ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 14, Issue, 10, pp.22475-22481, October, 2022
DOI: https://doi.org/10.24941/ijcr.44135.10.2022

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

REVIEW ARTICLE

ASSESSMENT OF GERMINATION AND GROWTH IN NURSERY OF 24 LOCAL AND EXOTIC CHILLI PEPPER (CAPSICUM SPP.) VARIETIES IN CÔTE D'IVOIRE

Moroh J. AKAZA[1]*, Noel GROGA[1], Yah G. GNAMIEN[1], Bi Boh N. GORE[1], Konan E. N'DRI[2] and Soumaïla K. KONKOBO

[1]Laboratoire d'amélioration de la production agricole, Département Génétique, Biologie, Physiologie, UFR Agroforesterie, Université Jean Lorougnon Guédé, BP 150 Daloa, Côte d'Ivoire; [2]UFR Agriculture, Ressources halieutiques et Agroindustrie, Université de San Pedro, 01 BP 1800, 01, San-Pédro, Côte d'Ivoire

ARTICLE INFO

Article History:
Received 20th July, 2022
Received in revised form
17th August, 2022
Accepted 19th September, 2022
Published online 22nd October, 2022

Key words:

germination rate and time, local and improved varieties, nursery, pepper (*Capsicum* spp.), seedling growth.

Corresponding Author:
Moroh J. AKAZA

ABSTRACT

Improved exotic varieties of pepper are widely cultivated, in Côte d'Ivoire,to the detriment of local varieties. But some of them present difficulties in germination and plant growth which decrease production levels. However, their statistical magnitude, the parameters involved, the state of this situation relative to local varieties and between individual varieties are not known. Thus, this work was to determine characteristics of germination and in nursery growth of local and improved pepper varieties. Tweenty-four local and exotic varieties collected in Haut-Sassandra region in Côte d'Ivoire were evaluated in nursery according to a randomized complete block design with three replications for seven parameters. Data recorded were subjected to analyses of variance and multivariate analyses. First, it was noticed that no seeds germinated in two of the 14 exotic varieties. Thus, germination rate varied from 0 to 100 %, whereas it was from 60 to 100 % in local varieties. The 22 remaining varieties were highly significantly ($p < 1$ %) different for six parameters, except number of leaves. In addition, local varieties were highly significantly ($p < 1$ %) different fron exotic ones for only germination rate and germination time. Indeed, the seeds of local varieties germinated better (85.61 %) than those of improved varieties (76.19 %). Also, seeds of local varieties germinated in a shorter mean time (7.66 days) than those of exotic varieties (8.82 days). Otherwise, three clusters of varieties were distinguished significantly ($p < 5$ %) for stem diameter and plantlet height, but highly significantly ($p < 1$ %) for germination rate. Thus, a cluster, composed of 11 varieties whose all seeds germinated (100 %), with lowest stem diameter value (0.11 cm) and highest plantlet height value (3.16 cm) opposed another cluster comprising four varieties with weakest germination rate (65 %), highest mean stem diameter (0.19 cm) and weak plantlet height (2.7 cm). This study demonstrates, on the one hand, non-germination and very low germination in certain improved varieties and, on the other hand, the shorter average germination time in local varieties. All these results open up perspectives for regressive and inferential evaluations of growth, development and production.

Citation: ***Moroh J. AKAZA, Noel GROGA, Yah G. GNAMIEN, Bi Boh N. GORE, Konan E. N'DRI and Soumaïla K. KONKOBO.*** **2022.** "Assessment of germination and growth in nursery of 24 local and exotic chilli pepper (*capsicum* spp.) varieties in Côte d'Ivoire*". International Journal of Current Research*, 14, (10), 22475-22481.

INTRODUCTION

Pepper (*Capsicum* spp.) fruits are a spice rich in mineral elements and vitamins A and C (Zou *et al*., 2015 ; Zaki *et al*., 2018). Thus, the roots, leaves and fruits of pepper are used in vegetable food or condiments (Kouassi et Koffi-Nevry, 2012), in traditional medicine (Koffi-Nevry *et al*., 2012), in the pharmaceutical industry for its anti-oxidant and anti-biotic properties (Koffi *et al*., 2014 ; Kouassi *et al*., 2016). In Côte d'Ivoire, moreover, pepper is one of the crops used to diversify agricultural exploitations, due to its increasingly attractive price. Indeed, according to Diarra *et al*. (2017), of the 12 commonly grown food crops, pepper is the second most profitable after tomato. Thus, to make the most of this economic importance and to increase pepper production, producers are increasingly cultivating improved varieties, most of which are exotic (Fondio *et al*., 2015). Recently, Akaza *et al*. (2022) established the very wide use and cultivation of improved varieties to the detriment of local varieties. On the sidelines of this cited study, the producers expressed the difficulties of germinating the seeds of certain improved varieties and the poor growth abilities of the plants which would reduce their production levels. This situation thwarts the efforts of producers and adds to their difficulties. However, their statistical magnitude, the parameters involved, the state of this situation compared to local varieties and between individual varieties are not known.

Thus, the present study aimed to determine the seeds germination and nursery early growth characteristics of local and improved exotic varieties of pepper. The study is based on the idea that the evaluation, in a trial, of both local and improved varieties makes it possible to determine all these characteristics.

MATERIALS AND METHODS

Study zone and experimental site: Mature fruits were collected in villages of the four departments (Daloa, Issia, Vavoua, Zoukougbeu) of the Haut-Sassandra region (Figure 1). This region is located at 7°00'0.00" North latitude and -6°34'59.99" West longitude (Anonymous, 2022). The climate is of the humid tropical type with two rainy seasons alternating with two dry seasons (Sangaré *et al*., 2009), Rainfall of 1200 to 1600 mm per year and an average monthly temperature of 20 to 35 ° C over the past 20 years (SODEXAM, 2022). The soils are very deep, in general, of granitic origin, of moderately to slightly denatured, ferralitic under forests, mostly little evolved and hydromorphic (Koffie-Bipko et Kra, 2013). The region is covered with preforest savannahs, fallow land and on its most part of surface with dense semi-deciduous humid forest(Kouamé et Zoro, 2010 ; Koffie-Bipko et Kra, 2013 ; Rci, 2019). Nursery experiments were conducted at the experimental site of Université Jean Lorougnon Guédé in Daloa town.

Plant material: Fresh, mature and ripe fruits, seeds and plantlets of 10 local and 14 exotic pepper varieties were considered in this study (Table 1). Seeds extracted from fresh, mature and ripe fruits were sun dried for two days then conserved in aluminium foil.

METHODS

Experimental activities: A shadehouse made of oil palm leaves was made up and under which plastic blister packs were placed. These pads were filled with soil of the experimental site. The seeds were tested for germination ability. As a test method, seeds of each variety were placed in a dish containing water. Thus, only seeds that migrated to the bottom of the dish were considered able to germinate. Seeds retained were sown according to a randomized complete block design with three replications at the rate of five seeds per hole and seven holes (alveoli) per variety. Daily watering with tap water every morning and evening was provided.

A gauze cloth served as a mean of protecting the nursery against insects. Germinaion time (GT) was recorded in each hole. Thinning with three seedlings was carried out on the 15th day after sowing (DAS). To allow the seedlings to acclimatize to the external environment, a slight elimination of shade was carried out on the 25th DAS and then a complete elimination of the shade on the 30th DAS. Fourty-five DAS, seedlings must be transplanted in field. At that date, values of five variables were recorded on each individual plantlet. There are stem diameter (SD), plantlet height (PH), number of leaves (NL), leaf length (LL) and leaf width (LW).

Data analyses : Descriptive statistics (minimum, mean, maximum, standard deviation, coefficient of variation) as well as Pearson correlation coefficients between variables were calculated. The effects of variety and type of variety (local and improved) on the variations of the values of the parameters were tested, respectively, by analysis of variance (ANOVA) and Student's t test, at 5 % and 1 %. If the analysis was significant, then a homogeneous grouping of the means of the values by variable, therefore of the varieties, was carried out by the Newman-Keuls test at the level of significance alpha = 0.01. Also, the structuring of the varieties based on their germination and growth characteristics was established by Hierarchical clustering using the method of Ward and Euclidean distance (non-centered-reduced) and by Discriminant Factorial analysis. These calculations and analyses were performed with Statistica software version 7.1.

RESULTS

Statistical description of the parameters considered: Descriptive values of germination and early growth parameters are indicated in table 2. No seeds germinated in the improved varieties *Piment Noir* and *Sent bon*. Thus, germination rates varied from 60 to 100 % in local varieties and from 0 to 100 % in improved ones (Table 2). Overall, the seeds of local varieties germinated better and much more (85.61 %) than those of exotic varieties (76.19 %). Germination time interval is quite the same (5 to 16 DAS) for local and exotic seeds. Parameters values were, on the one hand, quite heterogeneous (12.79 % $\leq$ CV < 26 %) for number of leaves (NL), plantlet height (PH), germination rate (GR) in local varieties, leaf length (LL), leaf width (LW) and germination time (GT) in exotic varieties and, on the other hand, highly heterogeneous (26 % $\leq$ CV $\leq$ 66.67 %) for germination time (GT) and stem diameter (SD) in local varieties, germination rate (GR) and stem diameter (SD) in exotic varieties. Stem diameter exhibited the highest heterogeneity (CV = 58.33 % and 67 %).

Relationships between variables : Pearson correlation coefficients among germination and growth variables are given in table 3. The values are very low. The number of leaves (NL) and plantlet height (PH) were each significantly correlated with each of the other variables, except germination time (GT). The highest correlation, r = 0.56, and in addition at p < 1%, was found between leaf length (LL) and leaf width (LW)

Influence of varieties on germination and growth parameters

The analysis of variance (ANOVA) of the 22 local and exotic varieties (Table 4) showed no significant difference (p = 0.617461) for the number of leaves (NL), but highly significant differences (p < 1 %) for germination time (GT), germination rate (GR), stem diameter (SD), plantlet height (PH), leaf length (LL) and leaf width (LW). In this case, Newman-Keuls test distinguished (p < 1 %), depending of the variable, two to 10 groups of varieties (Table 4). For germination time, 10 groups were distinguished. These groups were ranged into three large groups (GI, GII and GIII) composed of local and exotic varieties. Group I includes varieties with a short mean germination time (5-6 days). The landrace *Court-Court africain* presented the shortest mean germination time, 5.4 days. Group II gathers varieties with mean germination time qualifying as intermediate varying from 7 to 9 days. Group III concentrates the varieties having presented long mean germination time of 11 to 12 days. *Mankouflôlô*, an exotic variety, presented the longest mean germination time, 12 days. For the germination rate, eight groups of varieties (Table 4) were ranged into five large groups (GI, GII, GIII, GIV and GV). The GI consisted of two varieties whose seeds have not germinated (0 %). Groups II, III and IV included varieties whose seeds have germinated, respectively, at 33, from 60 to 66, from 83 to 94 %. Group V included varieties with all seeds germinated (100 %). Concerning stem diameter, two groups were distinguished (Table 4). *Sans nom 2 brakaguhé*, an exotic variety, presented the highest average value (0.37 cm) against the values (0.11 to 0.12 cm) of the other 21 local and exotic varieties. Regarding plantlet height (PH), four groups were distinguished. *Gros-Gros*, an exotic variety, and *Sans nom 1 brokoua*, a local variety, presented the highest mean seedling heights (3.40 cm). *Court-Court*, an improved variety, presented the lowest average height (2.15 cm).
Five groups of varieties were observed for leaf length (LL). *Court-Court, Gros-Gros, Court-Court africain* presented the longest leaves (2.64 to 2.70 cm). Whereas *Gros-Gros du Burkina Faso*, an exotic variety, presented the lowest leaf length (1.82 cm). Also, five groups were distinguished for leaf width (LW). *Sans nom 1 brokoua*, a landrace, exhibited the largest leaf (1.94 cm). *Sans nom 2 brakaguhé*, an exotic variety, presented the lowest leaf width, 1.23 cm. Moreover, the Student's t test showed (Table 5) significant, highly (p < 1 %), differences between local and exotic varieties only for germination time (GT) and germination rate (GR) (Table 5). The seeds of local varieties germinated in a shorter mean time (7.66 days) than those of the exotic varieties (8.82 days). Also, the seeds of local varieties germinated much more, on average (85.61 %) than those of improved varieties (76.19 %).

Structuration of varieties for their germination and growth characteristics : Three clusters were obtained on the dendrogram (Figure 2) by applying Method of Ward and Euclidean distances.

Table I. Chillipeppervarietiesstudied

Local varieties	*Court-Court africain, Gros-Gros africain, Mankouflôlô long-long, Mince court-court, Mince long-long, Noir-Noir, Piment baoulé, Piment d'oiseau, Sans nom 1 brokoua, Sans nom 2 brokoua*
Exoticvarieties	*Bec d'oiseau, Court-Court, Gros-Gros, Gros-Gros du Burina Faso, Mankouflôlô, Mankoufloôlô court, Piment noir, Sans nom 1 brakaguhé, Sans nom 2 brakaguhé, Sans nom 1 kibouo, Sans nom 1 zakoua, Sans nom 1 vavoua, Sans nom 6, Sent bon*

Table 2. Descriptive values of germination and earlygrowthparameters in local and exoticpeppervarieties

Variable	Minimum	Mean	Maximum	Standard deviation	CV (%)
Germination time (GT) (day)	5	7.74	15	2.28	29.46
	6	8.55	16	2.21	25.85
Germination rate (GR) (%)	60	86.55	100	14.32	16.55
	0	82.05	100	31.52	38.42
Steemdiameter (SD) (cm)	0.1	0.12	0.17	0.08	66.67
	0.10	0.12	0.16	0.07	58.33
Planletheight (PH) (cm)	1.5	3.08	4.6	0.54	17.53
	2.00	3.06	4.2	0.47	15.36
Number of leaves (NL)	3	5.62	8	0.79	14.06
	4	5.63	7	0.72	12.79
Leaflength (LL) (cm)	1.20	2.29	4	0.44	19.21
	1	2.22	3.5	0.44	19.82
Leafwidth (LW) (cm)	1	1.52	2.5	0.32	21.05
	0.80	1.55	2.50	0.35	22.58

For a givenbiologicparameter, statisticparameters of local varieties are on black lin, those of exoticvarieties on white line. CV: coefficient of variation. GT: germination time, GR : germination rate, SD : stem diameter, PH : plantletheight, NL : number of leaves, LL : leaflength, LW :leafwidth.

Table 3. Pearson correlation coefficients between germination and growth variables

	GT	NL	LL	LW	SD
NL	- 0.05	1			
LL	0.01	0.13	1		
LW	0.02	0.13	0.56*	1	
SD	0.02	- 0.10	- 0.10	- 0.08	1
PH	- 0.00	0.17*	0.35*	0.29*	- 0.12

GT : Germination time, GR : germination rate, SD : stem diameter, PH : plantletheight, NL : number of leaves, LL : leaflength, LW : leafwidth. In bold, significantcorrelationat $p < 5$ %. * significantcorrelationat $p < 1$ %.

Table 4. Homogeneous groups of pepper varieties from the Newman-Keuls test at the level of significance alpha = 0.01

Variety	GT (days)	GR (%)	SD (cm)	PH (cm)	NL	LL (cm)	LW (cm)
Bec d'oiseau	7.00^{fg}	100^{a}	0.12^{b}	3.20^{ab}	5.60^{a}	2.33^{abc}	1.62^{abc}
Court-Court	7.38^{ef}	66.67^{f}	0.13^{b}	2.15^{c}	5.75^{a}	2.70^{a}	1.87^{ab}
*Court-Court africain**	5.40^{g}	100^{a}	$0.11b$	3.31^{ab}	5.70^{a}	2.61^{a}	1.77^{abc}
Gros-Gros	6.83^{fg}	100^{a}	0.12^{b}	3.42^{a}	5.50^{a}	2.63^{a}	1.66^{abc}
Gros-Gros africain	6.53^{fg}	94.44^{b}	$0.11b$	3.21^{ab}	5.66^{a}	2.27^{abc}	1.46^{abc}
Gros-Gros du Burkina Faso	7.00^{fg}	100^{a}	0.11^{b}	3.13^{ab}	5.62^{a}	1.82^{c}	1.33^{bc}
Mankouflôlô	12.00^{a}	100^{a}	$0.11b$	3.22^{ab}	5.61a	2.16^{abc}	1.40^{abc}
Mankouflôlô court	10.40^{b}	83.33^{e}	$0.11b$	3.09^{ab}	5.82^{a}	2.55^{ab}	1.65^{abc}
Mankouflôlô long-long	7.41^{ef}	92.73^{c}	0.14^{b}	2.99ab	5.66^{a}	2.37^{abc}	1.60^{abc}
Mince court-court	10.06^{bc}	91.67^{d}	0.16^{b}	3.19^{ab}	5.84^{a}	2.45^{abc}	1.48^{abc}
Mince long-long	7.55^{def}	91.69^{d}	0.12^{b}	2.73^{abc}	5.72^{a}	2.08^{abc}	1.46^{abc}
Noir-Noir	7.50^{def}	60.00^{g}	0.16^{b}	2.99^{ab}	5.53^{a}	2.51^{abc}	1.60^{abc}
Piment baoulé	9.79^{bc}	83.33^{e}	0.12^{b}	3.00^{ab}	5.42^{a}	2.15^{abc}	1.44^{abc}
Piment d'oiseau	9.33^{bcd}	100^{a}	0.12^{b}	3.32^{ab}	5.63^{a}	1.86^{bc}	1.31^{bc}
Piment Noir	-	0^{i}	-	-	-	-	-
Sans nom 1 brakaguhé	8.50^{cdef}	100^{a}	$0.11b$	2.66^{abc}	5.19^{a}	2.08^{abc}	1.66^{abc}
Sans nom 2 brakaguhé	9.00^{bcde}	33.33^{h}	0.37^{a}	2.53^{abc}	5.66^{a}	2.07^{abc}	1.23^{c}
Sans nom 1 brokoua	6.75^{fg}	66.67^{f}	$0.11b$	3.40^{a}	6.00^{a}	2.35^{abc}	1.94^{a}
Sans nom 2 brokoua	7.83^{def}	100^{a}	0.12^{b}	3.13^{ab}	5.42^{a}	2.38^{abc}	1.63^{abc}
Sans nom 1 kibouo	7.95^{def}	100^{a}	0.12^{b}	3.07^{ab}	5.57^{a}	2.33^{abc}	1.49^{abc}
Sans nom 1 vavoua	8.00^{def}	100^{a}	0.12^{b}	3.26^{ab}	5.92^{a}	2.07^{abc}	1.61^{abc}
Sans nom 1 zakoua	10.40^{b}	83.33^{e}	0.12^{b}	2.98^{ab}	5.72^{a}	2.28^{abc}	1.66^{abc}
Sans nom 6	8.00^{def}	100^{a}	$0.11b$	3.18^{ab}	5.66^{a}	2.06^{abc}	1.43^{abc}
Sent bon	-	0^{i}	-	-	-	-	-
P	0.00	0.00	0.003437	0.000000	0.617431	0.000000	0.000065

*in bold, names of local varieties.

GT : germination time, GR : germination rate, SD : stem diameter, PH : plantletheight, NL : number of leaves, LL : leaflength, LW :leafwidth.

Table 5. Student t test on local and exoticpeppervarieties for the variables considered

Parameter	GT (days)	GR (%)	SD (cm)	PH (cm)	NL	LL (cm)	LW (cm)
Local	7.66[b]	85.61[a]	0.12[a]	3.08[a]	5.62[a]	2.28[a]	1.52[a]
Exotic	8.82[a]	76.19[b]	0.12[a]	3.06a	5.63[a]	2.23[a]	1.55[a]
P	0.000000	0.000188	0.709326	0.782912	0.914724	0.232780	0.387146

GT : germination time, GR : germination rate, SD : stem diameter, PH : plantletheight, NL : number of leaves, LL : leaflength, LW :leafwidth.

Table 6. Comparison of mean values of germination and growthparameters for the three clusters of peppervarietiesobtained by clusteringanalysis

Variables	Cluster 1 (n = 11)	Cluster 2 (n = 7)	Cluster 3 (n = 4)	P
GT	7.98±1.68a	8.85±1.63a	7.94±1.00a	0.483403
GR	100.00±0.00a	88.59±5.03b	65.67±15.86c	0.000000
SD	0.11± 0.00b	0.13± 0.02b	0.19± 0.12[a]	0.044288
PH	3.16± 0.20[a]	3.02±0.15[ab]	2.73± 0.49[b]	0.032994
NL	5.59± 0.18a	5.69± 0.14a	5.58±0.18a	0.404143
LL	2.21± 0.27a	2.30± 0.16a	2.41±0.26a	0.350398
LW	1.53±0.15a	1.54±0.09a	1.63±0.29a	0.606175

GT : germination time, GR : germination rate, SD : stem diameter, PH : plantletheight, NL : number of leaves, LL : leaflength, LW :leafwidth.

Table 7: Weights of canonical functions and contributions of variables

Components	Canonical function 1	Canonical function 2
Eiggen value	21.78917	0.30441
Variance explained (%)	98.622	1.378
Cumulative variance (%)	98.622	100
GT	0.002178	0.522788
GR	- 0.532387	0.195836
SD	0.129865	- 0.261840
PH	- 0.140625	0.005844
NL	- 0.001045	0.573268
LL	0.071676	0.125173
LW	0.046942	- 0.141467

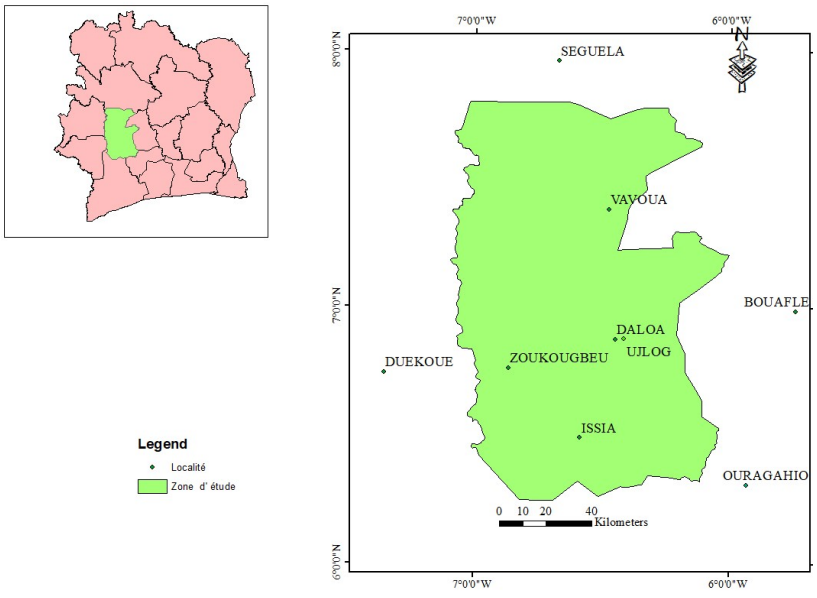

Figure 1. Localization of the study area on a map of Côte d'Ivoire

Characterization of the clusters: Analysis of variance showed differences among the three clusters distinguished by Hierarchical Clustering Analysis (HCA) : significant ($p < 5$ %) for stem diameter (SD) and plantlet height (PH) (Table 6), but highly significant ($p < 1$ %) for germination rate (GR). Thus, cluster 1 comprised varieties whose all seeds germinated (GR = 100 %), with lowest stem diameter value (0.11 cm) and highest plantlet height (3.16 cm). Cluster 3 encompassed varieties with lowest germination rate (65 %), highest average stem diameter (0.19 cm) and low plantlet height (2.7 cm) (Table 6). Cluster 2 encompassed varieties with intermediate values of the three parameters.

The discriminant factorial analysis (DFA) confirmed the three clusters of varieties (Figure 3) obtained by the Hierarchical clustering analysis with their compositions. The first canonical function is statistically significant ($p = 0.000001$) with 98.62 % of the total discriminant power (Table 7). It most clearly distinguishes the three clusters (Table 7; figure 3). This function is defined by the germination rate which is negatively correlated to it (Table 7). The canonical component 1 opposes cluster 1 positioned in the negative part to cluster 3 positioned in the positive part (Figure 3). Cluster 2 is positioned between these two clusters. Cluster 1 comprised the varieties with higher germination rates.

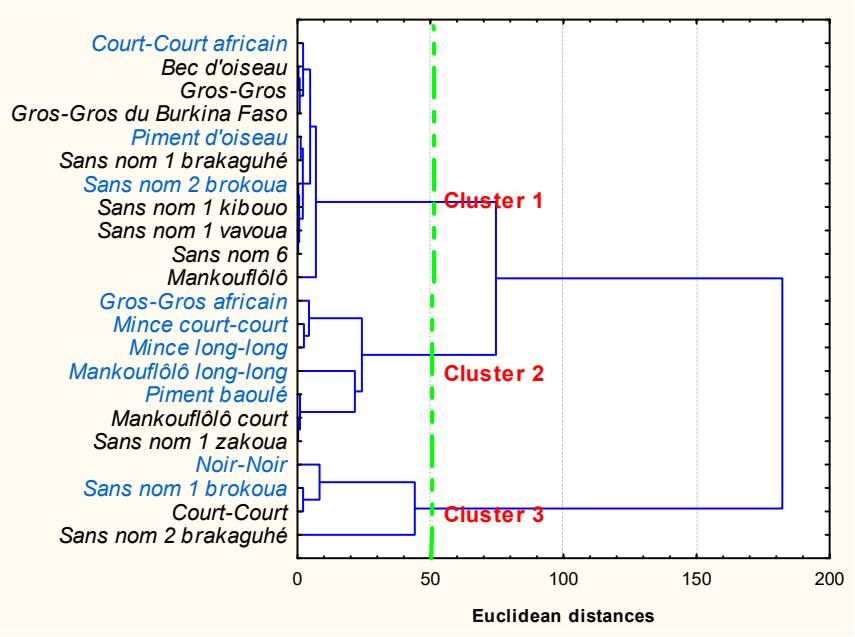

Figure 2 : Clusters of pepper varieties distinguished on the dendrgram generated using Method of Ward and Euclidean distance In blue, names of local varieties

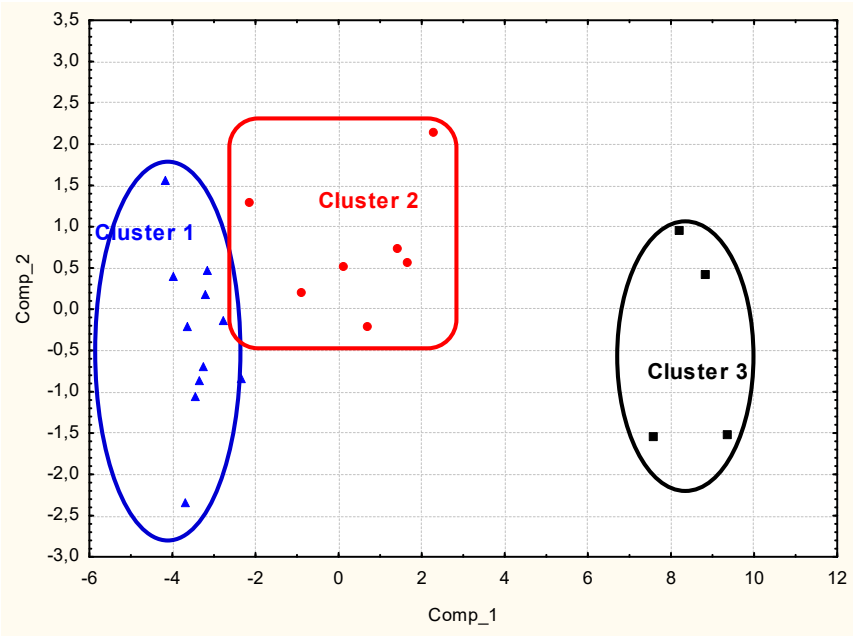

Figure 3. Projection of the three clusters of pepper varieties in canonical plane (1, 2)

DISCUSSION

Exotic varieties of pepper are much more cultivated than local ones. However, germination and growth difficulties seem to be linked to these improved varieties and whose magnitude, variables, state in relation to local varieties and betwen varieties are not established. To determine germination and early growth characteristics in the nursery, 24 local and exotic varieties were evaluated. In this evaluation, parameters values recorded were, on the one hand, quite heterogeneous (2.79 % ≤ CV < 26 %) for number of leaves, plantlet height, germination rate in local varieties, leaf length, leaf width and germination time in exotic varieties and, on the other hand, highly heterogeneous (26 % ≤ CV ≤ 66.67 %) for germination time and stem diameter in local varieties, germination rate and stem diameter in exotic varieties. Stem diameter exhibited the highest heterogeneity (CV = 58.33 % and 67 %). Regarding germination parameters, as a consequence of this strong heterogeneity, the analysis of variance of local and improved varieties showed highly significant differences ($p < 1$ %) for germination time and germination rate. These differences resulted in the distinction of 10 and height groups of varieties, respectively, for germination time and germination rate. In addition, the t test showed highly significant differences ($p < 1$ %) between local and exotic varieties for germination time and germination rate. For germination rate, it was observed that no seed germinated in two exotic varieties *Piment Noir* and *Sent bon*. Thus, the germination rate varied from 60 to 100 % in local varieties and from 0 to 100 % in exotic ones. On average, seeds of local varieties germinated better and much more (85.61 %) than those of improved varieties (76.19 %). Similar results were observed byAvinash *et al*. (2019) in rice. In pepper, Kpinkoun *et al*. (2018) observed 100 % germination for local cultivars and an improved variety with a longer germination time in the improved variety. About germination time, interval is quite the same (5 to 16 days after sowing) for local and exotic seeds. Nevertheless, seeds of local varieties germinated in a slightly shorter mean time (7.66 days) than that (8.82 days) of exotic seeds. In chilli pepper (*Capsicum* spp.), El Khaldi *et al*. (2021) found that local cultivars exhibited shortest mean germination time.

Also, Garané *et al*. (2018) noticed the late emergence of seedlings (15 days) in five varieties introduced in Burkina Faso. Concerning seedlings early growth, also as a consequence of the high heterogeneity of the values, analysis of variance showed highly significant ($p < 1$ %) differences among the 22 local and exotic varieties for stem diameter, plantlet height, leaf length and leaf width. These differences resulted in the distinction of two to five groups of varieties depending to the variable. However, the t test showed no significant difference ($p > 5$ %) between local and exotic varieties. El Khaldi *et al*. (2021) noticed, on the other hand, that local chili pepper cultivars exhibited highest mean plumule length. Likewise, Nsabiyera *et al*. (2013) observed significant differences ($p < 0.001$) among local and exotic genotyps for most quantitative characters, namely stem diameter, plant height. Otherwise, the 22 varieties studied were presented, by multivariate analyses (Hierarchical clustering analysis, Discriminant Factorial Analysis), in three clusters, each comprising both local and exotic varieties. These clusters differ on the significant values ($p < 5$ %) of the stem diameter and plantlet height, highly significant values of the germinate rate. Thus, a cluster comprising 11 varieties whose all seeds germinated (100 %), with lowest stem diameter value (0.11 cm) and highest plantlet one (3.16 cm) opposes another cluster of four varieties with weakest germination rate (65 %), highest average stem diameter (0.19 cm) and weak plantlet height (2.7 cm). These findings show two facts. One is that the germination parameters, particularly the germination rate, discriminate, on the one hand, between individual varieties and, on the other hand, between local and exotic varieties. The other fact is that the early growth parameters do not differentiate the local varieties from the exotic ones. Similar clusters composed of both local and exotic varieties or genotypes were also obtained in pepper by Asiimwe *et al*. (2021) but for nutritional quality and fruit shape. All the results obtained in this work open up prospects for regressive and inferential studies for plants growth and development and their production.

CONCLUSION

In this work, seeds did not germinate in two of the 14 exotic varieties. So germinate rate varied from 0 to 100 %, whereas it was 60 to 100 % in local varieties. Overall, the seeds of local varieties germinated better and much more on average (85.61 %) than in exotic varieties (76.19 %). Germination time interval is quite the same (5 to 16 days) for the two types of varieties. Also, the 22 varieties were highly significantly different ($p < 1$ %) for germination time, germination rate, stem diameter, plantlet height, leaf length and leaf width. In addition, local varieties are highly significantly different ($p < 1$%) from exotic ones only for germination time and germination rate. Seeds of local varieties germinated in a shorter average time (7.66 days) than those of exotic varieties (8.82 days). Otherwise, three clusters of varieties were distinguished significantly ($p < 5$%) for stem diameter and plantlet height, but highly significant ($p < 1$%) for germinate rate. Thus, a cluster composed of varieties whose all seeds germinated (100 %), with lowest stem diameter value (0.11 cm) and hjghest plantlet value (3.16 cm), opposed to another cluster encompassed varieties with weakest germination rate (65 %), highest average stem diameter (0.19 cm) and weak plantlet height (2.7 cm). This study demonstrates non-germination and very low germination in certain exotic improved varieties and also the shorter average germination time in local varieties. All these results open up perspectives for regressive and inferential evaluation of growth, development and production.

REFERENCES

Akaza, MJ., Yao, KAG., Gbotto, AA., Konkobo, KS., Akaffou, DS. 2022. Caractérisation de l'état des variétés de piment (*Capsicum* spp.) de la région du Haut-Sassandra en Côte d'Ivoire. *International Journal of Development Research*, 12(09) :58989-58994.

Anonymous, 2022. GPS coordinates of région du Haut-Sassandra, Ivory Coast. https://latitude.to/map/ci/ivory-coast/regions/region-du-haut-sassandra, visitedMonday15 august 2022 at 4 h 45 min am.

Avinash, S., Sheelawati, M., Devadas, VS., Boppa, L., Anchali, Y., Azizul, H. 2019. Determination of seed germination and seedling growth of local and exotic rice varieties with different water. *The Pharma Innovation Journal*, 8(5): 45-53.

Asiimwe, S., Ochwo-Ssemakula, M., Ssekkadde, P., Ribeiro, CS., Karungi, J. 2021. Nutritional quality, fruit shape and relationships among exotic and local *Capsicum* pepper genotypes in Uganda. *International Journal of Horticultural Science*, 27: 33-39.

Diarra, I., Dizoe, DF., Sarka, CGL.,N'da, L. Etude des opportunités de marché des culturesvivrières. Rapport final, PRO-PLANTEUR, 2017, 120 p. https://www.kakaoforum.de/fileadmin/Redaktion/Doloads/Oeffentliche_Downloads/Infomaterial/2018-01_FR_PRO-PLANTEURS_Etude_opportunites_de_marche.pdf

El Khaldi,R., Latifa, D., Houda B. 2021. Response of Oasian and exotic pepper (*Capsicum* spp.) cultivars from Tunisia to salt stress at germination and early seedling stages. J*ournal of horticulture and postharvest research*, 4(1) : 13-24.

Fondio, L., N'zi, J.-C., Kobenan, K. 2015. Comportement agronomique et sanitaire de nouvelles lignées de piment (*Capsicum* sp) dans le Sud de la Côte d'Ivoire. Journal of Applied Biosciences, 92 : 8594-8609.

Garané, A., Somé, K., Nikiema, J., Traoré, M., Sawadogo, M. 2018. Évaluation agro-morphologique de quelques variétés de poivron ou piment doux (Capsicum annuum L) au nord du Burkina Faso. *Journal of Applied Biosciences*, 130: 13245 – 13257.

Koffi, AC., Koffi-Nevry, R., Kouassi, KC., Loukou, YG. 2014. Activité des extraits de six variétés de piment (*Capsicum*) utilisés en Côte d'Ivoire. Journal of Applied Biosciences, 82 : 7379 - 7388.

Koffi-Nevry, R., Kouassi, C., Nanga, Z., Koussémon, M., Loukou, G. 2012. Antibacterial activity of two bell pepper extracts:*Capsicum annum* L. and *Capsicumfrutenscens*. International Journal of Food Properties, 15:961-971.

Kouamé, NF., Zoro, BIA. 2010. Nouveau découpage de la zone de forêt dense humide de la Côte d'Ivoire. Sciences & Nature, 7(2): 177 -194.

Kouassi, KC., Koffi-Nevry, R. 2012. Evaluation de la connaissance et utilisation des variétés de piment (*Capsicum*) cultivées en Côte d'Ivoire. International Journal of Biological and Chemical Sciences, 6(1) : 175-185.

Kouassi, KC., Coulibaly, B., Coulibaly, I., Koffi, AC., Koffi-Nevry, R. 2016. Antimicrobial Activity of the Varieties of Peppers (*Capsicum*) of Côte d'Ivoire on Multiresistant Strains. International Journal of Current Microbiology and Applied Sciences, 5(10) : 875-890.

Kpinkoun, KJ., Zanklan, AS., Montcho, D., Kinsou, E., Komlan, AF., Mensah C. GA., Wouyou, DA., Gandonou, CB. 2018. Response of Chili Pepper (*Capsicum spp.*) Cultivars Cultivated in Benin to Salt Stress at Germination Stage. *International Journal of Plant & Soil Science*, 23(3): 1-11,

Nsabiyera, V., Logose, M., Ochwo-Ssemakula, M., Sseruwagi, P., Gibson, P., Ojiewo, C. 2013. Morphological Characterization of Local and Exotic Hot Pepper (*Capsicum annuum* L.) Collections in Uganda. *Bioremediation, Biodiversity and Bioavailability,*7(1) : *22-32.*

Rci. Projet d'électrification rurale de 1 088 localités en Côte d'Ivoire. Plan cadre de gestion environnementale et sociale (pcges). Lot 4 : Sassandra-Marahoué (31), Yamoussoukro (01), lacs (93), zanzan (88), comoe (09), lagunes (09). Rapport final, République de Côte d'Ivoire, 2019, 169 p.

Sangare, A., Koffi, E., Akamou, F.,Fall, CA..*Etat des ressources phytogénétiques pour l'alimentation et l'agriculture; second rapport national*. Ministère de l'Agriculture, République de Côte d'Ivoire, 2009, 64 p.

SODEXAM, 2022. Climat en Haut-Sassandra (Côte d'Ivoire) : Températures moyennes diurnes et nocturnes. https://www.donneesmondiales.com/afrique/cote-divoire/climat-haut-sassandra.php, consulté le mercredi 17 aout 2022 à 01 h 05 min.

Zaki, N., Hasib, A., Dehbi, F., El Batal, H., Hakmaoui, A., Meftah, H., Hanine, H., Latrache, H., Ouatmane, A. 2018. Caractéristiques physicochimiques, nutritionnelles et antioxydantes du paprika produit par procédé semi-industriel à partir de la Niora (*Capsicum annuum* L.) cultivée dans trois régions Marocaines, Nature & Technology Journal. Vol. B : Agronomic & Biological Sciences, 19 : 01-12

Zou, Y., Ma, K., Tian, M. 2015. Chemical composition and nutritive value of hot pepper seed (*Capsicum annuum*)grown in Northeast Region of China.Food Science and Technology, 35(4): 659-663.

****