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VARIATION, CORRELATION AND HERITABILITY OF INTEREST CHARACTERS FOR SELECTION OF AFRICAN EGGPLANT

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ABSTRACT

The eggplant (*Solanum aethiopicum*) is the species of *the Solanum* genus, whose geographical distribution is broadest. It is grown throughout tropical Africa, and includes three groups of cultivars commonly called African or indigenous eggplant. *Kumba* group or "bitter eggplant" is an important *Solanaceous* vegetable crop in Burkina Faso. The objective of this study was to determine genetic variability, strength of association and level of heritability among agronomic interest traits. Phenotypic and genotypic variations and heritability of 14 traits were estimated in 61 accessions at Institut de Développement Rural (IDR), Gampela in Burkina Faso. High phenotypic and genotypic coefficients of variation were observed for fruit diameter, number of seeds per fruit, fruit weight, leaf blade length and width, and height at flowering. In addition, genetic and phenotypic variances were high for the number of seed, fruit weight, plant height at flowering and days to 50% flowering. High heritability estimates were recorded for all traits. Fruit weight showed a positive association with fruit diameter and thickness. The fifty percent flowering cycle registered positive correlations with plant height and fruit diameter. Fruit number showed a negative association with fruit weight and diameter, and 50% flowering cyle.

Key Words: Agromorphological, bitter eggplant, Burkina Faso

RÉSUMÉ

Solanum aethiopicum est une espèce largement répandue en Afrique tropicale. Au Burkina Faso, parmi les *Solanacées*, l'aubergine africaine du cultivar *Kumba* est l'une des plus importants légumes. L'objectif général de cette étude est de contribuer à une meilleure connaissance de la plante à travers un certain nombre de caractères d'intérêts. Ainsi, soixante-un accessions ont été évaluées selon un dispositif complètement randomisé afin de déterminer la variabilité génétique, les corrélations et le niveau d'héritabilité de 14 caractères d'intérêts agromorphologiques. Pour se faire, les variances phénotypiques et génotypiques ainsi que l'héritabilité de ces caractères ont été estimées. De forts coefficients de variations phénotypique et génotypique ont été observés pour les caractères, diamètre du fruit, le nombre de graines par fruit, le poids du fruit, la longueur et la largeur de la feuilles, la longueur du pétiole et la hauteur de la plante à la floraison. En plus, les variances génotypiques et phénotypiques sont élevées pour le nombre de graines par fruit, le poids du fruit, la hauteur de la plante à la floraison et le cycle 50% floraison. L'héritabilité estimée s'est révélée forte pour tous les caractères. Le poids du fruit est positivement corrélé aux dimensions du fruit. Quant au cycle 50% floraison, il est positivement corrélation à la hauteur de la plante à la floraison et le diamètre du fruit. Le nombre de fruit par plant indique une corrélation négative avec les dimensions du fruit et le cycle 50% floraison. Le résultat le plus remarquable est l'absence de corrélation entre le nombre de graines par fruit et le diamètre du fruit. Cela suggère la possibilité d'une sélection systématique d'accessions à gros fruits contenant moins de graines.

Mots Clés: aubergine amère, *kumba*, agromorphologique, diversité, paramètres génétiques

INTRODUCTION

The eggplant, *Solanum aethiopicum,* is the species of *the Solanum* genus whose geographical distribution is broadest. It includes three groups of cultivars commonly called African or indigenous eggplant (Lester and Seck, 2004; Sunseri *et al.,* 2010). Cultivars of *Gilo* Group, cultivated throughout tropical Africa in humid regions, cultivars of *Shum* Group are prevalent in Central Africa, and cultivars of *Kumba* Group or "bitter eggplant" are mainly present in warmer and semi-arid sahel regions. *Kumba* Group is predominantly grown in Burkina Faso for fruits and leaves, and constitute one of the most popular leafy vegetables. It is appreciated in the cities, especially during festivities (baptism, weddings, etc.).

Both fruit and leaves are cooked as sauce and sometimes eaten raw. They are used as medicine to treat diarrhoea, hypertension, bee and scorpion bites among other diseases (Chinedu *et al.,* 2011; Adeniji and Aloyce, 2012; Glinus, 2014). The steady increase in its demand especially in Burkina Faso has led to the need for its increased production. Fruits and leaf marketing provides significant incomes for the population. Today, eggplant ranks third after tomato and onion, and is followed by okra in sub-Saharan Africa, and particularly in Burkina Faso (Plazas *et al.,* 2014; Bationo-Kando *et al.,* 2015). In 2013, over 5510 tonnes of eggplants were harvested in Burkina Faso (FAOSTAT, 2013). In spite of the beneficial uses of *Kumba* group, research into production and general improvement of this group through breeding has received very little attention in the country.

Generaly, african eggplant are highly heterogeneous due to cross pollination (Horna *et al.,* 2007). The *Kumba* group have a great variability of forms, colour and dimensions of the fruits (Bationo-Kando *et al.,* 2015). Farmers's knowledge revealed a great diversity within the local varieties.

An ethnobotanical survey carried out among producers, cookers, seller and consumers showed that the consumers appreciated the fruits and leaves of *Kumba.* As fruit size, the preferences were large fruits because they reportedly had good taste and contained less seeds. The white colour fruits were also preferred to those with green colour.

Genetic improvement of african eggplant is necessary for the exploitation of their potential for commercial vegetable production. However, virtually no studies have been done to determine the inheritance of these quantitative characters in *Kumba* group. Furthermore, the association among various characters has not been established. Heritability is important in helping plant breeder plan and executes effective breeding strategies. Knowledge of correlation among characters is important in deciding what selection strategy to use. The objective of this study was to determine the amount of genetic variability available for selection in the accessions and, to assess the strength of association and to estimate the level or amount of heritability among agronomic traits.

MATERIALS AND METHODS

Experimental site. This study was done in the experimental station of the IDR in Gampela located 18 km from Ouagadougou on National Highway N° 4. It is located in the north-Sudanese area and is characterised by an annual rainfall between 600 and 900 mm. The site coordinates are 1°21'96'' West and 12°24'29'' North. The trial was established on a sandy- clayey soil type (BUNASOL, 1988).

Plant materials. This study involved 61 local varieties collected in three agricultural regions (West, North-West and Centre of Burkina Faso) located in three climatic zones namely, the Sahelian zone with an annual rainfall of less than 600 mm, the North Sudanese zone between isohyets 700 and 900 mm and the South Sudanese region between isohyets 900 and 1100 mm (Guinko, 1984; PGRFA, 2007). Twenty seven accessions came from the sahel, 12 accessions of the North Sudanese region and 22 in the South Sudanese.

Treatments and design. The study was laid out in a randomised complete block, with three replicates. The sowing process was conducted in a nursery, and transplanting took place thirty days after seeding emergence. Each accession was sown in rows of 3.2 m long with 0.8 m spacing. Biopesticides (HN and PIOL at dose of 15 L. ha^{-1}) were used to control diseases and enemies of *S. aethiopicum* every two weeks.

Variables observed. Twelve quantitative and two qualitative variables (Table 1) were observed on 5 plants randomly selected by accession in each plot, except for the sowing-flowering cycle for which the observation involved the whole line. Measurements of these variables is described in Table 1.

Statistical analysis. Descriptive analysis of statistical data of the ethnobotanical survey and qualitative phenotypic variables, were obtained using EXCEL software. An analysis of variance (ANOVA) was done using the software GenStat V 4.10.3. in order to determine quantitative characters that discriminated accessions. A correlation matrix between the characters was generated using the Xlstat Version 7.5.2 software.

The genotypic and phenotypic variances (VG and VP), the coefficients of phenotypic and genotypic variation (PCV and GCV), the broad-sense heritability (H^2) and expected genetic gain (GA) accessions were calculated according to formulas used by Rex (2002) and Hosseini *et al.* (2012) (Table 2).

RESULTS

Variation of phenotypic characters. Figure 1 presents the qualitative characteristics observed in the collection of indigenous eggplant in Burkina Faso. Fruit colour was dark-green to creamy white, with a sweet to very bitter taste. The majority of accessions gave green fruits (72%) (Fig.1A). Seventy-seven percent of accessions had bitter fruit and 23% had soft fruit (Fig. 1B). The coefficients of variation of characters such as date at 50% flowering, peduncle length, fruit diameter and length, were low (CV <20%) (Table 3). On the contrary, they were high for all other characters (CV> 20%). Accessions flowered between 57 and 85 days after sowing, and had an average height of 20.5 cm. The number of fruits per plant was 13, with average weight of fruit 89.65 g, and average diameter of 7.1 cm. The number of seeds per fruit varied from 125 to 1880.

Phenotypic and genotypic variances. Phenotypic variance was greater than genotypic variance for all characters (Table 4). The phenotypic variance varied from 0.30 to 315998.33, while genotypic variance ranged from 0.27 to 300062. The number of grain per fruit (NGR) had the highest phenotypic and genotypic variances (315998.30 and 300062.00, respectively), followed by fruit weight (4385.67 and 4175.70) and plant height at flowering (68.64 and 60.08). Petiole length, peduncle length and thickness, and fruit diameter had the lowest phenotypic and genotypic variances (<10) .The other characters exhibit high phenotypic and genotypic variances (>20).

Broad sense heritability. Heritability of the studied characters that varied from 69.6 to 96.6% which was high for all characters (Table 4). Fruit characteristics such as, weight (95.21), thickness (96.05%), diameter (96.57%) and number of seeds per fruit (94.96%) were the most heritable. The number of fruiting branches was the least heritable (69.6%).

Correlation between characters. There were correlations between traits studied (Table 5). Positive correlations were observed between petiole length and leaf blade length (r = 0.771) and leaf blade width (r = 0.765); the plant height at flowering (r = 0.702) and fruit diameter (r = 0.345).

Plant height at flowering was positively correlated with fruit thickness (r = 0.446) and fruit diameter (r = 0.490), fruit weight (r = 0.490), and the cycle of 50% flowering (r=0.490). Some negative correlations were found between cycle

TABLE 1. Description of quantitatives and qualitatives characters examined in Burkina Faso

Characters	Abbreviations	Description of procedures
Cycle of 50% flowering (days)	CFL	Number of days from sowing to the opening of the first flower
Plant height at flowering (cm)	HPF	Height from ground level to the final bud at the opening of the first flower
Fruit weight (g)	WFR	Weight of the mature green fruit was determined. The average of the first 10 fruits per plant was used
Peduncle length (cm)	LPD	A ruler served for the measurement of length of the stalk of the first 10 fruits per plant
Fruit diameter (cm)	DFR	A slide caliper was used to measure the diameter of the first 10 fruits per plant
Fruit thickness (cm)	EFR	A slide caliper served to measure the thickness of the first 10 fruits per plant from the base of the fruit attached to the stalk
Fruit colour	CFR	Colour of the first 4 fruits/plant was noted at the same stage of maturity
Taste of the fruit	GFR	Taste of one fruit of each plant was appreciated by three persons after eating part of the fruit
Numbers of seeds per fruit	NGR	Seeds of the first fruit/plant were extracted washed and counted manually
Numbers of fruits per plant	NFR	Fruits per plant numbers was mentioned by counting manually
Petiole length (cm)	LPE	Petiole length was measured from the base of the blade to the leaf sheath
Leaf blade length (cm)	LLB	Length of the first 3 limbs from the base to the point of the limb to the opening of the first flower were measured
Leaf blade width (cm)	LAB	Width of the limb on the level of the broadest part (1/3 inferior) to the opening of the first flower was noted
Number of fruiting branches	NBF	Number of fruiting branches/plant was counted at the end of the experiment

of 50% flowering and number of fruit (r = -0.352). It is the same between the number of fruit and fruit thickness (r = -0.663), fruit diameter (r = -0.545) and fruit weight (r = -0.586). However, no significant correlations between the number of seeds per plant and fruit thickness and fruit diameter.

DISCUSSION

The accessions studied are heterogeneous for most qualitative variables (Fig. 1). That is observed by presence of several modalities for each characters. In addition, according to Lester and Daunay (2003), Burkina Faso would be the centre of diversity of *S. aethiopicum* var *Kumba*. Generally, the most cultivated ecotypes were those with green fruit, which represented 72% of the accessions, against only 12% of accessions with creamy white fruits. By combining colour and taste (bitter taste whose accessions were 61%), this study agrees with consumers that green fruits are bitter.

Major differences between the minimum and maximum, and high coefficients of variation of quantitative traits also reflect the existence of large morphological variability within accessions. Bationo-Kando *et al.* (2015) showed that the great morphological diversity of the Burkina Faso eggplant is explained by the mode of reproduction of the plant, in relation to farmers' practices of management and conservation of the plant genetic resource.

The higher phenotypic and genotypic variance values for seed number per fruit, plant height at flowering and fruit weight showed that the genotype could be reflected by the phenotype. Even the effectiveness selection based on the phenotypic performance of these traits could be reached. These results are in line with some studies involving other varieties of eggplant (Islam and Uddin, 2009; Naik *et al.,* 2010; Danquah and Ofori, 2012).

High genotypic and phenotypic variances of the number seeds per fruit, height at flowering and days to flowering in this study are not uncommon with *solanaceous* vegetable crops (Aliero, 2007; Farhad *et al.,* 2008; Sood *et al.,* 2009; Tumbilen *et al.,* 2011). In general, the values of phenotypic coefficients of variation (PCV) are

TABLE 2. Formulae of genetic parameters estimated

Parameters	Formulas
Phenotypical Variance (VP)	VP=VG + (MSE/r) = MSG/r
Genotypic Variance (VG)	VG = (MSG-MSE)/r
Broad-sense heritability (H^2)	H^2 (%) = (VG/VP)*100
Coefficient of phenotypical variation (PCV)	PCV (%) = ("VP/X)*100
Coefficient of Genotypic variation (GCV)	GCV (%) = ("VG/X)*100

MSG = mean square of genotypes; MSE = mean square error; r = number of repetitions

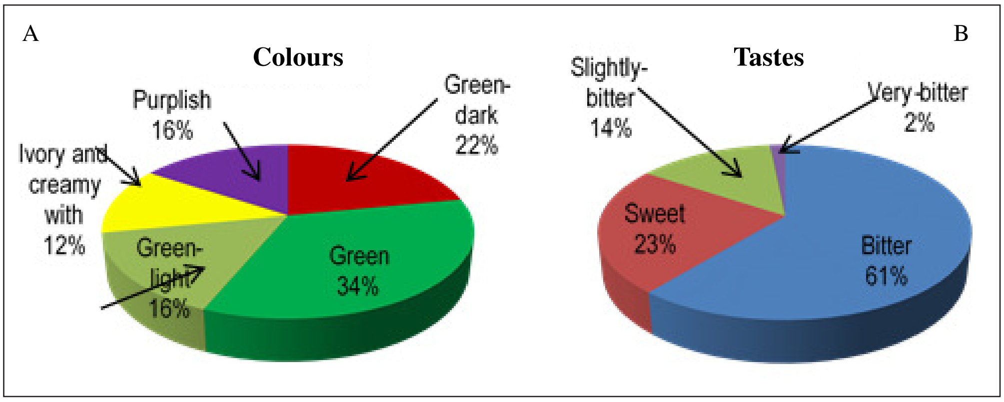

Figure 1. Distribution of color and fruit taste of the 61 accessions of *Kumba* Group. A: fruit colour: green, light green, dark green and creamy white. B: Taste of the fruit: sweet, bitter, slightly bitter and very bitter.

TABLE 3. Analysis of variance of 12 quantitative variables

Variables	Minimum	Maximum	Means	Ecart-type	MSG	MSE	CV (%)
CFL	57,00	85,33	73,07	4,54	167,91**	26,24	7,03
LPE	2,46	8,46	4,80	1,16	11,20**	1,42	24,80
LLB	7,04	23,66	14,91	2,91	74,67**	8,86	20,00
LAB	5,33	20,46	12,59	2,75	69,86**	8,04	22,58
HPF	10,20	42,60	20,64	4,78	205,92**	25,69	24,54
NBF	8,40	39,00	18,92	6,17	184,40**	56,03	39,81
NFR	6,00	32,80	12,88	4,23	139,62**	25,11	38,82
LPD	1,07	2,85	1,74	0,30	0,90**	0,08	15,72
DFR	4,31	9,23	7,12	1,01	12,00**	0,41	9,01
EFR	2,07	4,66	3,38	0,50	2,91**	0,12	10,01
WFR	20,70	180,76	90,72	34,21	13157,00**	629,90	27,63
NGR	125,00	1880,00	875,74	330,01	947995,00**	47809,00	24,92

**Significant at 0.01 probability level, MSG = mean square of genotypes; MSE = mean square error; r = number of repetitions

TABLE 4. Calculated genetic parameters of *S. aethiopicum* of Burkina Faso

Variables	VG	VP	H^2 (%)	“VG	“VP	GCV (%)	PCV (%)
CFL	47,22	55,97	84,37	6,87	7,48	9,40	10,24
LPE	3,26	3,73	87,33	1,81	1,93	37,65	40,28
LLB	21,94	24,89	88,14	4,68	4,99	31,41	33,46
LAB	20,61	23,29	88,50	4,54	4,83	36,06	38,33
HPF	60,08	68,64	87,52	7,75	8,28	37,55	40,13
NBF	42,79	61,47	69,61	6,54	7,84	34,57	41,43
NFR	38,17	46,54	82,02	6,18	6,82	47,97	52,97
LPD	0,27	0,30	91,64	0,52	0,55	30,06	31,40
DFR	3,86	4,00	96,58	1,97	2,00	27,62	28,11
EFR	0,93	0,97	96,05	0,97	0,99	28,53	29,11
WFR	4175,70	4385,67	95,21	64,62	66,22	71,23	73,00
NGR	300062,00	315998,33	94,96	547,78	562,14	62,55	64,19

VG = Genotypic variance, VP = Phenotypical variance, GCV = Coefficient of genotypic variation, PCV = Coefficient of phenotypical variation

slightly higher than genotypic coefficients of variation (GCV). But the magnitude of the difference between them is a little lower, an indication of less environmental influence on the expression of these attributes. This corroborates with the study of Danquah and Ofori (2012) in garden eggplant *(Solanum gilo raddi)* in Ghana.

Desmukh *et al.* (1986) categorised PCV and GCV values into following classes: high (>20%), medium (10-20%) and low (<10%). Based on this classification, the only agronomic traits which recorded medium values for PCV and GCV was cycle of 50% flowering, respectively 10.2 and 9.4%. All other agronomic characters or traits recorded values of GCV and PCV were above the high range. This suggests sufficient genetic variability to facilitate improvement through selection of all agronomic traits. The development of an effective breeding programme depends on existence of genetic variability. The results of this study are similar to those of other studies involving different species of eggplant (Naik *et al.*, 2010; Denton and Nwangburuka, 2011).

In our study, broad sense heritability estimates on the basis of genotypic and phenotypic variances are high for all traits considered. This high heritable characters confirms the low influence of environmental factors on characters expression. In this case, the phenotype is a good predicator of accessions genotype (Visscher *et al.*, 2008). Several studies (Islam and Uddin, 2009; Danquah and Ofori, 2012) reported mostly high heritability values for fruit length, days to flowering, fruit weight and height at flowering, respectively in *Solanum gilo Raddi* and *Solanum melongena*. The high heritability values recorded for all traits, suggest that selection could be practiced for all agronomic traits. However, high heritability value alone is not enough guarantee to ensure a high genetic gain (Ibrahim and Hussein, 2006).

In Burkina Faso, bitter eggplants are grown for fruits and leaves. The significant correlations observed between petiole length and other vegetative variables of the plant such as LLB, LAB and HPF indicate that varieties with better morphology characters can be selected by considering only these variables. On the other hand, negative correlation between the plant cycle and the number of fruit per plant; number of fruits and fruit thickness; and fruit diameter and fruit weight (EFR, DFR, WFR) show that these are early accessions, which produce many fruits of small size, with low weights. Similar results were reported by Bationo-Kando *et al*. (2015).

The positives correlations between fruit diameter and fruit weight, fruit thickness, and height at flowering suggest that selection for shorter plants could lead to earliness of accessions in this collection. Similar results were reported by Bationo-Kando *et al*. (2015) on eggplant of *Kumba* group. Consumers prefer big

TABLE 5. Correlation matrix between the variables (1%)

Variables	CFL	LPE	LLB	LAB	HPF	NBF	NFR	LPD	EFR	DFR	WFR	NGR	GFR	CFR
CFL														
LPE	0,275													
LLB	0,489*	0,771*												
LAB	0,556*	0,765*												
HPF	0,333*	0,702*	0,654*	0,645*										
NBF	-0,255	0,149	0,123	0,071	0,273									
NFR	-0,352*	-0,046	-0,398*	-0,343*	-0,184	0,178								
LPD	0,182	0,197	0,466*	0,329*	0,440*	0,268	-0,433*							
EFR	0,065	0,216	0,419*	0,278	0,466*	0,248	-0,663*	0,681*						
DFR	0,070	0,345*	0,526*	0,372*	0,490*	0,249	-0,545*	0,748*	0,919*					
WFR	0,019	0,232	0,422*	0,279	0,490*	0,322*	-0,586*	0,689*	0,973*	0,921*				
NGR	0,054	0,013	0,029	0,069	0,084	0,008	-0,270	0,016	0,160	0,135	0,097			
GFR	0,022	0,119	0,183	0,176	0,122	0,195	-0,063	0,233	0,335*	0,409*	0,335*	0,105		
CFR	-0,165	-0,112	-0,011	-0,053	0,002	0,224	-0,069	0,095	0,126	0,052	0,132	-0,179	0,084	

Legend: CFL = cycle of semi-flowering, LPE = petiole length, LLB = leaf blade length, LAB = leaf blade width, HPF = plant height at flowering, NBF = number of fruiting branches, NFR = number of fruit per plant, LPD = peduncle length, EFR = thickness of the fruit, WFR = fruit weight, DFR = fruit diameter, NGR = number of seed/ fruit, GFR = fruit taste, CFR = fruit colour
*: significant at 0.01 probability level

eggplant fruits, and fruits with high diameter fetch premium prices on the market. However, selection for this agronomic trait could increase the cycle of the plant. Height at flowering revealed a positive association with fruit diameter.

Fruit diameter showed no association with number of seeds per fruit, implying that the number of seed per fruit does not vary with fruit size. In this fact, breeders could directly select fruits with big size and containing few seeds (Danquah and Ofori, 2012). In other words, there are accessions in this collection which possessed big fruit size and containing few seeds. Cookers and consumers prefer large fruits with few seeds. Thus, any breeding programme that will facilitate a reduction in seed content of the fruit, will be helpful. This result shows that systematic selection for accessions with low seed content is possible. This is the fact that high heritability values were registered for these two agronomic traits in these accessions of *Kumba*.

CONCLUSION

The availability of significant genetic variability and high level of heritability for fruit thickness, days to flowering, fruit weight, height at flowering and number of seeds per fruit in the accessions, suggests that selection to improve these traits is possible. The notable result is the non-significant association of fruit diameter with seed content of the fruit. Thus, selecting systematic for fruit diameter in the accessions could improve the quality of the fruit through reduction in seed content.

REFERENCES

Adeniji, O.T. and Aloyce, A. 2012. Farmer's knowledge of horticultural traits and participatory selection of African eggplant varieties (*Solanum aethiopicum*) in Tanzania. *Tropicultura* 30: 185-191.

Aliero, A.A. 2007. Response of four *Solanum* species seasonal dynamics in Sokoto-Nigeria. *International Journal of Agricultural Research* 2 (1): 62-68.

Assefa, K., Tefera, H., Merker, A., Kefyalew, T. and Hundera, F. 2001. Variability, heritability and genetic advance in phenomorphic and agronomic traits of Tef [Eragrostis tef (Zucc.) Trotter] germplasm from eight regions of Ethiopia. *Hereditas* 134(2) : 103-113.

Bationo-Kando, P., Sawadogo, B., Nanema, K. R., Kiébré, Z., Sawadogo, N., Kiébré, M., Traoré, R.E., Sawadogo, M. and Zongo J.D. 2015. Characterization of *Solanum aethiopicum* (*kumba* group) in Burkina Faso. *International Journal of Science and Nature* 6 (2):169-176.

Bilgin, O., Korkut, K. Z., Baser, I., Dalioglu, O., Ozturk, I.T., Kahraman and Balkan, A. 2010. Variation and heritability for some semolina characteristics and grain yield and their relations in Durum Wheat (*Triticum Durum* Desf.).*World Journal of Agriculture Sciences* 6 (3): 301-308.

BUNASOL, 1988. Etude pédologique de la station expérimentale de Gampela, échelle 1/5000. N° 59: 279p.

Chinedu, S.N., Olasumbo, A.C., Eboji, O.K., Emiloju, O.C., Arinola, O.K. and Dania, D.I. 2011. Proximate and phytochemical analyses of *Solanum aethiopicum* L. and *Solanum macrocarpon* L. Fruits. *Research Journal of Chemical Sciences* 1(3): 63-71.

Danquah, J. A. and Ofori, K. 2012. Variation and correlation among agronomic traits in 10 accesssions of garden egg plant (*Solanum gilo Raddi*) in Ghana. *International Journal of Science and Nature* 3(2): 373-379.

Denton, O.A. and Nwangburuka, C.C. 2011. Heritability, genetic advance and character association in six yield related characters *Solanum anguivi*. *Asian Journal of Agricultural Research* 5 (3): 207-207.

Deshmukh, S.N.N., Basu, M.S. and Reddy, P.S. 1986. Genetic variability, character association and path coefficient analysis of quantitative triats in Virginia bunch varieties of groundnut. *Indian Journal of Agricultural Sciences* 56: 515-518.

Falconer, D.S. and Mackay, T.F.C. 1996. Introduction to quantitative genetics. 4th Ed., Benjamin Cummings. England. ISBN. 9780582243026.

FAOSTAT, 2013. http://faostat3.fao.org/ home/ index. html# SEARCH_DATA

Farhad, M., Hasanuzzaman, M., Biswas, B.K., Azad, A.K. and Arifuzzaman, M. 2008. Reliability of yield contributing characters for improving yield potential in chilli. *International Journal of Sustainable Crop Production* 3 (3): 30-38.

Glinus, 2014. Medicinal Plants and Herbal Medicine: African eggplant. http://glinusplant.blogspot.com/2014/04/african-eggplant.html.

Guinko, S. 1984. *Etude de la végétation de la Haute Volta*, Tome I. Thèse Univ. de Bordeaux III, France: 394p.

Horna, D., Timpo, S. and Gruere, G. 2007. Marketing underutilized crops: The case of the African garden egg (Solanum aethiopicum) in Ghana. Global Facilitation Unit for Underutilized Species (GFU) Via dei Tre Denri, Rome, Italy.

Hosseini, S.J., Sarvestani, Z.T., Pirdashti, H., Afkhami, A. and Hazrati S. 2012. Estimation of heritability and genetic advance for screening some rice genotypes at salt stress conditions. *International journal of Agronomy and Plant Production* 3 (11): 475-482.

Ibrahim, M.M. and Hussein, R.M. 2006. Variability, heritability and genetic advance in some genotypes of Roselle (*Hibiscus sabbariffa* L.). *World Journal of Agriculture Science* 2: 340-345.

Islam, M.S. and Uddin, M.S. 2009. Genetic variation and trait relationship in the exotic and local eggplant germplasm. *Bangladesh Journal of Agriculture Research* 34 (1): 91-96.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. 1955. Estimates of genetic and environmental variability in Soybeans. *Agronomy Journal* 47(7): 314-318.

Lester, R.N. and Seck, A. 2004. *Solanum aethiopicum*. In: Grubben, G.J.H and Denton, O.A (Editors). Plant resources of Tropical Africa 2. Vegetables. PROTA Foundation, Wageningen, Netherlands: Backhuys publisher, Leiden, Netherlands /CTA, Wageningen, Netherlands: pp. 472-477.

Lester, R. N. and Daunay, M. C. 2003. Diversity of African vegetable *Solanum* species and its implications for a better understanding of plant domestication. pp. 137-152. In: Knuepffer and Ochsmann (Eds.). Rudolf Mansfeld and Plant Genetic Ressources. Schriften zu genetischen ressourcen 22, Bonn, Germany.

PGRFA, 2007. Rapport National sur l'état des Ressources Phytogénétiques pour l'Alimentation et de l'Agriculture. Ministère de l'Agriculture de l'Hydraulique et des ressources Halieutiques, Burkina Faso.

Plazas, M., Andújar, I., Santiago Vilanova , Pietro Gramazio , F. Javier Herraiz and Jaime Prohens 2014. Conventional and phenomics characterization provides insight into the diversity and relationships of hypervariable scarlet (*Solanum aethiopicum* L.) and gboma (*S.macrocarpon* L.) eggplant complexes. *Crop Science and Horticulture* 5 (318):13.

Rex, B. 2002. Breeding for quantitative traits in plants. Stemma Press Woodbury. Singh R.K.

Stanfield, W. D. 1975. Genetics. Mc Graw-HillInc, New York. 281 p.

Visscher, P.M., William, G.H. and Naomi, R.W. 2008. Heritability in the genomics Era-concepts and misconceptions, *Nature Reviews Genetics* 9(4): 255-266.