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Agronomic Performance of Genotypes [F1 and F2] of *Lagenaria siceraria* (Molina) Standl. to Insect Foliar Damage

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Lagenaria siceraria (Molina) Standley is a plant with high nutritional potential and high market value. However, production is relatively low due to foliar damage caused by insect pests. Two experimental were put in place during 2019 and 2020 in the village of Manfla approximately 400 km from of Abidjan in order to identify and select the most productive genotypes of *L. siceraria.* Thus, a

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comparative study of parental individuals P1 and P2, $F1_d$ hybrids, resulting from a direct crosses, hybrids $F1_{ind}$, from an indirect crosses and the segregating F2 population $F2_d$ and $F2_{ind}$ were carried out. Phenological and agronomic parameters of all plants were measured in the presence of insect pests. The results obtained showed that P2 individuals caused more than 90% of foliar damage compared to less than 25% for P1. The level of foliar damage of individuals resulting from the cross is closer to the parent that served as a female plant. Two groups were identified. The first group consisting of P1 and $F1_{ind}$ were distinguished by a low rate of foliar damage and by a high seeds number and fruits and seeds weight.

The second group composed of P2, $F1_d$, $F2_{ind}$ and $F2_d$ were characterized by a short reproductive cycle. However, a series of backcrossing, involving the F1 hybrid and the P2 parent, must be carried out in order to obtain early and productive individuals.

Keywords: Lagenaria siceraria; foliar damage; agronomic evaluation; F1 hybrid; F2 segregating population.

1. INTRODUCTION

*Lagenaria siceraria*is one of the most cultived cucurbitaceous vegetables around the world (Agata & Beata, 2020). It has two types of fruits. The calabash type is used as musical instruments, decorative objects or kitchen utensils (Fajinmi et al. 2022) and the oleaginous type, commonly known as "pistache" is consumed in sauce during traditional ceremonies (Zoro Bi et al. 2003). *L. siceraria* is used also in medicinal treatment (Zatout et al. 2023), in agronomy (Touré et al. 2021) and is a good source of protein and lipid (Syed et al. 2019; Mehboob et al. 2022).

Despite its importance, the production is low in Côte d'Ivoire (Dje Bi et al. 2017). This observation has been verified in Benin where the fruit number per plant does not exceed three (Achigan-Dako et al. 2006; Achigan-Dako et al. 2008). The relative weakness of *L. siceraria* production is caused by insect pests (Anzara et al. 2015).

The search for improved varieties capable of obtaining similar production in the presence and absence of pests is a considerable asset for farmers. Several improved varieties have been obtained through inter-varietal crosses of cultivated species, particularly in cowpea (Owusu et al. 2018; Oluwafemi et al. 2019), in melon (Adjoumani et al. 2016; Amanullah et al. 2021) and in tomato (Lokonga et al. 2020).

In *L. siceraria*, hybrids and segregating populations have also been obtained from crosses between oilseed and calabash types. These data made it possible to determine the heritability of qualitative parameters (Amangoua et al. 2018; Gaonkar et al., 2025) and the genetic determinism of tolerance to insect pests (Pitan et al. 2011; Anzara et al. 2015). However, the agronomic evaluation of such populations has not yet been addressed. Many studies have shown that hybrid varieties have recorded yields than local landraces (Chimonyo & Modi, 2013; Shivapriya et al. 2021; Saleem et al. 2024; Mashilo et al., 2017). Indeed, production of hybrids showed greater improvement for economic traits (Bekzod et al. 2024). Thus, the objective of this study was to identify genotypes (F1 or F2) with high agronomic potential to entomological pressure in order to optimize production.

2. MATERIALS AND METHODS

2.1 Materials

2.1.1 Study site

Experiments were conducted under field conditions during april to august respectively in 2019 and 2020 in the village of Manfla (6°49’34.38’’N, 5°43’47.68’’W), located in the department of Zuenoula, characterized by high production of cucurbits. This department is located in the Center-West of Côte d’Ivoire, approximately 400 km from of Abidjan (Fig. 1). The vegetation is of the wooded savannah type. The soil characteristics, at 20 cm depth, are as follows: pH = 6.45, with 57% sand, 36% silt, 7% clay, 6% organic matter, 3.5g/Kg of total N, 24.4g/Kg of available P and 0.45g/Kg of K (Kouassi & Zoro Bi, 2009).

2.1.2 Plant material

Two cultivated varieties calabash P1 (NI431) and oilseed P2 (NI227) were provided from four successive self-pollination. They were repectively characterized by a higher weight fruit and a short reproductive cycle. P1 and P2 were hybridized to generate the segregating populations. Both direct cross ($F1_d$) and reciprocal crosses ($F1_{ind}$) (Fig. 2) were made. These plants ($F1_d$ and $F1_{ind}$) were self-pollinated to generate respectively $F2_d$ and $F2_{ind}$. Experiment materials were composed of parental seeds P1 and P2, hybrids seeds $F1_d$, $F1_{ind}$ and segregating populations $F2_d$ and $F2_{ind}$.

2.2 Methods

2.2.1 Experimental design

Experiments were conducted in the first cropping season (March–july) respectively at 2019 and 2020 on an area measured 50 m x 30 m (1500 m^2). A total, 120 plants including 40 for parental genotypes (20 for P1 and 20 for P2), 40 hybrids F1 (20 $F1_d$ and 20 $F1_{ind}$) and 40 components of the F2 (20 $F2_d$ and 20 $F2_{ind}$) were used. Three seeds are sown per pocket on the same day on the entire plot. The seedlings were thinned after emergence in order to keep a single plant (the most vigorous). The planting distance was 3 m between and within rows with 1.5 m of edges. This distance makes it possible to take into account the creeping nature of the species which covers the ground very quickly. Manual weeding was carried out during plant development and no chemical product is applied during this experiment.

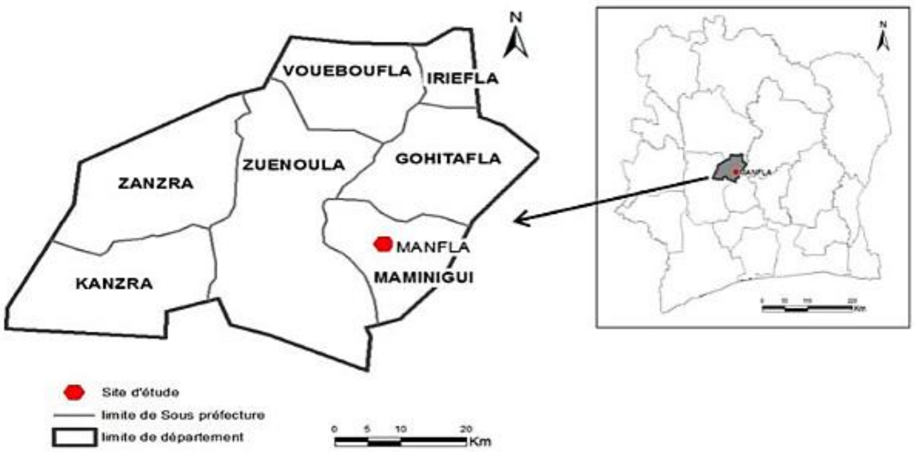

Fig. 1. Geographical location of the Manfla site (Monnier, 1983)

NI431 (male parent) **$F1_d$** **NI227 (female parent)**

A

NI227 (male parent) **$F1_{ind}$** **NI431 (female parent)**

B

Fig. 2. F1 hybrid obtained from an direct (A) and indirect cross (B) between NI227 and NI431

Table 1. Methods of measuring different parameters

Characters	Type and period of observation
Germination time (TG)	Number of days from sowing to cotyledonary leaf opening
Male flowering time (FM)	Number of days from sowing to first male flower opening per plant.
Female flowering time (FF),	Number of days from sowing to first female flower opening per plant.
Fruit Maturity Time (MF)	Number of days from sowing to first mature fruit per plant
Number of fruits per plant (FN)	Total number of fruits at plant maturity
Fruit weight (WF)	Weight of the mature fruits in gram
Seed Number (SN)	Total number of seeds per fruit
Seed Weight (WS)	Weight of seeds after drying in gram

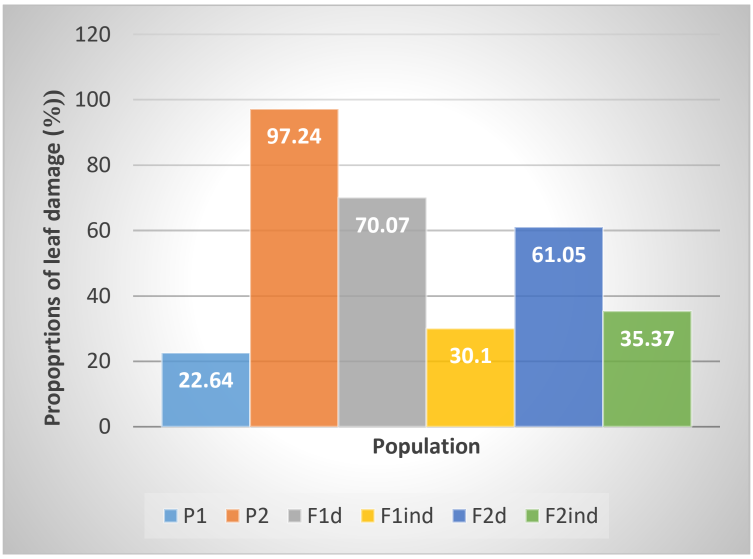

Fig. 3. Proportions of leaf damage according to populations

2.2.2 Morphological data

From sowing to harvest eight parameters have been collected on the 120 plants. It's about Germination Time (GT), Male flowering time (MF), Female flowering time (FF), Maturity Fruit time (MF), Fruit Number (NF), Fruit weight (FW), Seed Number (SN) and Seed Weight (SW) (Table 1) and Foliar Damage (FD). It was evaluated during the vegetative stage of the plant and calculated using the following formula: FD = nFa/nFt x 100 With nFa: number of leaves destroyed by insects; nFt: number of total leaves of a plant.

2.2.3 Statistical analysis

Comparison of the averages of the agronomic parameters was achieved between the different generations by variance analysis (ANOVA) at the 5% probability threshold. When a significant difference is noted between the factors considered for a given trait, the test of the smallest significant difference (ppds) HSD of TUKEY was performed. In order to determine the degree of divergence between the different populations a hierarchical classification on the collected data were carried out. All these analyses were carried out with the software Stastistica version 7.1.

3. RESULTS AND DISCUSSION

3.1 Foliar Damage of Different Populations

Several plant reactions were observed following insect damage. Some populations were less attacked than others (Fig. 3). Parental individual P2 recorded the most destroyed leaves (97.24%) followed respectively by $F1_d$ (70.07%), $F2_d$ (61.05%); $F2_{ind}$ (35,7 %) and $F1_{ind}$ (30.1%). Another parental individual P1 caused the least foliar damage (22.64%).

The response of parental individuals P1 and P2 as being respectively tolerant and sensitive to insects carried out by Anzara et al. 2020 were confirmed in this study. This study showed that populations react differently to insect attacks. The herbivorous insects preferred some populatin than others. Similar observations were reported by Adja et al. (2015) who showed that the level of insect damage varied from plants within species and from one species to another. When the female parent was P1 (NI431), foliar damage of $F1_{ind}$ and $F2_{ind}$ was also lower and less than 40%. When the female parent was P2 (NI227), foliar damage of $F1_d$ and $F2_d$ were above 60%. Intensities of hybrids and segregating populations damage foliar were closer to that of the parents that served as female plants. This indicates the presence of maternal or cytoplasmic factors in the control of tolerance against foliar damage. Several studies have also shown the maternal effect in the transmission of certain traits in cultivated species (De Castro et al., 2013; Oluwafemi et al., 2019).

3.2 Comparison of Agronomic Parameters of Different Generations

Analysis of Variance carried out between the six generations revealed a significant difference existed for all phenological parameters excepted Germination Time (GT) (Table 2). Seeds of all the generations germinated in five days. Analysis test indicated that Male and Femelle Flowering time (FF) and Mature Fruit Time (MFT) were longger for the P1 than the other generations. The parental individuals P1 therefore had a long reproductive cycle (122 days). It was followed by $F1_{ind}$ which reached maturity 15 days earlier and then respectively by $F2_{ind}$, $F2_d$ and $F2_{ind}$. The parental individuals P2 quickly reached fruit maturity at 63 days and only 32 days for Male Flowering (MF). It therefore had a short reproductive cycle. No individual resulting from the cross between these two individuals produced a shorter reproductive cycle than P2. However, varieties cultivated with a short reproduction cycle are recommended in agriculture in order to allow producers to quickly obtain profits to meet their financial needs (Doumbia et al. 2013).

Statistical tests showed also a significant difference of agronomic parameters between the different populations (Table 2). The parental individual P1 recorded a lower Fruit Number harvested with two fruits per plant. Those of P2 obtained the lightest fruits (six fruits). Fruit Number of others popultations ($F1_{ind}$, $F2_{ind}$, $F1_d$ and $F2_d$) varied between two to three. On the other hand, the fruit number and the fruit weight per plant were above in P1 and $F1_{ind}$ than the other populations.This showed that the weight of a plant's fruit is not related to the number of fruits. A positive correlation was also observed between the number of seeds per fruit with total fruit mass (Koffi et al. 2009; Majid et al. 2020; Ezin et al. 2022).

Seeds Weight were higher for P1 followed by $F1_{ind}$, $F2_{ind}$, $F1_d$, $F2_d$ and P2. The significant drop in seed production of populations P2, $F1_d$ and $F2_d$ would be due to the increased damage caused to these populations by insects. The degree of association estimated by the Pearson *r* correlation coefficient between foliar damage and and Seed Weight was 0,711. Thus, plants with the most leaf damage recorded a low Seed Weight. Correlation between insect damage and Seed Weight observed in this study has been verified in several studies, including melon (Edelson et al. 2003), cowpea (L.) Walp (Rahman et al. 2008) and corn (Barimavandi et al. 2010). Indeed, leaves are important for photosynthesis, which is the major process regulating plant growth. The productivity of a plant depends on the efficiency of its photosynthetic processes and therefore on the size of its photosynthetic surface (Karadogan & Akgün, 2009).

3.3 Structuring of Agronomic Parameters and Generations

Examination of the factor weight matrix made it possible to retain the first two axes which expressed 74.28% (Table 3). These first two axis can therefore be retained for the interpretation of our results since they bring together the greatest variability. Eight descriptors contributed significantly to the formation of the two axis. The first axis (62.20%) is defined by percentage of Foliar Damage which is positively correlated with this axis. It was also defined by the Seeds Number, Fruits Weight, Seeds Weight, Male and Female Flowering time and Fruit Maturity time. These parameters were however negatively correlated to this axis. These different parameters represented the phenological and agronomic parameters of plants. Fruit Number was the variable that contributed mainly to the formation of the second axis which explains 12.087% of the total variability. This variable is positively correlated with axis 2.

Table 2. Comparison of populations according to phenological and agronomic parameters

Population	Germination Time (j)	Male Flowering (j)	Female Flowering (j)	Fruit Maturity (j)	Fruit Number	Fruit Weight (g)	Seed Weight (g)	Seed Number
P1	5,65 ± 0,68[a]	74,48 ± 6,90[d]	98,05 ± 9,19[f]	122,55 ± 5,14[f]	2,15 ± 1,13[a]	1536,25 ± 380,5[d]	65,00 ± 14,18[d]	307,55 ± 74,83[c]
P2	5,60 ± 0,50[a]	32,05 ± 1,19[a]	41,25 ± 1,90[a]	63,15 ± 3,85[a]	6,05 ± 0,88[c]	641,25 ± 193,0[a]	31,67 ± 5,52[a]	122,8± 29,91[a]
$F1_d$	5,60 ± 0,68[a]	35,50 ± 3,79[a]	51,25 ± 4,84[b]	74,85 ± 5,14[b]	2,20 ± 0,41[a]	703,75 ± 244,58[b]	40,32 ± 5,28[b]	229,9± 38,10[b]
$F1_{ind}$	5,45 ± 0,60[a]	65,85 ± 9,51[c]	90,35 ± 9,57[e]	107,70 ± 13,20[e]	3,05 ± 0,68[b]	1510,00 ± 63,03[d]	68,72 ± 12,51[d]	313,05 ± 79,61[c]
$F2_d$	5,95 ± 0,82[a]	33,70 ± 4,18[a]	57,30 ± 7,73[c]	81,70 ± 12,32[c]	2,35 ± 0,58[a]	725,00 ± 187,60[b]	43,29 ± 6,88[b]	208,00 ± 30,41[b]
$F2_{ind}$	5,80 ± 0,69[a]	38,90 ± 5,86[b]	65,80 ± 7,03[d]	97,75 ± 9,48[d]	2,25 ± 0,55[a]	1045,00±354,35[c]	54,68 ± 13,45[c]	268,7± 59,28[b]
F	1,36	198,65	191,91	117,35	83,08	49,42	39,83	32,76
p	0,24	< 0,001	< 0,001	< 0,001	< 0,001	< 0,001	< 0,001	< 0,001

Mean values followed by the same superscript were not significantly different (p≥ 0.05)

Table 3. Eigenvalue matrix and percentage variation expressed by the principal axes of the PCA

Principal component	Axis 1	Axis 2
Eigenvalue	5,598	1,087
Total variance (%)	62,201	12,087
Total cumulative variance (%)	62,201	74,289
Foliar Damage	0,908	0,191
Fruit Number	0,537	0,795
Seed Number	-0,765	-0,217
Fruit weight	-0,837	0,256
Seed Weight	-0,816	0,077
Fruit Maturity Time	-0,923	0,074
Male flowering time	-0,883	0,320
Female flowering time	-0,946	0,147

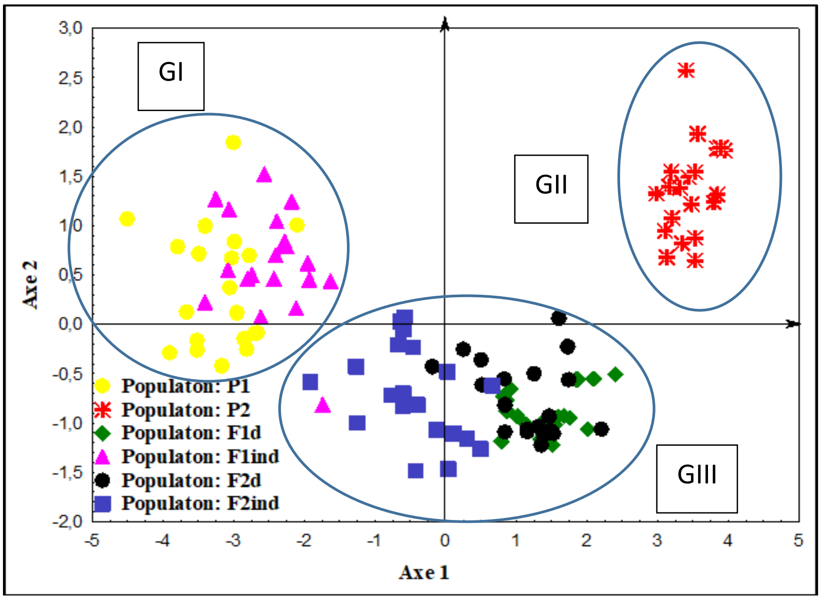

Fig. 4. Distribution of individuals in plane 1-2 revealed from PCA in the six populations of *Lagenaria siceraria*

Principal Component Analysis allowed to establish the existing relationship between the tested parameters and the different populations of the six populations allowed to establish the existing relationship between the different populations (Fig. 4). This analysis allowed to structure the populations into three groups. Group I composed of P1 and $F1_{ind}$ populations and was characterized by high agronomic parameters. Group II composed of P2 individuals was characterized by precocity with a high number of fruits. And group III composed of $F1_d$, $F2_{ind}$ and $F2_d$ had intermediate values.

In order to group the different populations into relatively homogeneous groups based on the similarities between them, the Hierarchical Ascending Classification (HAC) was used. The dendrogram produced highlighted two main groups). The two groups GI were composed of P1 and $F1_{ind}$. Group II is divided into two subgroups, the first subgroup consists of the P2 and the second, of the $F1_d$, $F2_{ind}$ and $F2_d$ populations (Fig. 5). The hierarchical classification analysis nevertheless associated the last two groups into one. Indeed, the phenological and agronomic parameters of group II (F2 population) are close to group III ($F1_d$, $F2_{ind}$ and $F2_d$).

$F1_{ind}$ hybrids with a low rate of foliar damage and high fruit and seed weights are recommended. However, back-crosses must be carried out in order to obtain individuals with these characteristics with a short reproduction cycle.

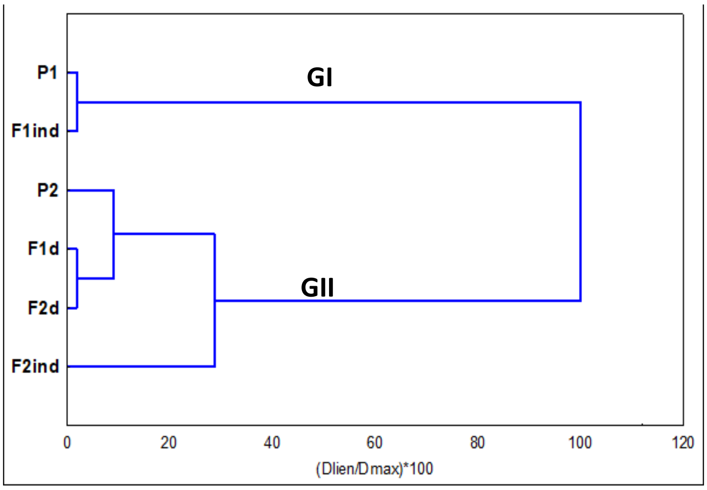

Fig. 5. Dendrogram (UPGMA) of the six populations of *Lagenaria siceraria*

4. CONCLUSION

In conclusion, comparative study of the agronomic performance of parental individuals (P1 and P2), hybrids ($F1_d$ and $F1_{ind}$) and segregating populations ($F2_d$ and $F2_{ind}$) in the presence of insect pests was carried out to identify and select the most productive genotypes. It emerges from this work that parental individuals P1 and P2 were identified as late and early respectively. Two groups of these evaluated populations were identified. The first group consisting of P1 and $F1_{ind}$ were distinguished by a low rate of foliar damage and by a high seeds number and fruits and seeds weight and the second group consisting of P2, $F1_d$, $F2_{ind}$ and $F2_d$ were characterized by a short reproductive cycle.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Achigan-Dako, E. G., Fagbemissi, R., Avohou, H. T., Vodouhe, R. S., Coulibaly, O., & Ahanchede, A. (2008). Importance and practices of *Egusi* crops (*Citrullus lanatus* (Thunb.) Matsum. & Nakai, *Cucumeropsis mannii* Naudin, and *Lagenaria siceraria* (Molina) Standl. cv. 'Aklamkpa') in socio-linguistic areas in Benin. *Biotechnology, Agronomy, Society and Environment, 12*(4), 393–403. https://popups.uliege.be/1780-4507/index.php?id=3254

Achigan-Dako, G. E., Fanou, N., Kouke, A., Avohou, H., Vodouhe, R. S., & Ahanchede, A. (2006). Agronomic evaluation of three species of *Egusi* (*Cucurbitaceae*) used in feed in Benin and development of a yield prediction model. *Biotechnology, Agronomy, Society and Environment, 10*(2), 121–129.

Adja, N. A., Danho, M., Alabi, T. A. F., Gnago, A. J., Zimmer, J. Y., Francis, F., Kouassi, P., Baudoin, J. P., & Zoro Bi, I. A. (2015). Entomofauna associated with African oleaginous cucurbits (*Lagenaria siceraria* Molina (Standl. 1930) and *Citrullus lanatus* Thumb (Matsum & Nakai 1916)) and impact of pests on production. *International Journal of Entomology, 50*(3–4), 301–310. https://doi.org/10.1080/00379271.2014.937104

Adjoumani, K., Kouonon, L. C., Koffi, G. K., Bony, B. S., Brou, K. F., Akaffou, D. S., & Sie, R. (2016). Analysis on genetic variability and heritability of fruit characters in *Citrullus lanatus* (Thunb.) Matsumura and Nakai (*Cucurbitaceae*) cultivars. *Journal of Animal and Plant Sciences, 28*(1), 4340–4355. http://www.m.elewa.org/JAPSISSN 2071-7024.

Agata, R. M., & Beata, O. (2020). Vegetables from the *Cucurbitaceae* family and their products: Positive effect on human health. *Nutrition, 78*, 110788.

Amangoua, F., Koffi, K. K., Baudoin, J. P., & Zoro Bi, I. A. (2018). Inheritance of fruit neck, rind and seed coat hardness, and seed coat color in bottle gourd. *South African Journal of Plant and Soil, 36*(1), 1–8. https://doi.org/10.1080/02571862.2018.1484191

Amanullah, S., Gao, P., Osae, B. A., Saroj, A., Yang, T., Liu, S., Weng, Y., & Luan, F. (2021). Genetic linkage mapping and QTLs identification for morphology and fruit quality-related traits of melon by SNP-based CAPS markers. *Scientia Horticulturae, 278*, 109849. https://doi.org/10.1016/j.scienta.2020.109849

Anzara, G. R., Angui, M. V. J., Doubi Bi, T. S., Akaffou, S. D., & Zoro Bi, I. A. (2020). Genetic determinism of *Lagenaria siceraria* (Molina) Standley (*Cucurbitaceae*) tolerance to insect pests and search for gene-associated SSR microsatellite markers. *European Scientific Journal, 17*(10), 233–248. https://doi.org/10.19044/esj.2021.v17n10p233

Anzara, K. G. G. R., Koffi, K. K., Coulibaly, S. S., Fouha Bi, D. N., Baudoin, J. P., & Zoro Bi, I. A. (2015). Influence of herbivorous insects on the production of *Lagenaria siceraria* (Molina) Standley (*Cucurbitaceae*). *African Journal of Plant Science, 9*(11), 449–456. https://doi.org/10.5897/AJPS2015.1316

Barimavandi, A. R., Sedaghathoor, S., & Ansari, R. (2010). Effect of different defoliation treatments on yield and yield components in maize (*Zea mays* L.) cultivar of S.C704. *Australian Journal of Crop Science, 4*(1), 9–15.

Bekzod, N., Alisher, A., Orip, K., Kholygit, R., Mirvakhob, M., & Isfandiyar, K. (2024). Inheritance of morpho-economic traits in F1-F2 progeny of cotton. *E3S Web of Conferences, 538*, 04023. https://doi.org/10.1051/e3sconf/202453804023

Chimonyo, V. G. P., & Modi, A. T. (2013). Seed performance of selected bottle gourd (*Lagenaria siceraria* (Molina) Standl.). *American Journal of Experimental Agriculture, 3*, 740–766. https://doi.org/10.9734/agea/2013/4114

De Castro, M. P., Baldin, E. L. L., Criz, P. L., De Souza, C. M., & De Silva, P. H. S. (2013). Characterization of cowpea genotype resistance to *Callosobruchus maculatus*. *Brasilia Agricultural Research, 48*(9), 1201–1209. https://doi.org/10.1590/S0100-204X2013000900003

Dje Bi, I. R., Kouassi, K. I., Koffi, K. K., Kouakou, K. L., Baudoin, J. P., Bi Irie, A., & Zoro Bi, I. A. (2017). Effect of seed dates on agronomic performance of *Lagenaria siceraria* (Molina) Standl. (*Cucurbitaceae*) and *Manihot esculenta* Crantz (*Euphorbiaceae*) in associated culture. *Biotechnology, Agronomy, Society and Environment, 21*(4), 240–250. https://doi.org/10.25518/1780-4507.13772

Doumbia, I. Z., Akromah, R., & Sisibuo, J. Y. (2013). Comparative study of cowpea germplasm diversity from Ghana and Mali using morphological characteristics. *Journal of Plant Breeding and Genetics, 1*(3), 139–147.

Edelson, J. V., Duthie, J., & Roberts, W. (2003). Watermelon growth, fruit yield and plant survival as affected by squash bug (*Hemiptera: Coreidae*). *Journal of Economic Entomology, 96*(1), 64–70. https://doi.org/10.1093/jee/96.1.64

Ezin, V. G. U., & Ahanchede, A. (2022). Characterization of cultivated pumpkin (*Cucurbita moschata* Duchesne) landraces for genotypic variance, heritability and agro-morphological traits. *Saudi Journal of Biological Sciences, 29*(5), 3661–3674. https://doi.org/10.1016/j.sjbs.2022.02.057

Fajinmi, O. O., Olaoluwa, O., Olarewaju, G. D., Authur, R. M., & Coopoosamy, K. N. (2022). A review of the relevance of bottle gourd in Eastern and Southern African traditional music, and social life. *Journal of Medicinal Plants for Economic Development, 6*(1), 1-8. https://doi.org/10.4102/jumped.v6i1.141

Gaonkar, V. V., Bahadur, V., Topno, S. E., & Kerketta, A. (2025). Performance of bottle gourd (*Lagenaria siceraria* L.) genotypes for yield and quality under climatic conditions of Prayagraj. *International Journal of Environment and Climate, 13*(8), 1379-1387. Available from: https://journalijecc.com/index.php/IJECC/article/view/2083

Karadogan, T., & Akün, I. (2009). Effect of leaf removal on sunflower yield and yield components and some quality characters. *Helia, 32*(50), 123-1. https://doi.org/10.2298/HEL0950123K

Koffi, K. K., Anzara, G. K., Malice, M., Djè, Y., Bertin, P., Baudoin, J. P., & Zoro Bi, I. A. (2009). Morphological and allozyme variation in a collection of *Lagenaria siceraria* (*Molina*) Standl. from Côte d'Ivoire. *Biotechnology, Agronomy, Society and Environment, 13*, 257-270.

Kouassi, N. J., & Zoro, I. A. (2009). Effects of sowing density and seedbed type on yield and yield components of Bambara groundnut (*Vigna subterranea*) in woodland savannas of Côte d'Ivoire. *Experimental Agriculture, 46*(1), 99-110. https://doi.org/10.1017/S0014479709990494

Lokonga, O. J., & Muhuza, M. K. (2020). Effect of pig manure on the yield of two hybrid genotypes F1 (Mongal and Thorgal) exotic tomatoes (*Solanum lycopersicum* L.) cultivated under cover at Kisangani (DR Congo). *International Journal of Innovation and Scientific Research, 48*(2), 225-248.

Majid, R., Hussain, K., Syed, M. H., Syeda, F., Insha, J., Amreena, S., Syed, A., Afroza, A., Muzamil, A., & Sameena, M. (2020). Comparative performance of various bottle gourd [*Lagenaria siceraria* (*Molina*) Standl.] genotypes. *International Journal of Current Microbiology and Applied Sciences, 9*(06), 371-375. https://doi.org/10.20546/ijcmas.2020.906.048

Mashilo, J., Shimelis, H., & Odindo, A. (2017). Phenotypic and genotypic characterization of bottle gourd (*Lagenaria siceraria* (*Molina*) Standl.) and implications for breeding: A review. *Scientia Horticulturae, 222*, 136-144.

Mehboob, M., Irum, N., Aisha, S., & Ayesha, A. (2022). Medicinal and nutritional importance of *Lagenaria siceraria* (Lauki). *Saudi Journal of Biomedical Research, 72*, 67-73. https://doi.org/10.36348/sjbr.2022.v07i02.001

Monnier, Y. (1983). *Vegetation map of the Ivory Coast*. Young Africa. Paris (France), pp 1-72

Oluwafemi, D. A., Ogunkanmi, A. L., Adetumbi, J. A., Solomon, T., Akinyosoye, & Oluwatoyin, T. O. (2019). Morpho-genetic variability in F2 progeny cowpea genotypes tolerant to bruchid (*Callosobruchus maculatus*). *Journal of Agricultural Sciences, 64*(1), 53-68. https://doi.org/10.2298/JAS1901053A

Owusu, E. Y., Akromah, R., Denwar, N. N., Adjebeng-Danquah, J., Kusi, F., & Haruna, M. (2018). Inheritance of early maturity in some cowpea (*Vigna unguiculata* (L.) Walp.) genotypes under rain-fed conditions in Northern Ghana. *Advances in Agriculture*, (1), 1-10. https://doi.org/10.1155/2018/8

Pitan, O. O. R., & Ekoja, E. E. (2011). Yield response of okra, *Abelmoschus esculentus* (L.) Moench to leaf damage by the flea beetle, *Podagrica uniforma* Jacoby (*Coleoptera*: Chrysomelidae). *Crop Protection, 30*, 1346-1350.

Rahman, A. H. M. M., Anisuzzaman, M., Ahmed, F., Islam, A. K. M. R., & Naderruzzaman, A. T. M. (2008). Study of nutritive value and medicinal uses of cultivated cucurbits. *Journal of Applied Sciences Research, 4*(5), 555-558. https://www.researchgate.net/publication/269571068

Saleem, M. A., Anwar, S., Khan, M. Y., Saleem, A. S., Khan, M. S., Rahman, S. U., Khattak, L., Khan, A., Murad, S., Noor, E., & Khan, K. A. (2024). A comparative analysis of local maize hybrids versus commercial maize hybrids: Assessing yield and yield components. *International Journal of Sustainability in Research, 2*(1), 133-146. https://doi.org/10.59890/ijsr.v2i1.954

Shivapriya, M., Mamatha, S., Umesha, K., & Lingaiah, H. B. (2021). Genetic variation in melon (*Cucumis melo* L.) landraces and wild relatives of Karnataka state of southern India. *Plant Genetic Resources, 19*(5), 419-427. https://doi.org/10.1017/S1479262121000496

StatSoft. (2005). *Statistics for Windows* (Version 7.1). StateSoft Inc.

Syed, Q. A., Akram, M., & Shukat, R. (2019). Nutritional and therapeutic importance of pumpkin seeds. *Medical Treatment. Journal of Scientific and Technical Research, 21*, 15798-15803. https://doi.org/10.26717/BJSTR

Toure, A. I., Tovignon, G. C. Z., Mboko, A. V., Kimse, M., Matumuini, F. N., Doubi, B. T. S., Tro, H. H., Zoro Bi, I. A., & Boukila, B. (2021). Effects of dehulled seed pellets of bebu cultivar of *Citrullus lanatus* and

Lagenaria siceraria on growth performances of broiler. *International Journal of Biological and Chemical Sciences, 15*(4), 1494-1510. https://doi.org/10.4314/ijbcs.v15i4.16

Zatouta, N., Alshaikha, S., & Sallama, H. (2023). Phytochemical and biological activities of *Lagenaria siceraria*: An overview. *Egyptian Journal of Chemistry, 66*(10), 479-495.

Zoro Bi, I. A., Koffi, K. K., & Dje, Y. (2003). Botanical and agronomic characterization of three cucumber species consumed in sauces in West Africa: *Citrullus* sp., *Cucumeropsis mannii* Naudin, and *Lagenaria siceraria* (*Molina*) Standl. *Biotechnology, Agronomy, Society and Environment, 7*(3-4), 189-199.

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