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RESEARCH ARTICLE

AGROMORPHOLOGICAL CHARACTERIZATION OF BLACK NIGHTSHADE (*SOLANUM NIGRUM L.)* FROM BURKINA FASO

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ABSTRACT

Black nightshade (*Solanum nigrum* L.) is a leafy vegetable grown and consumed around the world. It is also used as medicine and fodder for animals. Despite its socio-economic importance, very few studies have been devoted to it in Burkina Faso and its agromorphological diversity has not been yet studied. The objective of this study is to contribute to a better knowledge of the agromorphological diversity of *Solanum nigrum* in Burkina Faso. Fifty-two black nightshade accessions, collected in the three climatic zones of Burkina Faso, were evaluated using a Randomized Complete Block Design (Fischer's Block) with three replicates. Thirty-two (32) variables including 14 qualitative variables and 18 quantitative variables were collected and subjected to an analysis of variance. The study revealed the existence of a large agromorphological variability within the accessions from each climatic zone. Significant differences at the 5% threshold were observed between the accessions from the three climatic zones for 26 agromorphological characters. The agronomic performances of the accessions from the Sahelo-Sudanian zone were respectively superior to those from the Sudanian and Sahelian zones. The structuring of the diversity of the accessions highlighted three major groups. Group I consisted mainly of accessions cultivated in the Sudanian zone. The second group was mainly made up of accessions collected in the Sudano-Sahelian zone and the third group of accessions from the Sudano-Sahelian and Sahelian zones. Conclusion: Ended, the results of this study could be exploited in future breeding work.

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INTRODUCTION

Black nightshade (*Solanum nigrum* L.) is an annual plant of the Solanaceae family, widely distributed in various habitats around the world, from tropical to temperate regions. In Africa, it traditionally exists as wild plant or cultivated in fields as a leafy vegetable (Schreckenberg *et al*., 2006). It adaptats well to local conditions and is less demanding in terms of inputs compared to exotic vegetables; which makes its cultivation easier. Black nightshade has high levels of vitamin A and C, iron, calcium, magnesium, proteins, fiber, (Bationo-Kando*et al*., 2015) sometimes even exceeding those of certain exotic vegetables in these elements. It can therefore play a crucial role in resolving certain malnutrition problems.

In Burkina Faso, *S. nigrum* leaves are most often used during periods of famine and drought (Konkobo-Yaméogo*et al*., 2002). Thus, with the current increasing food insecurity, its consumption is experiencing an exceptional increase, leading to slightly larger cultivation areas and attracting a greater number of producers (Ngo Bogmis*et al*., 2018). It therefore increasingly occupies a prominent place in peri-urban agriculture and provides significant income to producers, thus contributing to the fight against poverty in Burkina Faso (Kientega B.A.J., 2014). Despite this socio-economic importance of the species, very few studies have been devoted to it. If some studies carried out in Cameroon, the Democratic Republic of Congo and Ivory Coast have shown the existence of diversity within the species (Medagam*et al*., 2015), in Burkina Faso, its genetic diversity has not yet been studied. Indeed, it is little known and neglected following the introduction of exotic vegetables to the African continent which had a negative impact on native vegetables (Frechette *et al.,* 2016). The characterization of cultivated accessions allows the safeguarding and rehabilitation of the genetic heritage. The ability to identify genetic variation is essential for effective management and use of genetic resources. Thus, information on available genetic resources, their locations and understanding their relationships can be used to better understand population divergence (Johnson *et al.,* 1955). Characterization of accessions is a very essential preliminary step in quantifying genetic diversity within accessions, and serves as a starting point for establishing a core collection. This will allow the exploitation of useful traits in varietal improvement. The objectives of this study are (i) to establish the level and organization of its diversity and (ii) to evaluate the genetic variability of black nightshade accessions cultivated in Burkina Faso.

MATERIALS AND METHODS

Plant material collection: The plant material consists of 52 accessions collected in the three climatic zones of Burkina Faso (Figure 1). Thus, 41 accessions were collected in the Sahel-Sudanian zone, 9 in the Sudanian zone and 2 in the Sahelian zone (Table I). In total, 11 provinces including 07 provinces from the Sudano-Sahelian climatic zone with annual rainfall ranging between 600 and 900 mm, 03 from the Sudanian climatic zone with annual rainfall varying from 900 to 1100 mm, and 01 from the Sahelian climatic zone were affected by the collection. This collection was made from producers. This involved collecting samples in the form of seeds or ripe fruits used as seeds from producers. Each accession collected was accompanied by a collection sheet. Site of the study: The agromorphological evaluation was carried out at Gampela station, located at 18 km from Ouagadougou on the Ouaga-Fada N'Gourma axis at 12°15' North and 1°12' West. It is located in the North-Sudanese region and is characterized by an annual rainfall ranging between 600 and 900 mm (Thiombiano*et al*., 2010). The rainfall in this location during the 2022 agricultural campaign was of 789.7 mm with a peak in the month of August (266.1 mm). Temperatures fluctuated between 24.7 and 33.5°C. Before setting up the trial in July 2023, the plot was ploughed, amended with organic manure then leveled. The placements in the nurseries were carried out respectively on June 28 of the year 2022 and June 16 of the year 2023. Monitoring of the plants lasted 21 days before transplanting onto the experimental plot.

Experimental design: The experimental design used was a Fisher block (Randomized Complete Block Design) with three replicates. Each replicate was subdivided into two subblocks. The spacing between two successive replications and sub-blocks was of 1.5 m. Each accession was planted in a line of 4 m line on which 6 pockets were sown. The spacing between two consecutive lines and pockets were respectively of 1 m and 0.8 m.

Agromorphologicalparameters collected: The observations and biometric measurements focused on 32 variables, including 14 qualitative and 18 quantitative variables. The qualitative variables considered were: color (COL), edge (EOL) and shape of leaves (SOL), color of veins (COV), nodes (CNO), sepals (COS), petals (CPT), fruit (CFR), seed (CSE) and pericarp (COP), inflorescence type (ITY), plant growth type (PGT), predominant fruit shape (PFS) and shape of the seed (SOS). These variables were observed throughout the plant developmental cycle, except for the number of days to emergence (DTE), the number of days to 50% flowering (FLO50) and the number of days to 50% fruiting (FR50), that were recorded across the entire line, the biometric measurements were made on 4 plants per line 30 Days after sowing (DAS). The characteristics linked to the fruit were recorded on 4 fruits per plant and those linked to the flowers on the first 3 flowers per plant. These are plant height (PLH), leaf area (LA), number of leaves (NOL), peduncle length (PEL) and petiole length (PLE), stem diameter (SDI), the number of branches (NBR), primary branches (PBR), inflorescence per plant (IPP), and fruits per inflorescence (FPI), height (HFR) and width (WFR) of the fruit, average fruit weight (FEW), fruit weight per plant (FW/P). The number of fruits per plant (NF/P) was estimated by deduction using the IPP and FPI.

Statistical analysis: The collected data were processed and analyzed with Excel 2013, ArcGIS 10.8 and XLSTAT 2013.2.03 software. Excel was used for data entry, verification and graph construction. ArcGIS 10.8 was used to develop the map of the study area. The XLSTAT software was used to carry out the mean separation test in order to compare the different factors. For each of the discriminating traits, the broad sense heritability (H^2) was calculated from the genotypic (GV) and phenotypic (PV) variances according to the formula used by Johnson *et al.*, (1955): $H^2(\%) = (VG/VP) *100$. The study of relationships between variables was done using the total correlation matrix. A principal component analysis (PCA) was carried out and the coordinates of the individuals were used to group the accessions using an hierarchical ascendingclassification (HAC). The groups from the HAC were characterized by a discriminant factor analysis (DFA).

RESULTS

Diversity of qualitative characteristics: Four color modalities (purple striped with green, dark-purple, green and grayish-green) were noted for the stem of the plant (Table II). The color of the leaf depended on that of the main stem of the plant. Thus, accessions with purple stems striped with green presented light-green leaves, those with dark-purple, green and grayish-green stems had dark-green leaves. The proportions of the different colors were different between the accessions collected in rural areas and in peasant areas. Accessions collected from rural areas in gardens were more of light-green color, while those collected from peasant areas were more dark-green. Figure 2 shows the variation in the color of the stems and branches of the accessions. The majority of accessions (96,15%) showed glabrous pubescence. Accessions with low pubescence were observed as well. The majority of accessions (88,46%) with an erected habit were found in the Sudano-Sahelian zone, while a minority of accessions (11,53%) with a semi-erected habit were found in the Sahelian and Sudanian zones. With the exception of the color of the floral parts which did not show any variations. Intra-accession variability was noted for all the qualitative variables observed.

Diversity of quantitative characteristics: The results of the analysis of variance showed highly significant differences between the studied accessions at 5% threshold (Table III). The average leaf index area was 58.54. The height of the plant and the number of branches varied from 41.02 cm to 96.9 cm and from 5.34 to 24.02 cm, respectively. All variables presented a high coefficient of determination R^2.

Table I. Distribution of the accessions according to collection zones and provinces.

ClimZones	Provinces	Numb. Acc	Accessions' codes
Sahelian	Gnagna	02	N1, N2
	Kadiogo	11	Ade1, Poe2, BOG1, BOG2, 02, KSL01, Nag1, Nag2, KBS1, Ba1, BMG1
Sudano-Sahelian	Oubritenga	19	T2, Bas2, Bas4, Bb2, Bas3, KS1, Bb3, Bb4, BTB, L3, L4, L6, L5, KB1, Gar1,Poe1,Nagba1, Bas1, Kb2
	Boulgou	02	T1, Bid1
	Kouritenga	02	KP1, Kp2
	Bazèga	04	Kom01, Kom02, Sab1, Sab2
	Boulkiemdé	01	Gondy
	Zoundwéogo	02	Z1, Z2
Soudanian	Sissili	02	L1, L2
	Houet	04	BDS1, BDS2, BDS3, W1
	Comoé	03	Tingr1, Tingr2, Tingr3
Total	11	52	52

Clim Zones : climatic zones ; Numb. Acc : number of Accessions

Table II. Variation of the qualitative characters in the collection of *Solanum nigrum* L

Parameters	Modality	Number	Frequence (%)
Inflorescence type	Umbelliform cyme	52	100
Sepalcolor	Green	52	100
Petalcolor	White	52	100
Grain form	Oval	52	100
Growth type	Erected	46	88,46
	Semi-erected	6	11,53
Predominant form of the fruit	rounded	52	100
Fruit color	Purple	49	94,23
	Darkpurple	3	5,76
	Oval	11	21,15
Form of the leaf	Lanceolateoval	39	75
	Lanceolate	2	3,84
Leaf border	Winding	49	94,23
	Toothed	3	5,76
Leafcolor	Light green	34	65,38
	Dark green	18	34,61
	Light green	44	84,61
Veincolor	Dark green	6	11,53
	Grayish-green	2	3,84
Node color	Purple	34	65,38
	Green	18	34,62
Pericarpcolor	Purple	52	100
	Glabrous	50	96,15
Stem pubescence	Less pubescent	2	3,84
	Purplestripedwith green	16	30,76
Stem and branchcolor	Dark-purple	2	3,84
	Green	25	48,07
	Grayish-green	9	17,30

Table III. Performance of the studied accessions, results of the analysis of variance and the heritability of eight characters

Variable	Minimum	Maximum	Average	E.T.	R²	F	H²
PLH	41,020	96,900	75,257	16,581	0,967	148,496	68,222
SDI	7,330	24,110	16,937	4,689	0,981	266,631	89,014
NBR	5,340	24,020	10,806	4,554	0,984	314,304	51,849
IPP	34,180	94,560	58,051	13,458	0,963	133,882	98,993
SOP	40,080	96,110	73,185	16,147	0,991	591,228	63,527
NOL	11,240	699,030	230,351	163,128	0,893	42,347	90,776
WOL	1,410	9,060	6,148	1,923	0,934	72,182	99,936
LA	0,140	129,020	58,545	45,014	0,973	185,522	52,705

PLH: Height of the plant, SDI: Diameter of the stem, NBR: Number of branches, IPP: number of inflorescences per plant, SOP: span of the plant, NOL: number of leaves, WOL: weight of the leaves, LA: leaf area, E.T: Ecart type, F: Fisher's F, R^2: Coefficient of determination; H^2: Heritability.

Table IV. Vegetative growth and yield parameters of *S. nigrum* accessions by climatic zone

Variable	Sahelian	Soudano-sahelian	Soudanian	R²	F	Pr > F
PLH	90.245 a	77.182 b	56.148 c	0,197	37,835	< 0.0001
SDI	21.570 a	17.587 b	10.623 c	0,264	55,383	< 0.0001
NBR	6.712 c	10.415 b	15.039 a	0,137	24,623	< 0.0001
IPP	45.740 c	57.368 b	67.160 a	0,088	14,816	< 0.0001
SOP	84.890 a	75.395 b	53.077 c	0,216	42,489	< 0.0001
NOL	106.102 c	215.026 b	384.149 a	0,133	23,654	< 0.0001
WOL	7.538 a	6.408 b	3.776 c	0,212	41,506	< 0.0001
LA	97.273 a	63.692 b	7.897 c	0,186	35,352	< 0.0001

PLH: Height of the plant, SDI: Diameter of the stem, NBR: Number of branches, IPP: number of inflorescences per plant, SOP: span of the plant, NOL: number of leaves, WOL: weight of the leaves, LA: leaf area, F: Fisher's F; R^2: Coefficient of determination

Table V. Comparative average performances of black nightshade accessions depending on the years of cultivation

Variables	2022 Year	2023 Year	R² (%)	F	Pr > F
PLH	76.147 a	74.368 a	00,30	0,898	0,344
SDI	17.107 a	16.767 a	00,10	0,410	0,522
NBR	10.974 a	10.637 a	00,10	0,427	0,514
IPP	58.648 a	57.454 a	00,20	0,613	0,434
SOP	73.603 a	72.768 a	00,10	0,208	0,649
WCS	0.118 b	0.234 a	50,10	310,650	< 0.0001
NOL	254.057 a	206.644 b	02,10	6,710	0,010
WOL	6.346 a	5.949 a	01,10	3,357	0,068
LA	61.866 a	55.225 a	00,50	1,702	0,193
HFR	6.575 b	9.713 a	73,60	863,731	< 0.0001
WFR	10.480 b	13.582 a	59,80	460,622	< 0.0001
PEL	2.050 a	1.881 b	09,00	30,818	< 0.0001
FLO50	33.954 a	34.306 a	00,60	1,717	0,191
FPI	8.669 b	10.814 a	66,80	624,646	< 0.0001
NF/P	352.088 b	607.041 a	47,80	284,050	< 0.0001
NSE	61.408 b	84.590 a	54,70	374,827	< 0.0001
WFR	1.465 a	1.486 a	00,60	1,754	0,186
LPT	3.058 a	3.061 a	00,00	0,004	0,953

PHL: Plant height, SDI: Stem diameter, NBR: Number of branches, SOP: plant span, WCS: weight of 100 seeds, NOL: number of leaves, WOL: leaf weight,LA: leaf area, HFR: height of the fruit, WFR: width of the fruit, PEL: length of the peduncle, FLO50: Number of days at 50% flowering, FPI: number of fruits per inflorescence, NF/P: number of fruits per plant, NSE: number of seeds, WFR: weight of the fruit, LPT: Length of the petiole

Table VI: Correlations between the quantitative characteristics of *Solanum nigrum* from Burkina Faso

Variables	FLO50	PLH	SDI	NBR	SOP	NOL	WOL	LA	HFR	WFR	NF/P	LPT
FLO50	1											
PLH	0,903**	1										
SDI	0,822**	0,951**	1									
NBR	-0,671	-0,816	-0,754	1								
SOP	0,863**	0,924**	0,891**	-0,796	1							
NOL	-0,834	-0,946	-0,91	0,839**	-0,893	1						
WOL	0,889**	0,961**	0,928**	-0,783	0,939**	-0,909	1					
LA	0,89**	0,944**	0,923**	-0,715	0,92**	-0,873	0,947**	1				
HFR	0,277	0,153	0,073	-0,195	0,115	-0,117	0,091	0,085	1			
WFR	0,869**	0,894**	0,821**	-0,842	0,904**	-0,905	0,893**	0,872**	0,191	1		
NF/P	-0,749	-0,824	-0,769	0,792**	-0,77	0,84**	-0,768	-0,722	0,216	-0,831	1	
LPT	0,366	0,379	0,345	-0,385	0,369	-0,427	0,354	0,278	0,06	0,434*	-0,501	1

*FLO50: Number of days at 50% flowering, PLH: Plant height, SDI: Stem diameter, NBR: Number of branches, SOP: plant span, LA: leaf area, NOL: number of leaves per plant, LPT: Petiole length, NF/P: number of fruits per plant, WOL: leaf weight, HFR: fruit height, WFR: fruit width. **: Significant correlation at the 5% threshold.*

Tableau VII. Square cosines of 18 characters on 3 factors and the contribution to the total variability of these characters

Principal components	F1	F2	F3
Proper value	14,04	1,62	1,25
Total variance (%)	66,86	7,72	5,93
Cumulative total variance (%)	66,86	74,58	80,50
FLO50	0,883	0,000	0,021
PHL	0,922	0,001	0,001
SDI	0,803	0,001	0,001
NBR	0,698	0,021	0,004
IPP	0,797	0,012	0,002
SOP	0,908	0,007	0,000
WCS	0,677	0,000	0,027
NOL	0,874	0,025	0,012
WOL	0,905	0,010	0,000
LA	0,888	0,037	0,001
HFR	0,031	0,181	0,390
WFR	0,915	0,003	0,002
PEL	0,687	0,004	0,002
FPI	0,347	0,215	0,075
NF/P	0,675	0,137	0,005
NOS	0,588	0,286	0,002
WFR	0,487	0,272	0,049
LPT	0,186	0,200	0,248

The values in bold correspond for each variable to the factor for which the squared cosine is the largest and show the association of the variables with the principal components. FLO50: Number of days at 50% flowering, PLH: Plant height, SDI: Stem diameter, NBR: Number of branches, IPP: number of inflorescences per plant, SOP: plant span, LA: leaf area, LPT: Petiole length, WOL: leaf weight, HFR: fruit height, WHR: fruit width, PEL: peduncle length, FPI: number of fruits per inflorescence, NF/P: number of fruits per plant, NOS: number of seeds, WFR: weight of the fruit.

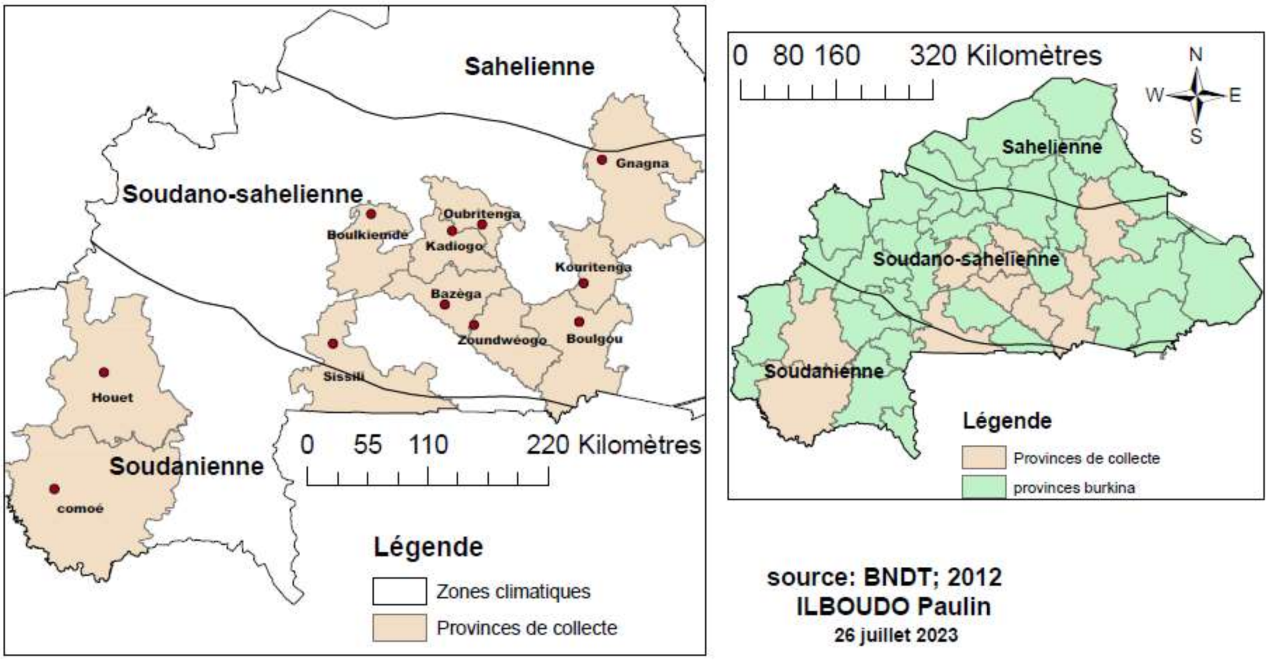

Figure 1. Distribution of the accessions according to their collection sites

Figure 2. Variation of the stem and branches color: A: purple striped with green; B: dark-purple; C: green; D: grayish-green

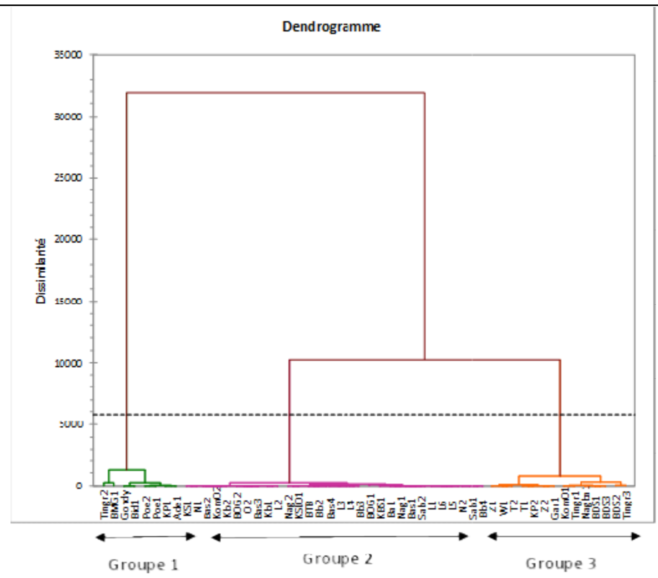

Figure 3. Dendrogram resulting from the hierarchical ascending classification of the 52 accessions

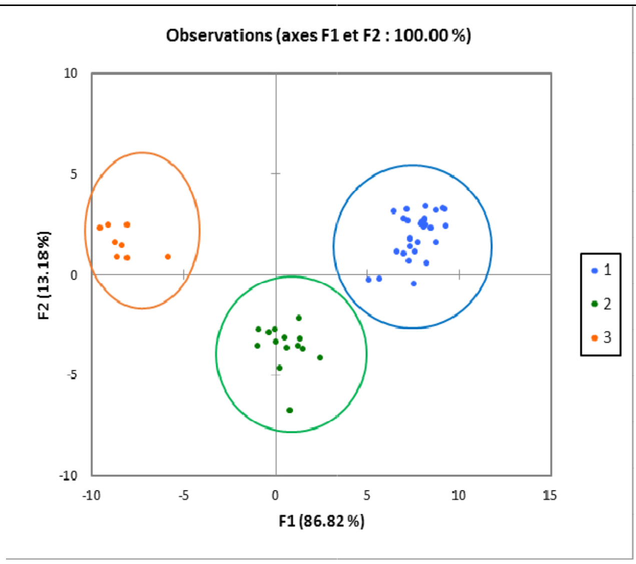

Figure 4. Representation in the AFD ½ plan of the three groups of accessions from the hierarchical ascesding classification (HAC)

The heritability is high when its value is greater than 50% (H^2>50%). Thus, heritability was high for all variables. Also, significant differences at the 5% threshold between the Sudano-Sahelian and Sudanian zones were observed (Table IV). The agronomic performances of the accessions collected in the Sahelian zone presented higher values than those of the accessions collected in the Sudano-Sahelian and Sudanian zones.

Comparative average performances of accessions: The average performance of the accessions depending on the years of cultivation showed significant differences for the variables relating to productivity such as 100 seeds weight, fruit height, fruit width, peduncle length, number of fruits per inflorescence, number of fruits per plant and number of seeds. The calculated R^2 (coefficient of determination) showed that the interannual variability is very low. The values found varied from 00.00% (for petiole length) to 73.60% for fruit height. Only the variables fruit height, 100 seeds weight, fruit width, peduncle length, number of fruits per inflorescence, and number of seeds showed interannual variability greater than 50%. The other variables explained the variability with each a lower percentage (Table V). By comparing the agronomic performances of the variables measured in the two years, the results of the Student Newman Keuls's test showed better performances for the variables 100 seeds weight, fruit height, fruit width, number of fruits per inflorescence, number of fruits per plant and number of seeds in year 2023. Only the variable peduncle length presented a better performance for the 2022 agricultural campaign. The other variables did not show a significant difference during the two agricultural campaigns.

Correlations between quantitative variables: The analysis of the correlations between the measured parameters showed that there are positive and negative relationships between these parameters ranging from low to high correlation (Table IV). Significant and positive correlations (Table VI) at 5% threshold were noted between plant height and stem diameter, between plant height and number of days to 50% flowering, plant span, leaf weight and leaf area and between stem diameter and leaf weight. The correlations were also significant between the variables fruit width and plant span, and between the number of fruits per plant and the number of leaves. Negative correlations were also noted between plant height and leaf number, and between leaf number and stem diameter.

Principal component analysis (PCA): A principal components analysis was carried out using 18 variables (Table VII). We noticed that the first axis alone explained 66.86% of the information. The squared cosines of the variables show that 16 variables used for the analysis were associated with the F1 factor. These variables will be used for hierarchical ascending classification. The second factor (F2) has an eigenvalue of 1.62 and explains 7.72% of the total variability and the third factor (F3) has an eigenvalue of 1.25 and explains 5.93% of the variability. Except for this factor, the eigenvalues of the other factors are less than 1, which means that they explain very little of the observed variability. Thus, by considering the first three factors (F1, F2 and F3), 80.50% of the total variability is explained.

Hierarchical ascending classification (HAC): The results obtained from multivariate analyzes highlighted significant variability within the accessions (Figure 3). From the results obtained, the hierarchical classification made it possible to identify the accessions, according to their phenotypic traits and classifies the accessions into three main groups where the majority of the genotypes grouped together have parents in common, or they have the same original climatic zone. The first level of truncation gives a structuring of diversity into three distinct groups. Considering the climatic zone, group 1 is mainly made up of accessions from the Sudanian zone. Group 2 comprises accessions from the Sudano-Sahelian zone, while group 3 comprises accessions collected in the Sudanian and Sahelian zones. On the other hand, taking into account the cultivated and uncultivated criterion, group 1 is mainly made up of accessions encountered in protoculture while groups 2 and 3 are essentially compounded of cultivated accessions.

Discriminant factor analysis (DFA): The characterization of the three groups by discriminant factor analysis (Figure 4) shows that group 1 contains accessions with better agronomic performance: accessions of large size, leaf surface, number of leaves, fruit length and number of seeds. Group 2 comprises accessions with average agronomic performance: accessions of medium size, average leaf surface, number of leaves, fruit length and number of seeds. Group 3 contains accessions with lower agronomic performances; plants of small size, with reduced leaf surface and fruit length, but whose number of leaves, number of fruits per plant and number of seeds are greater than those of groups 1 and 2.

DISCUSSION

The qualitative and quantitative parameters measured made it possible to highlight the existence of a diversity between the accessions of *Solanum nigrum* L. for all the characters considered. The significant variability observed between the performances of the collected accessions could be explained by the large differences observed between the minimum and maximum values of the variable, the very high standard deviations for some of the quantitative characters and the existence of several modalities for the majority of the qualitative characteristics observed. Indeed, previous studies carried out in Cameroon had already shown the existence of a large agromorphological variability within thirty (30) accessions of black nightshade (Frechette *et al*., 2016). This result confirms those of (Kientega., 2014) on morphotypes of black nightshade from central-eastern Burkina Faso. The great variability observed could serve as asset for an implementation of a breeding program of black nightshade species in Burkina Faso. The wide proportions of green color and erected habit of the plant of the accessions observed indicate that in Burkina Faso producers prefer black nightshade with green color and erect habit. The accessions of black nightshade cultivated in Burkina Faso are all early maturing.

The three agromorphological groups revealed from the Hierarchical Ascending Classification and the Discriminant Factor Analysis are composite groups made up of accessions from different localities. The distribution of these groups shows the existence of a variability of black nightshade accessions cultivated in Burkina Faso. The grouping of accessions was done on the basis of characteristics related to growth and yields, which are discriminating. The characterization of the groups by the AFD shows that the groups are very distinct. This allows us to confirm the existence of a diversity within black nightshade cultivated in Burkina Faso.

The different agromorphological groups obtained thus offer a possibility of choice for the identification of potential accessions for selection with interesting characteristics. In addition, they could facilitate the choice of breeders for the development of new varieties. The significant differences and the high agronomic performances of accessions from the Sudano-Sahelian and Sudanian zones compared to those from the Sudanian zone would indicate that the climatic zone was a determining factor in the expression of the diversity of the studied accessions. The difference in rainfall between the two zones would be the cause of such variability. The structuring of diversity according to collection areas indicates that there is a geographical distribution of S. nigrum diversity following the climatic gradient of Burkina Faso. The results of (Frechette *et al.,* 2016) and Ouedraogo M.H., 2016) which showed differences between the morphotypes collected in Cameroon and the Democratic Republic of Congo support such a hypothesis. Peasant practices have greatly influenced the structuring of the diversity of *S. nigrum.* The great variability observed in this study offers opportunities for genetic improvement of the species. The quantitative characteristics having presented the greatest variability were the plant size, the number of leaves per plant, the number of fruits per plant and the leaf area. The strong significant and positive correlation observed between the plant height and the average weight of leaves per plant on the one hand and the significant and negative correlation between the number of leaves per plant and the average weight of leaves per plant on the other hand means that plants of large size and smaller number of leaves per plant have a large leaf area and a high leaf biomass. Thus, the plants of these accessions having broad leaves and a high average weight of leaves per plant, could be of a particular interest to market gardeners producing leafy vegetables. Indeed, according to (Bedigian D., 2004) and (Eteka*et al.,* 2012), black nightshade plants with the largest leaf surfaces are the most capable of capturing light, and consequently, are capable of carrying out intense photosynthetic activity, which would result in rapid growth and improvement of leaf biomass. This would determine the productivity of the crop and would be of a great economic advantage for market gardeners. Furthermore, the number of leaves per plant was proportional to the number of branches per plant. This indicates that plants with a greater number of branches are those that have a large number of leaves but with a low average weight. Similar results have already been observed by (Grubben*et al.,* 2004). Indeed, an increase in the number of branches would lead to an increase in the number of leaves per plant and a decrease in leaf biomass and therefore less economic importance for producers.

The observed variability can only be used for genetic improvement when the heritability of traits is high. The very high heritability values shows that the contribution of genotypes to the expression of traits is important. Thus, the genetic improvement of S. nigrum is possible based on the variability highlighted in this study. It must be oriented towards the green color which is preferred by producers and consumers and towards the characters favoring biomass production such as the size of the plant and the number of branches and leaves per plant. This improvement could be made from accessions of group I which present the best agronomic performances. Most of these accessions are from the Sudano-Sahelian climatic zone.

CONCLUSION

The present study highlighted the existence of a great variability within the accessions of *Solanum nigrum* (L.) cultivated in Burkina Faso. The analysis of the qualitative characteristics, especially color of the leaf, the stem and the shape of the leaves showed a high variability in shape and color within the black nightshade collection. Among the cultivated black nightshade of Burkina Faso, three divergent groups exist. The correlations between the variables and the very high heritability of the traits show that genetic improvement can be considered based on the observed variability. A molecular analysis of the collected accessions would be necessary to better appreciate the diversity of *Solanum nigrum* in Burkina Faso.

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Glossary of Abbreviations

ANOVA: Analyse of variances
DFA: Discriminant Factor Analysis
F: Fisher's F
GV: Genotypic Variances
H^2: heritability
HAC: Hierarchical Ascending Classification
INERA: Institute for the Environment and Agricultural Research
PCA: Principal Component Analysis
PV: Phenotypic Variances

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