 37 accessions had mature stem spine on stem base (MSSSB), whereas 43 accessions did not. Furthermore, 57 accessions had mature stem spine on stem above base (MSSSAB) whereas it was absent in 23 accessions. Also, 40 accessions had mature stem present of coalescent spines (MSA/PCS) and 40 accessions did not have this feature. The matured stem color of spot at spine base (MSCSSB) were observed in 30 accessions, and it was absent in 50 accessions (Table 3). The result also showed that 12 accessions had the highest matured leaf petiole at base (MLP-A) greater than 5 cm while the remaining 68 accessions had less than 5 cm. With respect to the mature leaf petiole at middle (MLP-B) character in *D. burkilliana* (Table 3) also shows that 10 accessions had MLP -B greater than 5 cm, while 70 accessions had less than 5 cm. The matured leaf petiole at top(MLP -C) character possessed by 16 accessions were greater than 5 cm while 64 accessions were less than 5 cm (Table 3).

The mean square variance of qualitative characters in *D. burkilliana* accessions showed that the accessions were varied for BP, YSA/PSL, MSS-SB, MSS-SAB, MSA-PCS, MSC-SPB, MLP -A, MLP -B and MLP -C characters at $p< 0.05$ (Table 4). The result of mean square variance of quantitative characters in *D. burkilliana* accessions presented in Table 5 revealed significant variations for MLM length (A), MLM breadth (A), MLM breadth (B), MLM length (B), MLM length (C) and MLM breadth (C) at $P <0.05$. Eighty accessions delineated into seven cluster group were shown in Table 6. Cluster V had the highest with eighteen accessions; DbB03,DbB06, DbB 108, DbB 11, DbB 126, DbB 148, DbB 190, DbB 217, DbB 229, DbB 265, DbB 51, DbB 72, DbB 96, DbB 124, DbB 189, DbB 256,and DbB257, while cluster VI had the least (DbB222). The dendrogram of 80 accessions of *D .burkilliana* was delineated into seven cluster groups; cluster V being the highest with 18 accessions and cluster VI the least (one accession) (Fig. 1, Table 6). Characters were separated into fifteen (PRIN) groups using principal component analysis (PCA). The PCA consisted of fifteen traits in which Prin 1 had the highest eigen value of 3.122 and accounted for the highest proportion of 20.8%, while Prin 15 had the least (0.0168) eigen value with proportion of 0.11%. The variations were shown across the 15 PCA as 3.12 (20.81%), 2.36 (15.76%), 1.45 (9.90%), 1.43 (9.53%), 1.25 (8.34%), 1.12 (7.45%), 1.05 (6.96%), 0.79 (5.24%), 0.64 (4.27%), 0.54 (3.57%), 0.46 (3.05%), 0.29 (1.93%), 0.25 (1.67%), 0.21 (1.41%), and 0.017 (0.11%) respectively. The first PCA shows that MSA-PCS, MLM-breadth B and MLM-breadth A, are closely related and more associated with MLP-A, MLP-B, and MLP-C, while MSS-SB, MLM-breadth B were more related with MLP-A, MLP-B and MLP-C in Prin 2. In Prin 3, MSS-SAB and MSA-PCS were associated with MLM-length B and MLM-breadth B, while MSS-SB and MSS-SAB were related with MLM length C and MLM-breadth C in Prin 4. The MSS-SB and MLM-breadth C in Prin 5 were closely related with MSC-SPB and MLM-length B. In Prin 6, MLM-length C and MLM breadth C showed close association with MSS-SB and MLP-C, while MSS-SAB, MSA-PCS and MLM-length B showed close relationship with YSA/PSL and MLM-length A in Prin 7. Prin 8 showed that MSS-SB, MLM-length C and MLM-breadth were more associated with MSS-SAB and MSA-PCS, while MSS-SAB, MLM-length B and MLP-B, were associated with MSC-SPB and MLP-C in prin 9. In prin 10 BP, YSA/PSL, MLM-length A, MLM – length C and MLM- breadth C were more related with MSS-SAB and MSC-SPB, while YSA/PSL, MSS-SB and MSA-PCS were more associated with MSA-PCS, MLM-length C and MLM breadth C in prin 11.YSA/PSL and MSS-SB were associated with MLM-breadth B and MLM-breadth C in prin 12, while the thirteenth PCA showed that BP and MSS-SAB were related and more associated with MSC-SPB and MLM-length B. In prin 14, MSS-SAB and MLM length C were associated with MSC-SPB and MLP-B. Lastly Prin 15, BP, MSS-SAB, MLM-length A, and MLM breadth B were associated with MLM-length B and MLM breadth C.

Table 2. Phenotypic qualitative and quantitative characters for eighty accessions of *Dioscorea burkilliana*

Descriptions/ Accessions	BP	YSA/ PSL	MSS SB	MSS SAB	MSA/ PCS	MSC SSB	MLM Length (A) cm	MLM Breadth (A) cm	MLM Length (B) cm	MLM Breadth (B) cm	MLM Length (C) cm	MLM Breadth (C) cm	MLP A (cm)	MLPB (cm)	MLP C (cm)
DbB 01	0	0	3	7	0	99	7.4	6.1	12.7	9.1	14.5	10.4	1	1	1
DbB 03	0	0	3	3	0	99	8.1	4.6	10.4	6.4	9.4	10.4	1	1	1
DbB 06	0	0	3	3	0	99		0	10.7	6	10.4	2.3	1	1	1
DbB 11	0	0	3	3	0	99	10.4	6.1	10.2	6.1	10.2	7.9	1	1	1
DbB 15	1	0	7	7	1	99	9.9	6.4	10.4	5.6	8.1	3.8	2	2	2
DbB 19	1	1	7	7	0	99	10.1	6.6	10.7	7.4	7.6	4.6	1	2	2
DbB 22	0	0	7	7	0	99	9.6	6.4	7.9	8.4	5.1	11.9	1	1	1
DbB 23	1	0	7	7	0	99	9.6	3.8	8.4	5.3	11.9	7.6	1	1	1
DbB 26	1	0	3	7	1	2	10.9	6.9	9.4	5.3	10.2	8.1	1	1	1
DbB 28	0	0	3	7	1	2	.	.	6.4	3.8	.	.	1	1	1
DbB 33	1	1	7	7	0	1	7.9	5.1	10.2	9.9	10.2	7.9	1	1	1
DbB 35	1	0	7	7	0	1	10.2	6.4	8.9	5.1	7.6	7.1	1	1	1
DbB 39	1	0	7	7	1	1	10.4	7.6	10.1	6.4	11.4	6.4	1	1	1
DbB 41	1	0	3	7	0	1	11.9	7.6	10.2	7.1	6.6	6.4	1	1	1
DbB 51	0	0	7	7	0	99	7.6	5.1	6.4	4.3	9.1	5.3	1	1	1
DbB 53	0	0	3	7	0	99	11.4	5.1	10.4	9.4	10.2	5.6	2	2	1
DbB 56	0	0	7	7	1	99	9.7	6.4	7.8	5.1	6.1	5.1	1	1	1
DbB 60	0	1	7	3	1	99	9.4	6.9	11.4	7.1	6.1	4.3	1	1	1
DbB 69	0	0	7	3	1	99	10.7	6.1	11.7	6.4	8.6	5.6	1	1	1
DbB 72	0	1	3	3	0	99	8.9	6.1	9.4	6.6	5.8	3.1	1	1	1
DbB 76	1	1	7	3	1	99	7.6	6.4	12.2	6.6	11.4	8.1	1	1	1
DbB 85	1	1	3	7	0	99	7.1	5.1	9.1	6.4	8.9	6.4	1	1	1
DbB 91	1	1	7	3	0	99	10.9	7.1	11.9	8.6	7.6	5.1	1	1	1
DbB 93	1	0	3	3	0	99	8.9	6.1	8.6	7.4	10.9	7.6	1	1	1
DbB 95	1	0	7	3	1	1	10.1	6.9	10.7	5.3	12.7	6.9	1	1	1
DbB 96	1	0	3	3	0	99	8.9	4.8	8.6	5.6	8.1	4.3	1	1	1
DbB 99	1	0	3	3	0	99	8.4	6.1	7.6	5.6	8.1	5.6	1	1	1

Descriptions/ Accessions	BP	YSA/ PSL	MSS SB	MSS SAB	MSA/ PCS	MSC SSB	MLM Length (A) cm	MLM Breadth (A) cm	MLM Length (B) cm	MLM Breadth (B) cm	MLM Length (C) cm	MLM Breadth (C) cm	MLP A (cm)	MLPB (cm)	MLP C (cm)
DbB 102	1	0	3	7	1	1	8.4	6.3	9.9	7.4	9.1	5.6	1	1	1
DbB 103	1	1	7	7	1	1	10.7	8.1	9.4	6.1	6.6	3.3	1	2	2
DbB 104	1	1	7	7	1	1	8.4	6.5	9.7	7.4	12.2	9.4	1	1	1
DbB 105	1	0	7	3	0	99	8.4	6.6	9.9	6.4	8.1	5.1	1	1	1
DbB 106	1	1	3	3	1	99	8.4	6.7	9.1	5.1	8.6	4.1	2	2	2
DbB 108	1	1	3	3	1	99	8.4	6.8	9.1	10.6	10.8	5.8	1	1	1
DbB 110	0	1	7	7	1	99	9.9	5.8	10.2	5.6	10.2	5.3	2	2	2
DbB 117	1	0	3	3	0	99	11.2	6.4	10.2	5.1	8.6	6.1	1	1	1
DbB 119	1	0	7	3	0	99	9.4	6.6	10.4	6.1	10.4	6.4	2	2	2
DbB 124	0	1	3	7	0	99	7.1	3.8	6.9	3.1	3.8	1.8	1	1	1
DbB 125	0	0	3	7	0	99	10.9	7.4	10.2	5.6	11.7	6.4	1	1	1
DbB 126	0	0	3	7	0	99	7.1	4.3	7.9	6.6	8.4	4.1	1	1	1
DbB 128	1	0	7	7	1	99	10.2	6.4	10.7	6.4	8.9	4.6	1	1	1
DbB 132	1	0	7	7	0	99	9.4	6.6	9.1	5.8	8.6	3.6	1	1	1
DbB 135	1	0	3	7	1	1	7.1	5.1	8.1	5.8	7.9	4.8	1	1	1
DbB 148	1	0	3	7	1	99	11.2	6.4	9.9	6.6	8.1	5.3	1	1	1
DbB 149	1	1	3	7	1	99	.	0	13.9	8.9	13.9	8.9	1	1	1
DbB 156	0	1	7	7	0	1	8.6	6.6	10.2	6.4	7.6	3.8	1	1	1
DbB 161	0	0	3	7	0	1	11.9	7.4	10.4	6.9	8.9	5.1	2	2	2
DbB 165	1	1	7	7	1	1	7.1	5.8	10.2	7.9	7.6	4.6	1	1	1
DbB 166	1	1	7	7	1	1	.	.	.	.	7.9	7.4	1	1	1
DbB 174	1	0	3	7	1	99	8.9	6.1	11.2	8.6	9.1	5.3	2	2	2
DbB 175	1	1	7	7	1	99	7.1	6.9	10.2	7.1	7.9	4.6	2	2	2
DbB 177	1	0	3	7	1	99	10.2	6.4	9.4	5.8	10.2	6.9	2	2	2
DbB 181	1	0	7	7	1	1	9.4	6.9	12.7	9.4	11.4	9.1	1	1	1
DbB 183	0	1	3	7	1	1	8.6	5.8	9.6	6.1	7.6	5.6	1	1	1
DbB 189	0	0	3	7	0	99	9.9	5.1	8.4	5.8	10.2	7.1	1	2	2
DbB 190	0	1	3	7	0	99	11.7	6.9	10.2	4.8	7.6	3.6	1	1	1
DbB 193	0	1	3	7	1	1	8.9	6.6	10.2	6.4	5.4	5.1	1	1	1

Descriptions/ Accessions	BP	YSA/ PSL	MSS SB	MSS SAB	MSA/ PCS	MSC SSB	MLM Length (A) cm	MLM Breadth (A) cm	MLM Length (B) cm	MLM Breadth (B) cm	MLM Length (C) cm	MLM Breadth (C) cm	MLP A (cm)	MLPB (cm)	MLP C (cm)
DbB 195	1	1	0	7	1	1	7.6	6.6	8.9	6.4	8.6	3.8	1	1	1
DbB 216	1	0	3	7	0	99	.	.	13.7	9.4	11.9	8.9	1	1	1
DbB 217	0	1	3	7	0	99	9.7	5.3	10.7	6.1	9.7	4.6	1	1	1
DbB 222	0	1	7	7	0	99	10.2	6.6	9.4	6.1	8.9	5.9	1	1	1
DbB 227	0	0	3	7	1	99	11.4	6.9	11.4	7.1	11.7	7.1	1	1	1
DbB 229	0	1	3	7	1	99	.	.	10.4	7.1	8.6	5.1	1	1	1
DbB 240	1	0	3	7	1	99	.	.	.	.	11.4	9.1	1	1	1
DbB 257	1	0	3	7	1	99	9.7	6.6	11.4	6.1	7.6	3.3	1	1	1
DbB 261	1	0	7	7	0	1	9.4	7.6	11.2	6.4	6.4	4.3	1	1	1
DBB 265	0	0	3	7	1	99	8.1	4.6	6.1	5.8	10.2	6.4	2	2	2
DbB 270	0	1	3	7	1	1	10.7	7.6	8.4	7.6	8.6	6.6	1	1	1
DbB 276	0	0	3	7	1	1	9.4	6.6	11.2	9.4	8.6	4.3	1	2	2
DbB 280	1	0	7	7	1	1	8.9	5.8	9.9	6.1	8.9	5.1	1	1	1
DbB 286	0	0	7	7	1	1	10.2	6.4	11	6.6	9.1	4.6	2	2	2
DbB 293	0	0	7	7	1	1	11.2	5.6	11.4	6.4	10.7	6.6	1	1	1
DbB 300	1	1	7	7	1	99	10.9	5.3	9.4	5.6	8.4	5.1	1	1	1
Mean	0.629	0.371	4.815	5.985	0.556	61.727	9.442	6.261	9.84	6.498	8.921	6.349	1.176	1.234	1.249
Std	0.514	0.484	2.09	1.745	0.498	47.678	1.3	0.997	1.43	1.43	2.052	5.177	0.381	0.425	0.466

BP: Barky Patches (no= 0; yes= 1); YSA/P SL: Young Stem Absence/Presence of Scale Leaves (0) No, (1) Yes; MSS SB: Mature Stem Spine on Stem Base (3) Few, (7) Many; MSSSAB: Mature Stem Spine on Stem Above Base (3) Few, (7) Many; MSA/PCS: Mature Stem-Absence/Presence of Coalescent Spines (0) Absent; (1) Present; MSC SSB: Mature Stem-Colour of Spot At Spine Base (1) Red, (2) Purple, (99) Others; Mature Leaf Measurement At Base, MLM Length A; Mature Leaf Measurement At Base MLM Breadth A; Mature Leaf Measurement At Middle; MLM Length B: Mature Leaf Measurement At Middle; MLM Breadth B: Mature Leaf Measurement at Top;MLM Length C: Mature Leaf Measurement at Top;MLM Breadth C: Mature Leaf Petiole at Base; MLP (A): Mature Leaf Petiole Middle; MLP (B): Mature Leaf Petiole at Top; MLP (C): 1= ≤ 5 cm; 2= ≥ 6 – 9 cm

Table 3. Mean of morphological qualitative characters in *Dioscorea burkilliana* accessions

Accession	BP	YSA/PSL	MSS-SB	MSS-SAB	MSA-PCS	MSC-SSB	MLP A	MLP B	MLP C
DbB 01	0.000^b	0.000^b	3.000^b	7.000^a	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 03	0.000^b	0.000^b	3.000^b	3.000^b	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 06	0.000^b	0.000^b	3.000^b	3.000^b	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 11	0.000^b	0.000^b	3.000^b	3.000^b	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 15	1.000^a	0.000^b	7.000^a	7.000^a	1.000^a	99.00^a	2.000^a	1.000^b	2.000^a
DbB 19	1.000^a	1.000^a	7.000^a	7.000^a	0.000^b	99.00^a	2.000^a	1.000^b	2.000^a
DbB 22	0.000^b	0.000^b	7.000^a	7.000^a	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 23	1.000^a	0.000^b	7.000^a	7.000^a	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 26	1.000^a	0.000^b	3.000^b	7.000^a	1.000^a	99.00^a	1.000^b	1.000^b	1.000^b
DbB 28	1.000^a	1.000^a	7.000^a	7.000^a	0.000^b	1.00^c	1.000^b	1.000^b	1.000^b
DbB 33	1.000^a	0.000^b	7.000^a	7.000^a	0.000^b	1.00^c	1.000^b	1.000^b	1.000^b
DbB 35	1.000^a	0.000^b	7.000^a	7.000^a	0.000^b	1.00^c	1.000^b	1.000^b	1.000^b
DbB 39	1.000^a	0.000^b	7.000^a	7.000^a	1.000^a	1.00^c	1.000^b	1.000^b	1.000^b
DbB 41	1.000^a	0.000^b	3.000^b	7.000^a	0.000^b	1.00^c	1.000^b	1.000^b	1.000^b
DbB 51	0.000^b	0.000^b	7.000^a	7.000^a	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 53	0.000^b	0.000^b	3.000^b	7.000^a	0.000^b	99.00^a	2.000^a	1.000^b	1.000^b
DbB 56	0.000^b	0.000^b	7.000^a	7.000^a	1.000^a	99.00^a	1.000^b	1.000^b	1.000^b
DbB 60	0.000^b	1.000^a	7.000^a	3.000^b	1.000^a	99.00^a	1.000^b	1.000^b	1.000^b
DbB 69	0.000^b	0.000^b	7.000^a	3.000^b	1.000^a	99.00^a	1.000^b	1.000^b	1.000^b
DbB 72	0.000^b	1.000^a	3.000^b	3.000^b	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 76	1.000^a	1.000^a	7.000^a	3.000^b	1.000^a	99.00^a	1.000^b	1.000^b	1.000^b
DbB 83	1.000^a	1.000^a	3.000^b	3.000^b	1.000^a	99.00^a	2.000^a	1.000^b	2.000^a
DbB 85	1.000^a	1.000^a	3.000^b	7.000^a	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 91	1.000^a	1.000^a	7.000^a	3.000^b	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 93	1.000^a	0.000^b	3.000^b	3.000^b	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 95	1.000^a	0.000^b	7.000^a	3.000^b	1.000^a	1.00^c	1.000^b	1.000^b	1.000^b
DbB 96	1.000^a	0.000^b	3.000^b	3.000^b	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 99	1.000^a	0.000^b	3.000^b	3.000^b	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 102	1.000^a	0.000^b	3.000^b	7.000^a	1.000^a	1.00^c	1.000^b	1.000^b	1.000^b
DbB 103	1.000^a	1.000^a	7.000^a	7.000^a	1.000^a	1.00^c	1.000^b	1.000^b	2.000^a
DbB 104	1.000^a	1.000^a	7.000^a	7.000^a	1.000^a	1.00^c	1.000^b	1.000^b	1.000^b
DbB 105	1.000^a	0.000^b	7.000^a	3.000^b	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 106	1.000^a	1.000^a	7.000^a	3.000^b	0.000^b	99.00^a	2.000^a	1.000^b	2.000^a
DbB 108	1.000^a	1.000^a	3.000^b	3.000^b	1.000^a	99.00^a	1.000^b	1.000^b	1.000^b
DbB 110	0.000^b	1.000^a	7.000^a	7.000^a	1.000^a	99.00^a	2.000^a	1.000^b	2.000^a
DbB 117	1.000^a	0.000^b	3.000^b	3.000^b	0.000^b	99.00^a	1.000^b	1.000^b	2.000^a
DbB 119	1.000^a	0.000^b	7.000^a	3.000^b	0.000^b	99.00^a	1.000^b	2.000^a	1.000^b
DbB 124	0.000^b	1.000^a	3.000^b	7.000^a	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 125	0.000^b	0.000^b	3.000^b	7.000^a	0.000^b	99.00^a	1.000^b	1.000^b	1.000^b
DbB 128	1.000^a	0.000^b	7.000^a	7.000^a	1.000^a	99.00^a	1.000^b	1.000^b	1.000^b
DbB 135	1.000^a	0.000^b	3.000^b	7.000^a	1.000^a	1.00^c	1.000^b	1.000^b	1.000^b
DbB 137	1.000^a	0.000^b	7.000^a	7.000^a	1.000^a	1.00^c	1.000^b	1.000^b	1.000^b
DbB 140	1.000^a	1.000^a	3.000^b	7.000^a	1.000^a	1.00^c	1.000^b	2.000^a	2.000^a
DbB 141	1.000^a	1.000^a	3.000^b	7.000^a	1.000^a	1.00^c	1.000^b	1.000^b	1.000^b
DbB 149	1.000^a	1.000^a	7.000^a	7.000^a	1.000^a	99.00^a	1.000^b	1.000^b	1.000^b
DbB 156	0.000^b	1.000^a	7.000^a	7.000^a	0.000^b	1.00^c	1.000^b	1.000^b	1.000^b
DbB 161	0.000^b	0.000^b	3.000^b	7.000^a	0.000^b	1.00^c	2.000^a	2.000^a	2.000^a
DbB 165	1.000^a	1.000^a	7.000^a	7.000^a	1.000^a	1.00^c	1.000^b	1.000^b	1.000^b
DbB 166	1.000^a	1.000^a	7.000^a	7.000^a	1.000^a	1.00^c	1.000^b	1.000^b	1.000^b
DbB 174	1.000^a	0.000^b	3.000^b	7.000^a	1.000^a	99.00^a	2.000^a	2.000^a	2.000^a
DbB 175	1.000^a	1.000^a	7.000^a	7.000^a	1.000^a	99.00^a	2.000^b	2.000^a	2.000^a
DbB 181	1.000^a	0.000^b	7.000^a	7.000^a	1.000^a	1.00^c	1.000^b	1.000^b	1.000^b
DbB 183	0.000^b	1.000^a	3.000^b	7.000^a	1.000^a	1.00^c	1.000^b	1.000^b	1.000^b

Accession	BP	YSA/PSL	MSS-SB	MSS-SAB	MSA-PCS	MSC-SSB	MLP A	MLP B	MLP C
DbB 189	0.000^{b}	0.000^{b}	3.000^{b}	7.000^{a}	0.000^{b}	99.00^{a}	1.000^{b}	2.000^{a}	2.000^{a}
DbB 190	0.000^{b}	1.000^{a}	3.000^{b}	7.000^{a}	0.000^{b}	99.00^{a}	1.000^{b}	1.000^{b}	1.000^{a}
DbB 193	0.000^{b}	1.000^{a}	3.000^{b}	7.000^{b}	1.000^{a}	1.00^{c}	1.000^{b}	1.000^{b}	1.000^{a}
DbB 195	1.000^{a}	1.000^{a}	0.000^{d}	7.000^{a}	1.000^{a}	1.00^{c}	1.000^{b}	1.000^{b}	1.000^{a}
DbB 222	0.000^{b}	1.000^{a}	7.000^{a}	7.000^{a}	0.000^{b}	99.00^{a}	1.000^{b}	1.000^{b}	1.000^{a}
DbB 227	0.000^{b}	0.000^{b}	3.000^{b}	7.000^{a}	1.000^{a}	99.00^{a}	1.000^{b}	1.000^{b}	1.000^{a}
DbB 229	0.000^{b}	1.000^{a}	3.000^{b}	7.000^{a}	0.000^{b}	99.00^{a}	1.000^{b}	1.000^{b}	1.000^{a}
DbB 240	1.000^{a}	0.000^{b}	7.000^{a}	7.000^{a}	1.000^{a}	99.00^{a}	1.000^{b}	1.000^{b}	1.000^{a}
DbB 253	0.000^{b}	0.000^{b}	3.000^{b}	3.000^{b}	1.000^{a}	1.00^{c}	1.000^{b}	1.000^{b}	1.000^{a}
DbB 254	1.000^{a}	1.000^{a}	3.000^{b}	3.000^{b}	0.000^{b}	1.00^{c}	2.000^{b}	2.000^{a}	2.000^{a}
DbB 256	1.000^{a}	1.000^{a}	3.000^{b}	3.000^{b}	1.000^{a}	1.00^{c}	1.000^{b}	1.000^{b}	1.000^{b}
DbB 257	1.000^{a}	0.000^{b}	3.000^{b}	7.000^{a}	1.000^{a}	99.00^{a}	1.000^{b}	1.000^{b}	1.000^{b}
DbB 261	1.000^{a}	0.000^{b}	7.000^{b}	7.000^{a}	1.000^{a}	1.00^{c}	1.000^{b}	1.000^{b}	1.000^{b}
DbB 265	0.000^{b}	0.000^{b}	3.000^{b}	7.000^{a}	0.000^{b}	99.00^{a}	2.000^{a}	2.000^{a}	2.000^{a}
DbB 270	0.000^{b}	1.000^{a}	3.000^{b}	7.000^{a}	1.000^{a}	1.00^{c}	1.000^{b}	1.000^{b}	1.000^{b}
DbB 276	0.000^{b}	0.000^{b}	3.000^{b}	7.000^{a}	1.000^{a}	1.00^{c}	1.000^{b}	2.000^{b}	2.000^{a}
DbB 280	1.000^{a}	0.000^{b}	7.000^{b}	7.000^{a}	1.000^{a}	1.00^{c}	1.000^{b}	1.000^{b}	2.000^{a}
DbB 286	0.000^{b}	0.000^{b}	7.000^{b}	7.000^{a}	1.000^{a}	1.00^{c}	2.000^{a}	2.000^{a}	2.000^{a}
DbB 293	0.000^{b}	0.000^{b}	7.000^{b}	7.000^{a}	1.000^{a}	1.00^{c}	1.000^{b}	1.000^{b}	1.000^{b}
DbB 300	1.000^{a}	1.000^{a}	7.000^{b}	7.000^{a}	1.000^{a}	99.00^{a}	1.000^{b}	1.000^{b}	1.000^{b}

Means with the same letters within column are not significantly different at P≥ 0.05; Barky patches (BP); Young stem absent or present of scale leaves (YSA/PSL); Mature stem spine on stem base (MSSSB); Mature stem spine on stem above base (MSSSAB); Mature stem absent or present of coalescent spines (MSA/PCS); Mature stem color of spot at spine base (MSCSSB); Mature leaf petiole at base (MLP A); Mature leaf petiole at middle (MLP B); Mature leaf petiole at top (MLP C)

The phenotypic correlation coefficient among fifteen characters of *D. burkilliana* revealed that the matured leaf measurement at base length was strong and positively correlated with matured leaf measurement at top length with r =0.66 at p< 0.05 (Table 8). Similarly, matured leaf measurement at the middle length was also positively associated with matured measurement at base (breadth) with r= 0.59. A strong positive correlation was established between matured leaf petiole base with matured leaf petiole at middle (r=0.84) and matured leaf petiole at top (r=0.75). Finally, matured leaf petiole at middle was strong and positively associated with matured leaf petiole at top r=0.97 at P < 0.05. The barky patches did not correlate with MSS-SAB, MSC-SSP, and there was no significant relationship with the replicate. (r = 0.00).

4. DISCUSSION

There were genetic variations based on the phenotypic expressions of traits among the 80 *D. burkilliana* accessions. This result is in accordance with the findings of Girma et al. [16] on *Dioscorea* spp., and Olawuyi et al. [17] on *Celosia argentea* L.. The significant differences in mean values of the qualitative and quantitative characters in *D. burkilliana* accessions are an indication of variability in the characters. In this study, some phenotypic characters with significant contribution to variation among the eighty accessions of *D. burkilliana* were; barky patches, young stem absence or presence of scale leaves, mature stem spine base, mature stem spine above base, mature stem absence or presence of coalescent scale, mature stem color above base, mature leaf measurement at base, mature leaf at middle and mature leaf measurement at base. These showed their importance in selection as desirable traits for future breeding of *D. burkilliana*.

Girma et al. [16] also reported genetic variation in *Dioscorea* spp. accessions. The morphology of the characters such as mature leaf petiole at base, mature leaf measurement breadth at middle had direct relationships with other morphological characters as similarly reported on *Zea mays* L., and other species [18,19]. Principal Component analysis (PCA) is an important multivariate statistical analytical technique for classification of species [20]. The similarities observed in the component axes of some traits is an indication of their close relationship as similarly reported by Olowe et al. [21]. Cluster analysis and Dendrogram showed that cluster groups consist of accessions from different geographical environments. This indicates that different accession types from the same geographic or different regions were found in different clusters. Such wide adaptability had been attributed to similarity in requirements, heterogeneity, population genetic architecture, selection history and approach under domestic cultivation and developmental traits [22,23].

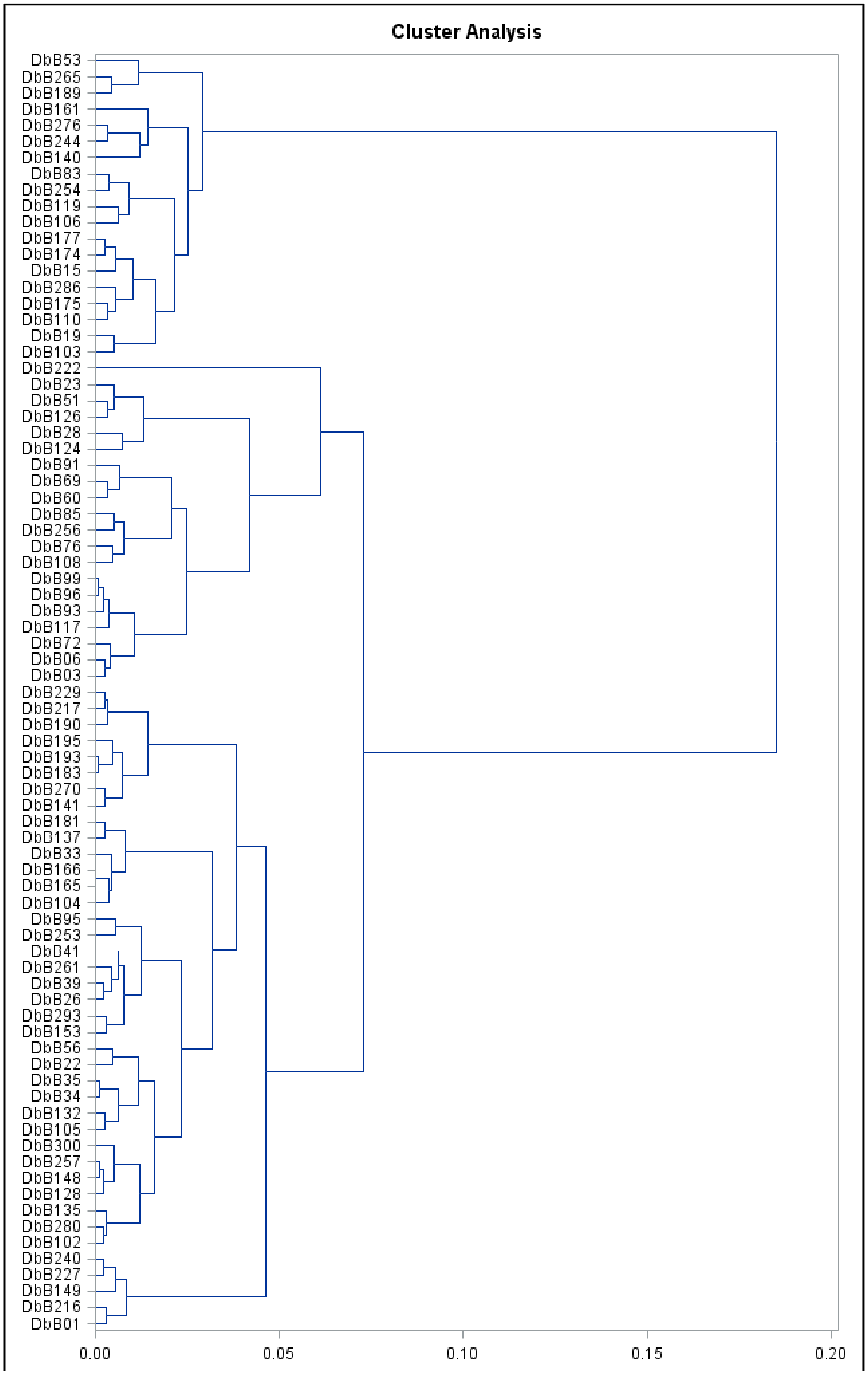

Fig. 1. Dendrogram showing 80 accessions of *Dioscorea burkilliana*

Table 4. Mean square variance of qualitative characters in *Dioscorea burkilliana*

	(df)	Bp	YSA-PSL	MSS-SB	MSS-SAB	MSA-PCS	MSC-SPB	MLP(A)	MLP(B)	MLP (C)
Accessions	79	0.789*	0.715*	12.70*	9.187*	0.740*	6861.32*	0.442*	0.533*	0.610*
Replicate	2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	81									
Corrected total	80									

** Significant at p< 0.05; Barky patches (BP), Young stem absent or present of scale leaves (YSA/PSL), Matured stem spine on stem base (MSSSB), Matured stem spine on stem above base (MSSSAB), Matured stem absent or present of coalescent spines (MSA/PCS), Matured stem colour of spot at spine base (MSCSSB), Matured leaf petiole at base (MLP A), Matured leaf petiole at middle (MLP B), Matured leaf petiole at top (MLP C)*

Table 5. Mean square variance of quantitative characters in *Dioscorea burkilliana*

	(df)	MLM Length (A)	MLM Breadth (A)	MLM Length (B)	MLM Breadth (B)	MLM Length (C)	MLM Breadth (C)
Accessions	79	5.245*	3.119*	7.864*	7.448*	12.861*	71.293*
Replicate	2	0.000	0.000	0.000	0.000	0.000	0.000
Total	81						
Corrected total	80						

** Significant at p< 0.05; Matured leaf measurement at base (MLM length A), Matured leaf measurement at base (MLM breadth A), Matured leaf measurement at middle (MLM Length B), Matured leaf measurement at middle (MLM breadth B), Matured leaf measurement at top (MLM Length C), Matured leaf measurement at top (MLM breadth C)*

Table 6. Cluster groups of 80 accessions in *Dioscorea burkilliana* wild yam

Cluster groups	No of accessions	Name of accessions
I	15	DbB 01, DbB 11, DbB 125, DbB 149, DbB 174, DbB 177, DbB 216, DbB 227, DbB 23, DbB240, DbB 53, DbB 76, DbB 83, DbB 93, DbB 254
II	14	DbB 104, DbB 137, DbB 140, DbB 161, DbB 181, DbB 244, DbB 253, DbB 273, DbB 293, DbB 33, DbB 34, DbB 39, DbB 95, DbB 166
III	15	DbB 110, DbB 119, DbB 128, DbB 132, DbB 15, DbB 165, DbB 19, DbB 22, DbB 300, DbB 60, DbB 69, DbB 91, DbB 56, DbB 105, DbB 106
IV	7	DbB 102, DbB 135, DbB183, DbB 195, DbB 26, DbB 270, DbB 28
V	18	DbB 03, DbB108, DbB 11, DbB 126, DbB148, DbB 190, DbB 217, DbB 229, DbB 265, DbB 51, DbB 72, DbB 85, DbB 96, DbB 124, DbB 99, DbB 189, DbB256, DbB 257
VI	1	DbB 222
VII	10	DbB 103, DbB 141, DbB 165, DbB 193, DbB 153, DbB 261, DbB 280, DbB 286, DbB 35, DbB 41

Table 7. Principal component analysis of *Dioscorea burkilliana*

Morphological Traits	Prin 1	Prin 2	Prin 3	Prin 4	Prin 5	Prin 6	Prin 7	Prin 8	Prin 9	Prin 10	Prin 11	Prin 12	Prin 13	Prin 14	Prin 15
BP	0.19	0.17	-0.30	-0.22	-0.17	-0.25	0.32	0.49	-0.52	0.21	0.12	-0.17	0.06	-0.02	0.02
YSA/ PSL	0.05	0.03	-1.00	-0.06	-0.28	0.80	0.05	0.15	0.06	0.26	-0.34	-0.14	-0.07	0.08	0.04
MSS-SB	0.10	0.22	-0.07	0.07	0.14	0.05	0.78	-0.39	-0.01	-0.10	-0.32	0.15	0.02	0.12	0.02
MSS-SAB	0.03	0.13	-0.22	0.01	0.74	0.10	-0.08	-0.03	0.02	0.57	0.13	0.11	-0.05	-0.14	0.03
MSA-PCS	0.25	0.26	0.23	-0.33	-0.16	-0.01	0.08	-0.04	0.63	-0.01	0.47	0.02	0.16	0.18	-0.02
MSC-SPB	-0.11	-0.40	0.19	0.21	-0.35	0.02	0.23	-0.12	-0.04	0.54	0.32	0.35	0.18	0.08	0.01
MLM-Length A (cm)	0.14	0.16	0.69	-0.11	0.12	-0.03	0.05	0.01	0.01	0.26	-0.02	-0.47	0.00	0.40	0.03
MLM-Breadth A	0.27	0.28	0.44	-0.21	0.02	0.14	-0.07	0.30	-0.06	-0.08	-0.09	0.67	0.07	-1672.0	0.00
MLM-Length B (cm)	0.31	0.33	0.10	0.19	-0.32	-0.06	-0.08	-0.37	-0.02	0.20	0.05	-0.20	-0.19	-0.62	-0.01
MLM-Breadth B	0.29	0.26	-0.18	0.31	-0.04	0.10	-0.34	-0.29	-0.41	-0.10	0.19	0.16	0.04	0.52	-0.03
MLM-Length C (cm)	0.20	0.09	-0.12	0.51	-0.08	-0.38	-0.10	0.32	0.37	0.204	-0.44	0.07	0.15	0.14	0.01
MLM-Breadth C	-0.03	0.12	0.12	0.59	0.14	0.32	0.16	0.38	0.06	-0.27	0.43	-0.15	0.02	-0.13	-0.01
MLP-A	0.41	-0.35	-0.03	0.01	0.02	-0.02	0.09	0.11	0.10	-0.03	0.06	0.10	-0.78	0.14	0.18
MLP-B	0.45	-0.37	0.00	-0.03	0.13	0.07	0.03	-0.01	-0.03	-0.05	-0.05	-0.09	0.20	-0.08	-0.76
MLP-C	0.44	-0.35	0.00	-0.02	0.14	0.05	-0.03	-0.08	-0.05	-0.14	-0.02	-0.12	0.47	-0.15	0.62
Eigenvalues0	3.12	2.36	1.48	1.43	1.25	1.12	1.04	0.79	0.64	0.54	0.46	0.29	0.25	0.21	0.02
Difference	0.76	0.88	0.06	0.18	0.13	0.07	0.26	0.14	0.11	0.08	0.17	0.04	0.04	0.19	0.00
Proportion (%)	20.81	15.76	9.90	9.53	8.34	7.45	6.96	5.24	4.27	3.57	3.05	1.93	1.67	1.41	0.00
Cumulative	0.21	0.37	0.46	0.56	0.64	0.72	0.79	0.84	0.88	0.92	0.95	0.97	0.98	1.00	1.00

Matured leaf measurement at base (MLM length A), Matured leaf measurement at base (MLM breadth A), Matured leaf measurement at middle (MLM Length B), Matured leaf measurement at middle (MLM breadth B), Matured leaf measurement at top (MLM Length C), Matured leaf measurement at top (MLM breadth C). Barky patches (BP), Young stem absent or present of scale leaves (YSA/PSL), Matured stem spine on stem base (MSSSB), Matured stem spine on stem above base (MSSSAB), Matured stem absent or present of coalescent spines (MSA/PCS), Matured stem color of spot at spine base (MSCSSB), Matured leaf petiole at base (MLP A), Matured leaf petiole at middle (MLP B), Mature leaf petiole at top (MLP C)

Table 8. Correlation matrix among eighty accessions of *Dioscorea burkilliana*

	BP	YSA/ PSL	MSS-SB	MSS-SAB	MSA-PCS	MSC-SSB	MLM-Length A (cm)	MLM-Breadth A (cm)	MLM-Length B (cm)	MLM-Breadth B (cm)	MLM-Length C (cm)	MLM-Breadth C (cm)	MLP-A	MLP-B	MLP-C	ACCN	REP
BP	1.00																
YSA/ PSL	0.01	1.00															
MSS-SB	0.21	-0.03	1.00														
MSS-SAB	-0.07	0.01	0.06	1.00													
MSA-PCS	0.24	0.18	0.11	0.18	1.00												
MSC-SSB	-0.16	-0.23	-0.08	-0.39	-0.40	1.00											
MLM-Length A	-0.09	-014.	0.06	0.05	0.07	-0.08	1.00										
MLM-Breadth A	0.15	0.09	0.05	0.03	0.28	-0.31	0.59*	1.00									
MLM-Length B	0.15	0.07	0.20	-0.06	0.37	-0.17	0.30	0.37	1.00								
MLM-Breadth B	0.12	0.12	0.06	0.17	0.21	-0.31	0.01	0.22	0.59*	1.00							
MLM-Length C	0.13	0.13	0.02	0.01	0.07	-0.06	0.04	0.02	0.34	0.29	1.00						
MLM-Breadth C	-0.13	0.09	0.17	0.10	-0.15	0.04	0.66*	0.25	0.04	0.14	0.22	1.00					
MLP-A	0.11	0.04	-0.03	0.01	0.18	0.12	0.05	0.11	0.12	0.12	0.19	-0.06	1.00				
MLP-B	0.06	0.08	-0.02	0.08	0.15	0.08	0.10	0.15	0.11	0.18	0.13	-0.10	0.84**	1.00			
MLP-C	0.02	0.05	0.04	0.10	0.16	0.03	0.09	0.14	0.13	0.23	0.11	-0.10	0.75**	0.97**	1.00		
Accession	-0.17	0.12	-0.15	0.38	0.37	-0.36	0.14	0.10	0.11	0.10	-0.01	0.05	0.15	0.16	0.20	1.00	
Replicates	0.01	0.01	0.01	0.01	0.01	-0.01	0.003	0.001	0.002	-0.001	0.01	0.004	0.003	0.003	0.003	0.01	1.00

*Remarks: * P < 0.05 Significant, ** P < 0.01 highly Significant, ns = not significant; Matured leaf measurement at base (MLM length A), Matured leaf measurement at base (MLM breadth A), Matured leaf measurement at middle (MLM Length B), Matured leaf measurement at middle (MLM breadth B), Matured leaf measurement at top (MLM Length C), Matured leaf measurement at top (MLM breadth C). Barky patches (BP), Young stem absent or present of scale leaves (YSA/PSL), Matured stem spine on stem base (MSSSB), Matured stem spine on stem above base (MSSSAB), Matured stem absent or present of coalescent spines (MSA/PCS), Matured stem color of spot at spine base (MSCSSB), Matured leaf petiole at base (MLP A), Matured leaf petiole at middle (MLP B), Matured leaf petiole at top (MLP C)*

5. CONCLUSION

The delineation of *Discorea burkilliana* into cluster groups could enhance selection and establishment of phylogenetic relationship among the accessions. The strong positive associations among MLP-A, MLP-B and MLP-C as well as MSS SAB and MSA/PCS suggested the consideration of these traits for future breeding. Accessions DbB 83, DbB 140 and DbB 254 could be recommended as parent material for the improvement of *Discorea burkilliana.*

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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