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Research Paper

Assessment of Some Agro-Morphological Parameters of Some Local and Exotic Varieties of Okra [*Abelmoschus Esculentus* (Moench)]

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Abstract. To put in place improved varieties in response to the needs of peasants, it is necessary to characterize the local ecotypes commonly used by the latter. These local ecotypes are usually more of populations than pure lineages. Very little or no work has been centered on the real evaluation of the potential of the different cultivated local and exotic okra varieties in Cameroon, in order to consider developing hybrids that fulfill the increasing desires and needs of the growing local populations. It is from this perspective that the general objective of this work focused, to identify among some varieties of okra, on those that have the best agro-morphological features. The results obtained from this study show that: the Local 1 (59.667 ± 0.577 Pa.s) and Local 2 (P) (48.667 ± 0.577) varieties respectively distinguished themselves by the high viscosity of their fruits; the Local 5 and Red of Thiès varieties had more nodes (11.600 ± 1.212 and 14.400 ± 2.862) and more fruits (6.133 ± 1.415 and 10.267 ± 3.547); the Clemson and Indiana varieties distinguished themselves by their precocity or early fruiting (53.333 ± 2.082 and 53.000 ± 3.606). It is therefore evident from this study that there exists among the local varieties, those having interesting characteristics that could be used for varietal improvement of okra. These results would permit breeders to put in place varieties which in addition to being productive and precocious also have satisfactory organoleptic properties like viscosity of the fruits.

Keywords: *Abelmoschus esculentus*, agro-morphological parameters, assesment, okra.

INTRODUCTION

Okra (*Abelmoschus esculentus*) is one of the most important traditional vegetables that one can find on almost all African markets (Nguelieu, 2010). According to the United States Agency for International Development (USAID, 2006), okra is the object of an intensive production system in urban and rural agriculture. Its nourishing value is important, far behind carrot but above that of tomato (Sawadogo et al., 2006). It is cultivated on the whole of Africa for its fruit (consumed as boiled soup or fried like spinach), its leaf (used as basis of cataplasm and food for livestock), its stem, rhizome, inflorescence and seed (as coffee substitute, as flocculating agent for water purification) (Agarwal et al., 2003; Siemonsma and Kouamé, 2004; Okigbo, 1975; cit. Nguelieu, 2010).

In spite of its multiple uses, its important nutritional value, financial value (Sawadogo et al., 2006), and the renewed interest in Cameroon towards gardening in general and the culture of okra in particular (Nguelieu, 2010), the supply of okra still remains very low. The major reasons of this insufficient supply are: the low availability on the market of improved varieties which are adapted to the hot and humid agro-ecological zone, the cultivation of old varieties and the massive import of seeds that are less adapted to the local conditions

(AVRDC, 2008). In Cameroon, an investigation led by MINAGRI revealed that 65% of the market gardeners use seeds coming from the previous harvests and that 12.5% of their seeds are obtained from their neighbors (LVDP, 1998; cit. Nguelieu, 2010). Mostly, local ecotypes are found among the peasants. These ecotypes cultivated by peasants are probably made up more of populations than of pure lineages.

Okra grows best in soil with a near-neutral pH between 6 and 6.7 (Huxley, 1992). Meanwhile, the exploitation of the existing diversity of the characters of each individual, their variability, is a major principle in plant improvement. A considerable challenge is the knowledge of genetic resources, be it of the wild or cultivated species, and of the old varieties or those lately created by man. In this context, it is necessary to have a large genetic variability through collection, characterization, preservation and management. The characterization of variability is done by the description and inventory of all the agro-morphological characters. The exploitation of the genetic variability of the different varieties of okra by the combination and grouping of characters into genotypes of interest could contribute to the varietal improvement of this species (Lukonge, 2005).

Studies in Cameroon (Dabandata et al., 2010) showed that heterosis effect exists between the hybrids of okra. Moreover, the heritability of the characters has also been verified (Dabandata et al., 2012). However, very little or no work has been focused on the actual evaluation of the potential of the different cultivated local and exotic varieties, in order to consider developing the hybrid variety that satisfies the needs of growing local populations. The general objective of this work was thus to identify among some varieties of okra, those that have the best agro-morphological features.

MATERIALS AND METHODS

Plant material and experimental site

This work was done in a farm located within the campus of the University of Yaounde I in Cameroon. Soil analysis shows these components: CO (2.77 %), MO (4.8%), C/N (25.2). The pH is about 5.23. Rainy conditions were evaluated and were as follows: average annual precipitation was 155.25 ml and temperature was 24.89°C.

The biological material consisted of 9 varieties of okra, 6 of which are local varieties and 3 exotic varieties (Red of Thiès, Clemson, and Indiana).

Assessment of biological and agronomic parameters

Biological parameters

With the help of a decameter ribbon and slide calipers, the size of the plants and diameter breadth, height, length of the internodes, distance between the cotyledon node and the 1st floral node, were measured. The latent period, time of germination, rate of germination, and precocity (50% of flowering) were also determined.

Agronomic parameters

With the help of a decameter ribbon and slide calipers, the length and diameter of the fruits (commercial and mature) were measured. With the help of a weighing balance, the mass of commercial fruits and 100 seeds were measured. The number of fruits per plant and the number of lobes and seeds per fruit were also noted.

Assessment of the viscosity of fruits

Fresh immature fruits (commercial fruits) of each okra variety were harvested, cleaned, ground with a grater (1 mm openings), and beaten in a beaker with a spatula in order to render its paste more soft and homogeneous. The homogenized paste was poured in a cylindrical bowl of 50 ml and then placed in a viscometer (Haake vistoter VT 02 model). The viscometer was then set to effect a rotational movement; the rotation time (1 min) of the apparatus was determined with a stopwatch (Hanhart model), and the reading of the viscosity was done with a meter incorporated in the device.

All instruments in contact with the okra paste of a variety were washed and wiped each time before passing on to the next variety.

Statistical analyses

The experimental design used for this study is the complete random blocks design. Each block was subdivided into nine plots corresponding to the nine varieties of okra studied. The experimental unit constituted of 30 plants for each variety and the number of repetition was 3. The collected data was entered into the SPSS software SAS 9.0. These data were submitted to analysis of variance in order to evaluate the different genotype effects. The significantly different means were separated by the smallest significant difference calculated at the threshold of 5%. The analysis in main components (ACP) was done by the software XLSTAT to sort out the different groups and classes of the studied okra varieties. The interrelationship and regression analysis permitted to show the existence of more or less narrow relations between some evaluated parameters.

RESULTS

Results of the ANOVA show that the different evaluated

Table 1. Biological parameters.

Parameters \ Varieties	Local 1	Local 2	Local 2 (P)	Local 3	Local 4	Local 5	Clemson	Indiana	Red of Thiès
Plant height (cm)	135.813 ± 39.537^{bc}	183.713 ± 23.083^{de}	220.883 ± 37.375^{e}	134.857 ± 17.067^{bc}	152.117 ± 25.422^{cd}	154.393 ± 10.057^{cd}	86.533 ± 9.680^{a}	113.143 ± 5.906^{ab}	98.740 ± 8.501^{ab}
Length of internodes (cm)	11.467 ± 0.975^{b}	10.917 ± 0.369^{b}	15.327 ± 0.112^{c}	11.393 ± 1.272^{b}	10.813 ± 0.548^{b}	11.243 ± 0.189^{b}	6.193 ± 0.424^{a}	10.770 ± 0.665^{b}	6.847 ± 0.465^{a}
Deadline of 50% flowering (DAP)	63.333 ± 3.055^{b}	67.000 ± 3.606^{b}	62.000 ± 5.568^{b}	53.333 ± 3.055^{a}	53.333 ± 4.163^{a}	55.000 ± 5.196^{a}	53.333 ± 2.082^{a}	53.000 ± 3.606^{a}	53.000 ± 0.577^{a}
Number of lobes	8.367 ± 0.318^{b}	8.910 ± 0.090^{cd}	9.060 ± 0.052^{d}	8.483 ± 0.380^{bc}	8.577 ± 0.321^{bc}	8.363 ± 0.162^{b}	8.150 ± 0.226^{b}	5.390 ± 0.052^{a}	5.697 ± 0.295^{a}
Rate of germination (%)	12.223 ± 5.091^{a}	36.667 ± 3.335^{bc}	36.667 ± 12.022^{bc}	45.553 ± 16.776^{c}	34.443 ± 8.386^{bc}	26.663 ± 5.774^{ab}	27.777 ± 10.716^{ab}	34.443 ± 11.710^{bc}	37.777 ± 10.716^{bc}
Latency period (day)	7.667 ± 2.517^{c}	5.333 ± 0.577^{ab}	5.667 ± 0.577^{abc}	6.333 ± 1.528^{abc}	4.333 ± 0.577^{a}	4.333 ± 0.577^{a}	6.333 ± 2.309^{abc}	6.333 ± 1.155^{abc}	5.333 ± 2.517^{ab}
Distance cotyledon node- 1st floral node (cm)	24.983 ± 7.720^{cd}	30.170 ± 4.806^{d}	42.937 ± 7.389^{e}	17.533 ± 0.900^{abc}	22.100 ± 3.166^{bc}	14.700 ± 1.502^{ab}	10.533 ± 0.407^{a}	17.400 ± 1.539^{ab}	13.600 ± 0.391^{a}

The values are expressed as mean ± std. dev. These values are accepted.

Table 2. Agronomical parameters.

Parameters \ Varieties	Local 1	Local 2	Local 2 (P)	Local 3	Local 4	Local 5	Clemson	Indiana	Red of Thiès
Length of mature fruits (cm)	12.01 ± 1.772^{a}	22.920 ± 1.955^{e}	14.547 ± 0.551^{b}	19.560 ± 1.391^{cd}	20.377 ± 0.919^{d}	30.780 ± 1.285^{f}	17.827 ± 0.453^{c}	24.453 ± 0.632^{e}	22.687 ± 0.650^{e}
Length of commercial fruits (cm)	4.917 ± 0.244^{a}	6.813 ± 0.645^{bc}	5.467 ± 0.517^{a}	7.577 ± 0.593^{c}	6.470 ± 0.361^{b}	9.390 ± 0.401^{d}	7.420 ± 0.475^{c}	9.970 ± 0.460^{d}	12.280 ± 0.947^{e}
Diameter of mature fruits (cm)	5.040 ± 0.236^{g}	3.393 ± 0.193^{de}	4.307 ± 0.265^{f}	3.720 ± 0.295^{e}	4.227 ± 0.261^{f}	3.167 ± 0.140^{cd}	2.850 ± 0.131^{bc}	2.557 ± 0.136^{ab}	2.373 ± 0.104^{a}
Diameter of commercial fruit (cm)	2.255 ± 0.033^{d}	1.698 ± 0.078^{b}	2.102 ± 0.046^{c}	1.833 ± 0.075^{b}	1.995 ± 0.121^{c}	1.517 ± 0.125^{a}	1.823 ± 0.026^{b}	1.543 ± 0.059^{a}	1.517 ± 0.082^{a}
Number of nodes	9.033 ± 1.692^{a}	14.300 ± 7.894^{a}	12.467 ± 2.155^{a}	9.567 ± 1.845^{a}	10.833 ± 2.350^{a}	11.600 ± 1.212^{a}	12.467 ± 2.701^{a}	9.233 ± 0.666^{a}	14.400 ± 2.862^{a}
Number of fruits	3.567 ± 1.026^{a}	9.433 ± 7.506^{b}	6.200 ± 0.954^{ab}	5.067 ± 1.124^{ab}	5.967 ± 2.318^{ab}	6.133 ± 1.415^{ab}	8.067 ± 1.950^{ab}	5.567 ± 0.208^{ab}	10.267 ± 3.547^{b}
Weight of commercial fruits (g)	10.36 ± 0.661^{a}	11.010 ± 3.437^{ab}	12.757 ± 1.021^{ab}	13.750 ± 0.702^{bc}	13.200 ± 1.290^{abc}	13.023 ± 1.059^{ab}	12.740 ± 0.843^{ab}	11.043 ± 0.847^{ab}	16.190 ± 3.330^{c}
Number of seeds/fruit	83.30 ± 17.670^{b}	109.367 ± 10.113^{c}	94.667 ± 6.700^{bc}	91.817 ± 7.471^{b}	84.433 ± 15.916^{b}	93.200 ± 15.638^{bc}	84.183 ± 17.650^{b}	52.550 ± 9.951a	57.850 ± 6.756^{a}
Weight of 100 seeds (g)	6.920 ± 0.192 ^{c}	8.300 ± 0.071^{g}	7.260 ± 0.055 ^{d}	7.680 ± 0.084^{f}	7.420 ± 0.286 ^{de}	7.480 ± 0.130 ^{e}	6.480 ± 0.148 ^{b}	6.040 ± 0.089 ^{a}	7.020 ± 0.110 ^{c}

parameters vary according to the different okra varieties.

Assessment of biological parameters

Concerning the plant height, the Clemson variety had the least height (86.533 ± 9.680 cm) while the Local 2 (P) variety had the highest height (220.883 ± 37.375 cm). With regard to early fruiting or precocity, Red of Thiès seemed to be the most precocious variety (53.000 ± 0.577 DAP) while Local 2 the late variety (67.000 ± 3.606 DAP). The longest length between the cotyledon node and the first most elevated fructiferous leaf was found on the Local 2 (P) variety (42.937 ± 7.389 cm) and the shortest length on Clemson (10.533 ± 0.407 cm) (Table 1).

Assessment of agronomic parameters

The highest number of fruits per plant was observed on the Red of Thiès variety (10.267 ± 3.547) while the least number was on the Local 1 variety (3.567 ± 1.026). The Local 2 variety had the highest number of seeds per fruit (109.367 ± 10.113) whereas the Indiana variety produced fruits with the least number of seeds (52.550 ± 9.951). Concerning the length of commercial fruits, Red of Thiès presented the longest fruits (12.280 ± 0.947 cm), while the shortest fruits were observed on the Local 1 variety (4.917 ± 0.244 cm); the largest commercial fruits were observed on the Local 1 variety (2.255 ± 0.033 cm) while the thinnest fruits were found on the Red of Thiès variety (1.517 ± 0.082 cm). Concerning the commercial fruit weight, Red of Thiès was found to be the variety with the highest weight (16.190 ± 3.330 g) while the lowest weight was obtained on the Local 1 variety (10.363 ± 0.661 g) (Table 2).

Table 3. Viscosity of commercial fruits of some varieties of okra.

Parameters \ Varieties	Locale 1	Locale 2	Locale 2 (P)	Locale 3	Locale 4	Locale 5	Clemson	Indiana	Red of Thiès
Viscosity of commercial fruits (Pa.s)	59.667 ± 0.577[e]	39.667 ± 0.577[c]	48.667 ± 0.577[d]	31.667 ± 0.577[a]	31.333 ± 1.154[a]	33.667 ± 2.309[b]	39.667 ± 0.577[c]	31.333 ± 1.154[a]	30.667 ± 0.577[a]

Table 4. Descriptive statistics of the parameters obtained from the analysis in main component.

Variable	Minimum	Maximum	Average	Standard deviation
MF	10.363	16.190	12.675	1.757
NG	52.550	109.367	83.487	17.939
NF	3.567	10.267	6.696	2.149
MG	6.040	8.300	7.178	0.665
LFC	4.917	12.280	7.812	2.345
DFC	1.517	2.255	1.809	0.268
TG	12.223	45.553	32.468	9.408
LEN	6.193	15.327	10.552	2.688
LFM	12.010	30.780	20.573	5.562
DFM	2.373	5.040	3.515	0.888
NN	9.033	14.400	11.544	2.047
TL	4.333	7.667	5.841	1.088
HP	86.533	220.883	142.244	41.964
NL	5.390	9.060	7.889	1.361
VIS	30.667	59.667	38.481	9.926
PC	53.000	67.000	57.074	5.464
DNCF	10.553	42.937	21.253	10.229

MF: Mass of fruit; NG: Number of seeds; NF: Number of fruits; MG: Mass of 100 seeds; LFC: Length commercial fruit; DFC: Diameter commercial fruit; TG: Rate of germination; LEN: length of internodes; LFM: Length of mature fruit; DFM: Diameter of mature fruit; NN: Number of nodes; TL: Latency time; HP: Plant Height; NL: Number of lobes; VIS : Viscosity; PC: Precocity; DNCF: Distance between the cotyledon node and the 1st fructiferous node.

Assessment of the viscosity of fruits

Concerning viscosity, the fruits of the Local 1 variety were the most viscous (59.667 ± 0.577 Pa.s) and those of the Red of Thiès variety the least viscous (30.667 ± 0.577 Pa.s) (Table 3).

The simple statistics obtained from the analysis in main component (ACP) showed also that the evaluated agro-morphological parameters vary from one variety to the other, thus confirming the results of the ANOVA (Table 4).

The matrix of interrelationship generated by the ACP shows that positive and perfect interrelationships, and negative and perfect interrelationships exist between the evaluated parameters. Parameters for positive and perfect interrelationships include MG and NG, LEN and NG, HP and NG, MF and LFC, HP and LEN, DNCF and LEN, DFC and DFM, HP and DNCF. On the other hand, the negative and perfect interrelation-ships include NF and DFM, NF and DFC, LFC and

Table 5. Matrix of interrelationships between the evaluated parameters.

Variables	MF	NG	NF	MG	LFC	DFC	TG	LEN	LFM	DFM	NN	TL	HP	NL	VIS	PC	DNCF
MF	**1**	-0.272	0.490	0.082	**0.735**	-0.496	0.603	-0.184	0.383	-0.463	0.250	-0.402	-0.187	-0.514	-0.563	-0.581	-0.309
NG	-0.272	**1**	-0.031	**0.797**	-0.417	0.123	0.166	**0.795**	0.149	0.421	-0.129	-0.263	**0.803**	0.492	0.318	0.593	0.525
NF	0.490	-0.031	**1**	0.213	**0.678**	**-0.712**	0.496	-0.307	0.504	**-0.708**	**0.700**	-0.414	-0.055	-0.537	-0.394	0.004	-0.134
MG	0.082	**0.797**	0.213	**1**	-0.184	-0.022	0.373	0.465	0.235	0.277	0.255	-0.458	0.661	0.486	-0.026	0.489	0.428
LFC	**0.735**	-0.417	**0.678**	-0.184	**1**	**-0.889**	0.337	-0.556	**0.691**	**-0.878**	0.293	-0.278	-0.552	**-0.813**	-0.603	-0.595	**-0.708**
DFC	-0.496	0.123	**-0.712**	-0.022	**-0.889**	**1**	-0.398	0.451	**-0.888**	**0.917**	-0.356	0.424	0.371	0.602	0.662	0.434	0.638
TG	0.603	0.166	0.496	0.373	0.337	-0.398	**1**	0.058	0.279	-0.401	0.292	-0.340	0.146	-0.116	-0.619	-0.289	0.017
LEN	-0.184	**0.795**	-0.307	0.465	-0.556	0.451	0.058	**1**	-0.206	0.638	-0.314	-0.098	**0.872**	0.473	0.552	0.482	**0.715**
LFM	0.383	0.149	0.504	0.235	**0.691**	**-0.888**	0.279	-0.206	**1**	**-0.667**	0.216	**-0.674**	-0.131	-0.325	-0.618	-0.370	-0.538
DFM	-0.463	0.421	**-0.708**	0.277	**-0.878**	**0.917**	-0.401	0.638	**-0.667**	**1**	-0.415	0.226	0.548	**0.694**	**0.680**	0.520	0.650
NN	0.250	-0.129	**0.700**	0.255	0.293	-0.356	0.292	-0.314	0.216	-0.415	**1**	-0.454	0.150	0.036	-0.332	0.239	0.229
TL	-0.402	-0.263	-0.414	-0.458	-0.278	0.424	-0.340	-0.098	**-0.674**	0.226	-0.454	**1**	-0.355	-0.119	0.527	0.150	-0.043
HP	-0.187	**0.803**	-0.055	0.661	-0.552	0.371	0.146	**0.872**	-0.131	0.548	0.150	-0.355	**1**	0.642	0.402	0.662	**0.878**
NL	-0.514	0.492	-0.537	0.486	**-0.813**	0.602	-0.116	0.473	-0.325	**0.694**	0.036	-0.119	0.642	**1**	0.225	0.513	0.659
VIS	-0.563	0.318	-0.394	-0.026	-0.603	0.662	-0.619	0.552	-0.618	**0.680**	-0.332	0.527	0.402	0.225	**1**	**0.710**	0.560
PC	-0.581	0.593	0.004	0.489	-0.595	0.434	-0.289	0.482	-0.370	0.520	0.239	0.150	0.662	0.513	**0.710**	**1**	**0.760**
DNCF	-0.309	0.525	-0.134	0.428	**-0.708**	0.638	0.017	**0.715**	-0.538	0.650	0.229	-0.043	**0.878**	0.659	0.560	**0.760**	**1**

The values in bold are significantly different from 0 to a level of significance alpha = 0.05. MF: Mass of fruit; NG: Number of seeds; NF: Number of fruits; MG: Mass of 100 seeds; LFC: Length commercial fruit; DFC: Diameter commercial fruit; TG: Rate of germination; LEN: length of internodes; LFM: Length of mature fruit; DFM: Diameter of mature fruit; NN: Number of nodes; TL: Latency time; HP: Plant Height; NL: Number of lobes; VIS : Viscosity; PC: Precocity; DNCF: Distance between the cotyledon node and the 1st fructiferous node.

DFC, DFC and LFM, LFC and NL (Table 5).

The figure combining both the evaluated parameters and different studied varieties reveal 4 varietal classes.

The first group is composed of the Clemson (C) and Indiana (I) varieties having no optimized parameter. This first group is antagonistic to the second group, constituted of the varieties Local 2 (L2), Local 2 (P) [L2 (P)], Local 3 (L3), Local 4 (L4) whose optimized parameters are the mass of seeds, the number of seeds, the height of the plants, the length of the internodes, the 50% of flowering, the distance between the cotyledon node and the first fructiferous node, and the number of lobes. The third group is made up of the Local 5 (L5) and Red of Thiès (T) varieties having six parameters optimized namely: number of nodes, rate of germination, number of fruits, mature fruit length, mass of fruit and length of commercial fruit. The last group is made up of the Local 1 (L1) variety having optimized parameters like the commercial fruit diameter, mature fruit diameter, viscosity, and latency time (Figure 1).

DISCUSSION

The analysis revealed a perfect and positive interrelationship between the number of nodes and the number of fruits. Therefore, genotypes with great number of nodes are those which give more fruits. This is further confirmed by the analysis in main components (ACP) which revealed that the highest number of fruits was obtained from the same varieties. Similar results have been found by Ouedraogo (2009) in a study on agro-morphological characterization of five varieties of *A. esculentus*.

It was also noted that exotics varieties such as Clemson, Red of Thiès and Indiana varieties are those that have the least distance between the cotyledon node and the first floral node. This is the cause of the small height of those varieties. These results agreed with the findings on the same species by Dabandata et al. (2010). This is in agreement with the main objective of breeding program on *A. esculentus* which is to obtain small plants height.

In the same way, exotics varieties such as Indiana and Clemson varieties are those of which half of the plants flowered earlier than the other okra varieties; these varieties are thus considered precocious. This is also in agreement with the breeding objectives. By considering the precocity of okra being linked to these three parameters (rate of 50% flowering, length of the internodes, distance between the cotyledon node and the first

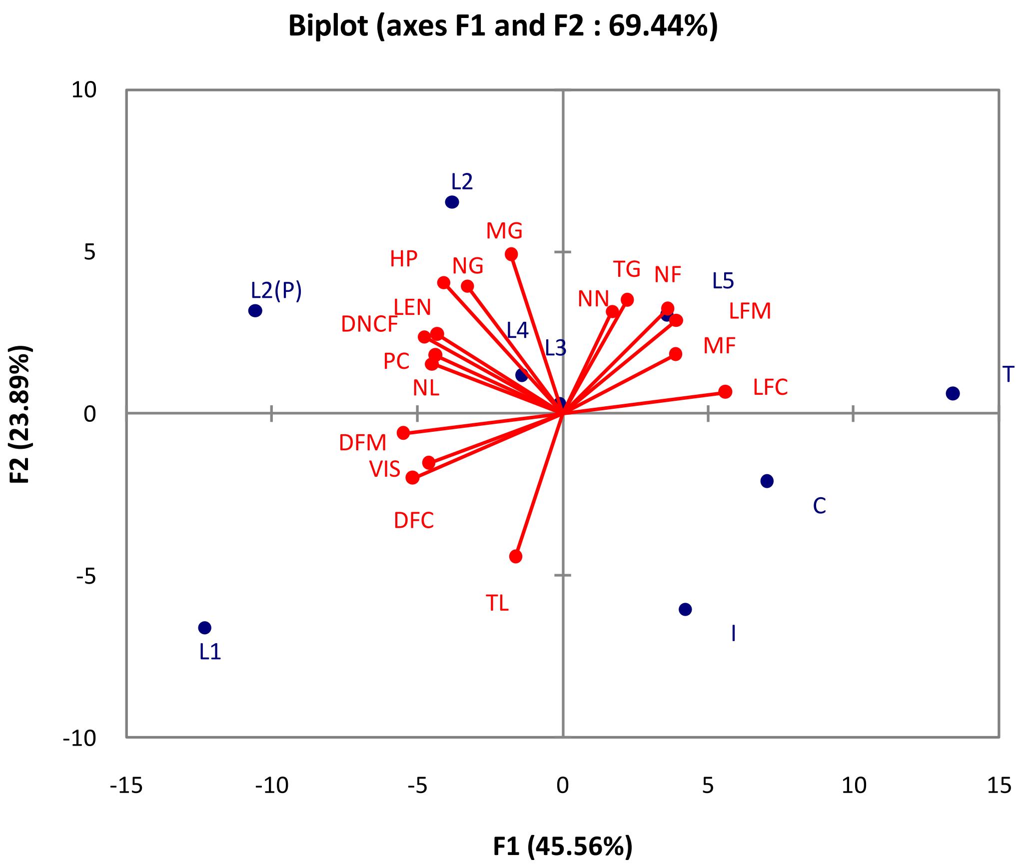

Figure 1. Principal component analysis of studied parameters.

floral node), it appears that the exotic varieties are the more precocious or early fruiting varieties. Although, exotics varieties are fruits of research breeding program considering the origin of those exotics varieties.

However, it is worth noting that regarding precocity, the choice of the varieties depends on the type of agricultural practice and the duration of seasons. In fact, the precocious varieties are recommended to farmers who practice intensive agriculture whereas, for the peasants, who practice subsistence agriculture, it is judicious to cultivate the late varieties especially as their flowering is spread in time. In this second case, the Local 2 (P) and Local 2 varieties are best suited.

The matrix of interrelationship generated by the ACP shows the existence of both positive and perfect relationships and negative and perfect relationships between the evaluated parameters. A positive and significant correlation has been found in a similar survey between such parameters (Akinyele and Osekita, 2006; Dabandata et al., 2012). In the same way, some negative and meaningful correlations have been observed between the length and the diameter of the fruit (Bello et al., 2000). Our results are then in conformity with those cited earlier. A positive and perfect interrelationship translates the existence of a good relation between the parameters put in inscription. On the other hand, the existence of negative and perfect relationships between two characters suggests that all growth of one induces a reduction of the other (Dabandata et al., 2012). Furthermore, the characters of those that exercise negative and non-meaningful correlation can be difficult to select and should not be taken in account in a program of varietal improvement (Henry and Krishna, 1990).

Concerning agronomic parameters, analysis of results revealed that with regard to the number of fruits, this parameter varies from one variety to another. These results confirm those of Farooq et al. (2002) and Bello et al. (2006) on similar parameters in a study on varieties of okra.

But concerning the number of seeds per fruit and the mass of the seeds, they are highest for the local varieties rather than exotics. This is linked to the fact that number of seeds is to be reduced for okra which will be used to prepare soup (Ouedraogo, 2009). However, this number of seeds per fruit depends on the objectives needed. For example, production of oil needs a great number of seeds. This constitutes an asset for seed producers and agriculturists. In fact, considering the low germination rate observed with okra, it is recommended at the time of sewing to put 3 to 4 seeds per hole in order to hope for at least a plant; the high number of seeds in the fruits of some varieties could resolve this insufficiency. Besides, the fact that these local varieties produce seeds with the highest weight, these may enhance good vigor of resulting young plants at the early growth stage.

The analysis of viscosity of fruits of the different varieties of okra shows that local varieties are classified among those having the most viscous fruits. It should be noted also that the fruits of these varieties are covered with little spiny hairs - especially those of the Local 1 variety. From this observation, viscosity of okra fruits could be linked to hairiness.

Considering the fact that this character binding fruits of this species is the major characteristic sought for by consumers from the culinary perspective, these two varieties present a non-negligible advantage that could be exploited in the production of improved hybrid varieties.

CONCLUSION

The different analyses and interrelationships carried out, permit to affirm that there exists among the local okra varieties, those having interesting characteristics that can be used for the varietal improvement of okra. The Local 1 and Local 2 (P) varieties distinguished themselves by the high viscosity of their fruits; the Local 5 and Red of Thiès varieties by the number of nodes and the high number of fruits; the Clemson and Indiana varieties for their early fruiting or hairiness. The results of this study would help plant breeders to develop not only productive and precocious varieties but also those with satisfactory organoleptic features, like viscosity of fruits. In perspective, it would be judicious to produce hybrid varieties and to evaluate their potentials; and to study the genetic link between viscosity and the hairy aspect of the fruits of okra.

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