Comparative studyof the agronomic performance of two sesame varieties (*Sesamum indicum L.*): The case of local variety of Central African origin and Pakréssaya variety of Burkinabe origin

ABSTRACT

Sesame (*Sesamum indicum L*) is a crop with high economic potential in Central African agriculture. This speculation is the subject of a booming international trade for its seeds, oil and meal. The objective of this study is to characterize the agro morphological variability of the two sesame accessions. The trial was conducted at the Bakéré Agricultural Research Station in Bossembele. The plant material used was composed of two sesame accessions from various sources (Central African Republic and Burkina Faso). The choice of land is marked by the delimitation of the plot, the staking and the surveying.The preparation of the soil was carried out in several stages. It is a plot of land of 0.75 hectares divided into three blocks of 0.25 hectares. Sowing took place on August 20, 2022. Before sowing, the sesame is mixed with the sand to respect the rate per hectare because the seeds are too fine. The different parameters measured are: stem length, number of branches per plant, number of pods per plant.The different parameters were assessed using the two-criteria analysis of variance (ANOVA) with the R software version 3.1.3. The results obtained showed that the Pakressaya variety is the earliest and gave the first flower at 31-32 days after sowing and reached 50% flowering at 33-34 days after sowing, thus reflecting the earliness in this variety.The variety(of Central African origin) is the latest and gave the first flower at 52-53 days after sowing and reached 50% flowering at 56-57 days after sowing with many more fruiting branches. The pakressaya variety proved to be productive and was selected for the rest of our project.In perspective, it is envisaged to determine the genetic diversity of the Pakréssaya accession using microsatellite markers.

Keywords: Sesame, Pakréssaya variety, Local variety, Agronomic performance.

1. INTRODUCTION

Sesame (*Sesamum indicum. L*) is a crop with high economic potential in Central African agriculture [1]. This speculation is the subject of a booming international trade for its seeds, oil and meal [2]. Its production improves purchasing power in rural areas and strengthens the empowerment of women, who are the main sesame-producing strata [3].The demand for sesame seeds is increasing on the world market. Indeed, the price per tonne of sesame seeds fluctuates between €269 on average in West Africa (Mali, Niger, Gambia) and more than €6,697 in the Republic of South Korea [4]. It has grown significantly in more than 60 countries but the largest producers are Asian (India 22%, China 21%, Myanmar 12%).In Africa, sesame is grown in 23 countries, the three (3) largest producers of which are Sudan, Uganda and Nigeria. Sesame production on the continent accounted for 45% of global production in 2020 [5]. This crop requires less agricultural fertilizers and can be installed as soon as the first rains fall, it is adapted to the current conditions of climatic variability. In addition, its leaves contribute to the regeneration of soil fertility [6].Sesame has a high nutritional value, being rich in fatty acids (45 to 55%), protein (19 to 25%) and minerals (Ca, P, Mg, Fe, Zn) [7], as well as vitamins (B and K) [8]. It belongs to the class Dicotyledons or Eudicotyledons, the order Lamiales, the family Pedaliaceae and the genus Sesameae [9]. Sesame production in the Central African Republic faces not only diseases and pests but also a lack of scientific expertise on the profitability of sesame production in the Central African Republic, the varietal selection of species and export opportunities on the world market. The improvement of this crop requires a great genetic exploration of local varieties. There are few references to the genetic diversity of cultivated species in the Central African Republic.

The objective of this work is to evaluate the agronomic performance of sesame variety (of Central African origin) grown in the Central African Republic and pakressaya varietyimported from Burkina Faso.

2. MATERIALS AND METHODS

2.1. Choice of Study Area

The trial was conducted at the Bakéré Agricultural Research Station in Bossembele. It is a station created in 1985 by PRODEROM (Rural Development Project of Ombella-M'poko). This station was chosen because it was an experimental support point for food crops.It is also a training center for harness farming that the Central African Institute for Agricultural Research (I.C.R.A) has set up as an agricultural research station. In addition, it is a savannah area very favourable to the cultivation of sesame.

The test was conducted at the Bakéré Agricultural Research Station (SRA) (05°04' South latitude, 018°49' East longitude and 499 m altitude) in the Ombella M'poko region. It is a tropical climate with two main seasons (the rainy season from March to April and from October to November and the dry season from November/December to February). The soil is of the dior modal type with a light texture, with 95% sand, 3.5 to 6% clay and 1.7 to 2.8% silt [10].It is a station created in 1985 by PRODEROM (Rural Development Project of Ombella-M'poko). This station was chosen because it was an experimental support point for food crops. It is also a training center for harness farming that the Central African Institute for Agricultural Research (I.C.R.A) has set up as an agricultural research station. In addition, it is a savannah area very favourable to the cultivation of sesame.

2.2 Vegetable Materials

Table 1.Descriptive table of the two accessions studied

Variety	Genetic nature (NGq)	Origin & Year of release	Date of introduction or registration in CAR	Cycle (days)	Height of Plants (cm)	100 seed weight (g)	Colour of seed	Seed Texture	Potential Yield (t/ha)	Organoleptic characteristics and suitability for processing
Pakréssaya	composite	Burkina fasso	2021	90	100	0.35	white	smooth	1 à 1.5	Good drought resistance, susceptible to lodging
Local variety	Composite	Inde	1970	120	90	0.24	white	smooth	0.6à 1	Less demanding of agricultural fertilizers

2.3 Experimental set-up And Measured Parameters

The experimental set-up was complete blocks randomized to two (2) replicates, whose elementary plots were 0.25 m long and 0.25 m wide, i.e. a usable area of 0.25 m² per plot. The factor studied was variety at different levels. The preparation of the seedbed consisted of clearing and removing the stumps from the previous crop, followed by hoeing and weeding. The sowing was carried out on August 20, 2022. It was practiced in rows using a tape to better respect the spacing recommended by the experimental protocol, which is 0.20 m between the rows and 0.60 m between the poquets, which corresponds to a seeding density of 62250 poquets. A first weeding was carried out 15 days after sowing, and a second weeding, 35 days after sowing. Three weeks after emergence, the plants were unmarried to four plants per patch.Measurements and observations were made on the center lines of the elementary plot. Comments focused on lifting; the sowing-flowering time, considered to have been reached when 50% of the plants in an elementary plot have flowered; the height of the plants.measured using a ruler; the number of days from sowing to physiological maturity, which is achieved when the basal leaves turn yellow, fall off, and the capsules turn yellow for three-quarters (3/4) of the plant's height. At harvest, the number of capsules per plant (on 10 plants per plot randomly drawn), and the number of seeds per capsule (on 3 batches of 5 capsules)[11].

2.4 Data Analysis

The agronomic performance of the Pakressaya and Localvariety were evaluated in October and December on the 3 blocks. The data relating to the height of the plants, the number of branches and the number of pods per plant.

Plant height follows a normal distribution for the Pakressaya variety(Shapiro-Wilk normality test, W = 0.9, P = 0.25) and for the Localvariety (W = 0.89, P = 0.4), so Student's test was used to compare averages between varieties in October. On the other hand, the numbers of branches are not normally distributed in the Pakressaya accession (W = 0.60456, P < 0.0001)

and in the Localvariety(W = 0.79, P<0.0001), so the Wilcoxon test is used for comparison.Data were also pooled for the 3 blocks as no statistical differences were observed between the blocks.

Since the pods appear late (December) in the local breeding, it is reasonable to compare their average numbers even at different periods as getting an idea of this aspect of agronomic performance is needed. The Wilcoxon test was then used for this as the number of pods do not follow normal distribution in the Pakressaya variety(W = 0.84, P = 0.04) and in the Locale variety (W = 0.79, P<0.0001). Data were presented as mean ± SD. The differences are significant at the probability level of 0.05.

3. Results and Discussions

3.1 Lifting

Emergence was homogeneous and lasted 3 days for all varieties, confirming the good quality of the seeds used. Germination of superficially sown viable seeds (1 to 2 cm) takes place between 3 and 10 days. However, it is strongly influenced by the water status of the soil, the temperature of the seedbed and certain atmospheric characteristics [12].

3.2 Flowering

Flowering takes place 34 days after sowing for Pakressayavariety and 45 days after sowing for local accession. Phenological characterization showed that Pakréssaya accession of Burkinabe origin is the earliest with a cycle of 90 days while local variety is late with a cycle length of more than 120 days.Sesame is a short-day plant, which can normally flower after 42 to 45 days after sowing with an illumination duration of 10 hours ([13], [14]).

3.3 Plant Height

The agronomic performance of the Pakresaya and Locale varieties was evaluated in October and December on the 3 blocks. Data for the Pakresaya variety were collected only in October on Block 1. The data relating to the height of the plants, the number of branches and the number of pods per plant. Plant height **(Fig. 1)** follows a normal distribution, sothe Student's test was used to compare averages between varieties in October. On the other hand, the numbers of branches are not normally distributed in the two varieties; the Wilcoxon test is then used for comparison. In the graph above, measured in October 2020, the Pakressaya variety has a higher height (69.6±12.7) than the Locale variety (49.7±10) with a significant difference (t = 4.3204, df = 15,P<0.001). This difference could be due to the difference in seeding density which was four plants per patch in our study. This certainly did not allow the plants to express their development potential to the best given the competition for the nutrient resources present in the soil. These results corroborate those of Macoumba, for whom the height of the plant would be between 70 and 200 cm and the degree of branching between 16 and 81 branches [15]. According to the INTERNATIONAL TRADE CENTRE, Sesamum indicum is a small annual plant with a height of between 60 and 200 cm depending on the variety [16]. In addition, plant height had a negative effect on grain yield. This seems to be the case with Amoukou and his collaborators [17]. Furthermore, Boureima states that this finding could be attributed to the insertion height of the first capsule on the main stem, which is generally long in late varieties [18].

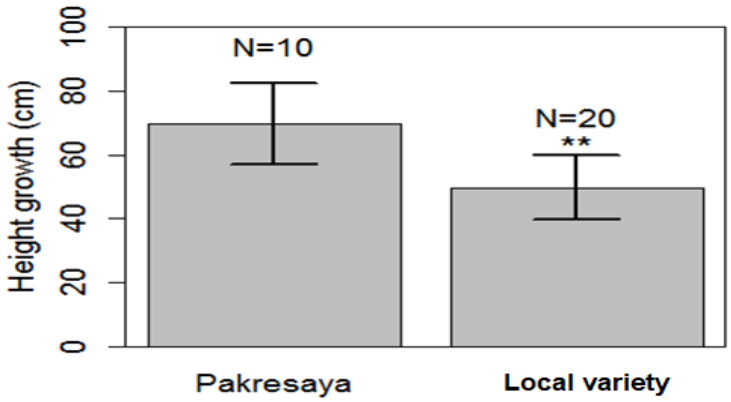

Fig.1.Plant height. Asterisks indicate statistical difference between varities (Student T test, P<0.001).

3.4 Number of Stem Branches

This number is higher in the local variety (9.5±4) than in Pakressaya (2.1.±0.7) **(Fig.2)** with a significant difference (W = 19.5, P<0.0001). On the other hand, the degree of branching had a negative relationship on grain yield in our experimental conditionfollowing the Pearson correlation test (t = 2.3, df = 8, p-value = 0.048). This confirms the results of Macoumba according to which highly branched varieties are less productive**.**

Nevertheless, Amoukou and his collaborators stated that plant height, degree of branching and number of capsules are the three selection criteria to be considered in a sesame varietal improvement program.

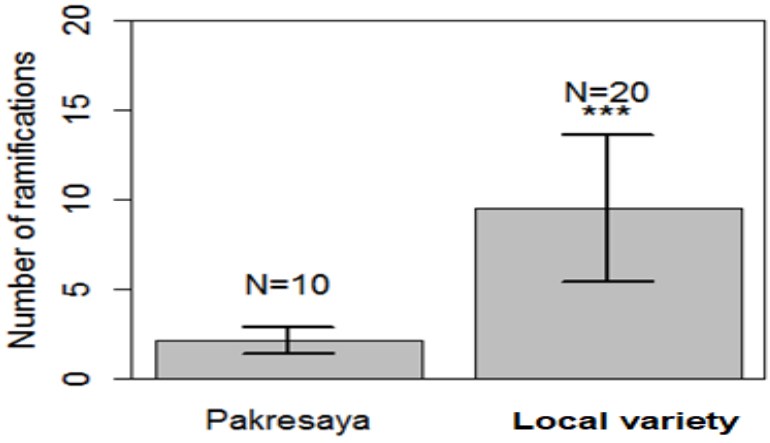

Fig.2.Number of stem branches on plants

3.5. Number of pods per plant

Since the pods appear late (December) in the local variety, it is reasonable to compare their average numbers even at different times if we want to get an idea of this aspect of agronomic performance. The Wilcoxon test was used for this. Data are presented as mean ± dev. Std. The differences are significant at the probability level of 0.05 **(Fig.3).**Number of pods was

significantly higher in the Local variety (10±4.6) compared to the Pakressaya variety (2±0.9) according to the Wilcoxon test (W = 200, P< 0.0001).

Indeed, the variety best adapted to the savannah zone would be the earliest due to the short duration of the rainy season. Precocity is an adaptive (avoidance) trait to drought that allows annual plants to avoid prolonged water deficit by completing the development cycle during rainy periods or periods of low climatic demand [19].Under our experimental conditions, the height of the plant has a direct negative effect on the yield of the sesame. These results are in agreement with those of Boureima, who found a weak relationship between yield and height of sesame plants [20].In this study, the medium-sized Pakressaya variety was the most productive in terms of grain yield. In addition, this variety was the earliest at 90 days and was able to complete its cultivation cycle in favourable rainfall conditions before the onset of the end-of-cycle droughts that were frequent in savannah areas in general and Bakéré in particular.The analysis of partial correlations shows that the dates of flowering, fruiting and physiological maturity have a significant direct effect on sesame yield. Similar results have been reported by [21].

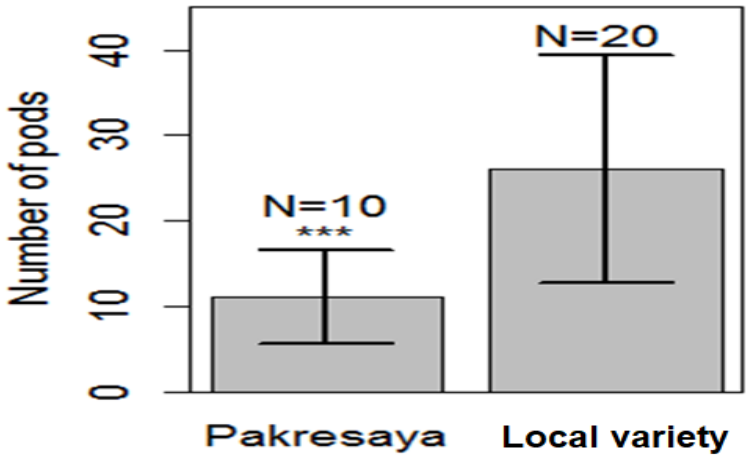

Fig.3.Number of pods per Pakressaya plant of the local variety

During this experiment, the phytosanitary status was marked by the presence of insect attacks and fungal diseases on the plants of local accession. For insect attacks, the most severe was the deformation of the capsules due to galls. Fungal diseases were visible by whole-plant wilting and the presence of black spots on leaves.The presence of galls on the capsules is due to the fly (Asphondylia sesami) that is observed during flowering and whose larvae develop in the capsules by feeding on sesame seeds.In addition, they claim that cercosporiasis caused by *Cercospora sesami* and *Fusarium* wilt due to Fusarium oxysporum are responsible for the leaf spots and wilt of sesame plants observed respectively [22].

Conclusion

This study evaluated the agronomic performance of two sesame accessions (of Burkinabe origin and Central African origin). In terms of phenology, a difference was observed between accessions. The Pakressaya accession had a cycle length of 90 and is said to be early.On the other hand, local accession had a cycle length of 130 days and is said to be late. In terms of morphological parameters, local accession had the highest number of branches, while

pakressaya accession had the highest plant height. In terms of seed production andphytosanitary status, the Pakréssaya accession was the most productive with an average yield of 15 kg per 0.25 ha and less sensitive.As far as the phytosanitary status is concerned, local accession has been very sensitive, all the pods have been aborted. This work to evaluate the agronomic performance of two sesame accessions has led to convincing results in the knowledge and behaviour ofsesame cultivation, especially in Ombella M'poko. It also provided necessary and indispensable preliminary information for any varietal breeding programme.

REFERENCES

[1] Economic Development Agency (AD'OCC), Central African Republic: the economic context (May 2021)

[2] Amoukou, I.A., Boureima, S., Lawali, S., 2013. Agro-morphological characterization and comparative study of two oil extraction methods from sesame accessions (Sesamum indicum L.). African Agronomy 25, 71-82

[3] Nouhou, I., 2019. Sesame in Niger: from a household crop to a cash crop. IN: CTA. 2019. Innovation and promotion of local agricultural product value chains in Africa. CTA Experience Capitalization Series 10. Wageningen (Netherlands). https://hdl.handle.net/10568/101546

[4] FAO 2012. FAO statistical databases and data sets. http://faostat.fao.org/site/339/default.aspx, site accessed June 20, 2012.

[5] International Trade Center; 2011; Sesame Export Sheet; 33p. ; Accessed October 7, 2015 on http://www.intracen.org

[6] Diatta, M. B., Diouf, M., & Faye, E., 2022. Sesame in succession with millet and peanuts in winter conditions in the North-Central Senegal peanut basin. Africa Science, 20(2), 120-130.

[7] Sene, B., Sarr, F., Sow, M.S., Diouf, D., Niang, M., Traoré, D., 2017. Physico-chemical composition of the sesame variety (Sesamum indicum L.) 32- 15 and characterization of its derived products (seeds, oil and oilcake) in Senegal. Food Sci Qual Manag 65, 5–10.

[8] Myint, D., Gilani, S.A., Kawase, M., Watanabe, K.N., 2020. Sustainable sesame (Sesamum indicum L.) production through improved technology: An overview of production, challenges, and opportunities in Myanmar. Sustainability 12, 3515

[9] Stevens P.F. 2011. Angiosperm Phylogeny
Website.

[10] Boulvert Y. Carte phytogéographique de la République centrafricaine (feuille Ouestfeuille Est) à 1:1000000. ORSTOM. 1986;31

[11] Schilling R., Cattan Ph., 1991.- Sesame cultivation in Tropical Africa. OZéaginem, 46 (3), 125-133

[12] CIRAD 1998 observatories of change p.31.

[13] Mazzani B., 1964.- Aspectos del mejoramiento del ajonjoli en Venezuela. Oilseeds, 19 (12), 775-782.

[14] Purseglove J.W., 1984.- Tropical crops: Dicotyledons. Longman group ltd. ed., Singapore, 719 p* Ramirez R., Ov.

[15] Macoumba D. (2002). Water requirements, growth and productivity of sesame (Sesamum indicum L.) in the semi-arid zone of Senegal. Tenure Memory, ISRA, 58 p.

[16] International Trade Center; 2011; Sesame Export Sheet; 33p. ; Accessed October 7, 2015 on http://www.intracen.org

[17] Amoukou I.A., Boureima S. and Lawali S. (2013). Agro-morphological characterization and comparative study of two sesame oil extraction methods (Sesamum indicum L.). African Agronomy 25(1): 71-82.

[18] Boureima S. (2012). Varietal improvement of sesame by induced mutation: effect of mutagesis on drought tolerance and productivity. Doctoral thesis (PhD), GhentUniversity, Ghent, Belgium, 194 p

[19] Amigues J. P., Debaeke P., Itier B., Lemaire G., Seguin B., Tardieu F. and A. Thomas. 2006. Drought and agriculture. Reduce the vulnerability of agriculture to increased risk of water shortage. Collective scientific expertise, summary of the report, INRA (France), 72 p

[20] Boureima S. 2012. Varietal improvement of sesame by induced mutation: effect of mutagenesis on drought tolerance and productivity. Doctoral thesis (PhD), Ghent University, Ghent, Belgium, 194

[21] Yol E., Karaman E., Furat S. and B. Uzun. 2010. Assessment of selection criteria in sesame by using correlation coefficients, path and factor analyses. AJCS 4(8): 598 – 602

[22] Miningou A., Traoré M. and Hijikata N. (2018). Certified seed production manual in Burkina Faso Sesame. 2nd edition, 41 p.