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Evaluation of Agronomic Performances of Five Cowpea Lines in the Experimental Research Station of Saria, Burkina Faso

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Abstract Considered by most producers as their coffee and cocoa as it plays a role of cash crop, cowpea constitutes in Burkina Faso an important source of income to satisfy the needs of families in rural environment. It is grown in all agro-ecological area of the country. Despite this advantage, its production is held back by biotic and abiotic constraints that significantly reduce yields. Best performing varieties are therefore needed by farmers to improve productivity and their livelihoods. The present study which is an agronomic performances evaluation of five cowpea lines at Saria station was done in the field in a Fisher block with three (03) replications. The results revealed significant differences ($P < 0.05$) among lines for the parameters chlorophyll content, the number of days to 95% maturity, and the weight of one hundred seeds. On the other hand, no significant difference ($P > 0.05$) was noted among lines concerning grain and fodder yields. However, the best results have been obtained with the improved lines $BC_3F_{10}P_{34\text{-}1}$ and $BC_3F_{10}P_{34\text{-}3}$. These lines were better than their parent KVx745-11P and could be disseminated to rural producers to ensure food security and improve their incomes.

Keywords: *cowpea, agronomic performances, evaluation, Burkina Faso*

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1. Introduction

Cowpea [*Vigna unguiculata* (L.) Walp.] is one of the main world's food legumes [1]. It is generally a staple food crop in sub-Saharan Africa, and particularly in the dry savannahs of West Africa. The area devoted to cowpea production in the world was estimated at 11,316,105 hectares, of whose 97.87% of this area are found in Africa [2]. Cowpea enriches the resource poor farmer's nutrition in protein and extends their living conditions since it is an important source of income.

In Burkina Faso, several factors reduce greatly cowpea yield. It is the combined action of soil and climate, pests such as aphids [3] thrips, bedbugs and storage bugs, fungal, bacterial and viral diseases [4]. To minimize the effect of these pests, the Institute of Environment and Agricultural Research ((INERA) ttirelessly conducts researches to create new cowpea varieties with high grain yield, but also high fodder yield for human consumption and be of great nutritional contribution for animals after pods harvesting [5] . These lines should also possess some abilities to withstand drastic climatic conditions, parasitic attacks and various diseases of cowpea. It's in this perspective that this study fits and set as a general objective to evaluate the agronomic performances of five cowpea, considering the main production constraints of cowpea at national level. Specifically, it is (i) to evaluate the grain and fodder yield of the five lines and (ii) thus identify the best line for rural popularization.

2. Materials and methods

2.1. Experimental Site

The study was conducted at Saria Research Station, belonging to the Institute of Environment and Agricultural Research (INERA) located in the west-central region, 23 km east of Koudougou and 80 km west of Ouagadougou. Its geographical coordinates are 12°16"N latitude 2°09"W longitude and an altitude of 300 m. The climate is north Sudan [6] alternating two unequally distributed seasons. A short rainy season from June to September, and a long dry season from October to May. In general, the climatic regime is highly irregular due to fluctuations of atmospheric parameters which are temperature, wind, rainfall, humidity and evaporation.

Temperatures are generally high during the year with a moderation in the rainy season (25-35°C). The average annual temperature is 28°C with monthly maxima of 40°C between March and April, and monthly minimums of 15°C in December.

Soils are leached and tropical shallow ferruginous types. This depth (50-80 cm) is limited by the presence of concretionary cuirass [7]. With a sandy-clay texture, these soils are poor in organic matter (<1% on average), nitrogen (0.7 g / kg) and phosphorus that can be absorbed (15 mg / kg), and their retention capacity in water is low (80 to 100 mm / m) [7]. The vegetation is characterized by the presence of annual grass savanna, trees and shrubs.

2.2. Genetic Ressources

The cowpea lines used as genetic resources in the study are KVx745-11P, KVx771-10G (Nafi), KVx775-33-2G (Tiligré), $BC_3F_{10}P_{34-1}$ and $BC_3F_{10}P_{34-3}$. They come from Burkina Faso and the first three lines are already popularized and the last two (02) which are the descendants of the fodder line KVx745-11P, are in the process of being popularized. Table 1 shows some characteristics of these lines.

2.3. Methods

2.3.1. Experimental Design

The experimental design of the study was a Randomized complete block with three (03) replications. Each replication consisted of five (05) plots each corresponding to a line. Each line was sown on three (03) lines of four (04) meters, with a spacing of 0.8 meters between the lines and 0.4 meters between the pockets at the rate of two seeds per pocket. The elementary and total areas were respectively 6.4 m² and 211.2 m². The elementary plots were 1.3 meters apart and the replications were two (02) meters.

2.3.2. Management of the experiment

The pre-planting operations consisted of the plowing, the leveling of the plot, delimitation of blocks and storing of elementary parcels. The sowing of the lines carried out on July 11, 2016 was manual. Each line was tagged in the different replications. The maintenance operations applied were weeding, application of $N_{14}P_{23}K_{14}$ fertilizer to the first weeding at a rate of 100Kg per hectare and insecticide treatments. Two insecticide treatments were carried out, one for the formation of flower buds and the other at the time of clove formation. The insecticide used was Titan at a dose of 2 ml per liter of water. Harvesting of the mature cloves was done after the date marking at 95% maturity. The harvest of by-products (tops) by cowpea line immediately followed that of the pods.

2.3.3. Data Collection

The observations focused on the following parameters:

- number of days to 50% flowering: the period from sowing to the day when 50% of the plants have bloomed on an elementary plot. It is expressed in number of days after sowing (JAS);

- SPAD: which is the content of chlorophyll (TC) contained in plants at the flowering stage;

- number of days to 95% maturity: also expressed in JAS, it has been the period separating the sowing to the date when 95% of the cloves dried on an elementary;

- the weight of one hundred (100) seeds in grams measured on each elementary parcel consisted in random counting and repeating 100 seeds of each line by repetition, followed by weight gain using an ITEM: NV-500 electronic scale with a capacity of 500g and a precision of 0.01g;

- the seed weight per line determined using the same scale and expressed in kilograms to calculate the grain yield;

- the weight of dry haul in kilograms per line was also determined using the same electronic scale.

2.3.4. Data Analyzes

The collected data was entered into an Excel 2013 spreadsheet and verified using Pivot Tables before averaging the measured variables. Then, they were subjected to a one-way analysis of variance (ANOVA) and comparing the averages obtained from the variables using the Pearson test at the 5% threshold. Correlations between the quantitative variables were estimated by the Pearson correlation test. All analyzes were performed using the software GENSTAT fifteenth edition (15.1).

3. Results

3.1. Chlorophyll Content

Measurement of chlorophyll content was performed for all flowering lines (Table 2). Analysis of variance was significant ($p = 0.045$) between the lines tested for this parameter. The chlorophyll rate of the lines tested varied from 42.20 to 62.00% between the lines with a general average of 51.38%. The coefficient of variation was 8.2%. The line $BC_3F_{10}P_{34-1}$ obtained the highest content of chlorophyll (57.23%) and the line KVx745-11P, the lowest content (47%). The lines $BC_3F_{10}P_{34-3}$, KVx775-33-2G and KVx771-10G had respectively the contents of 49.4%, 55.9% and 47.3%.

Table 1. Characteristics of cowpea lines studied

Lines	Origin	Cycle (in day)	Grain color	Grain size	Grain yield (Kg/ha)
KVx745-11P	Burkina Faso	70	White	Small	800
$BC_3F_{10}P_{34-1}$	Burkina Faso	70	White	Small	NN
$BC_3F_{10}P_{34-3}$	Burkina Faso	70	White	Small	NN
KVx771-10G	Burkina Faso	67	White	Big	2000
KVx775-33-2G	Burkina Faso	70	White	Big	2000

ND: Not None.

3.2. Date at 95% Maturity

The number of days to 95% maturity of pods showed a minimum of 66 JAS and a maximum of 78 JAS between cowpea lines (Table 2). The overall average score was 73 JAS and the coefficient of variation was 2.15%. The analysis of variance was highly significant (p = 0.001) for this parameter. In fact, the line KVx771-10G matured to 67 JAS, while the KVx745-11P matured only 77 JAS. Lines KVx775-33-2G, $BC_3F_{10}P_{34\text{-}1}$ and $BC_3F_{10}P_{34\text{-}3}$ grew respectively to 71, 74 and 75 JAS.

3.3. Weight of one Hundred Seeds (PCG)

The analysis of variance was highly significant (P = 0.001) for the one hundred seed weight parameter (Table 3). The weight of one hundred seeds varied from 10.90 to 21.30 g between the lines with a general average of 15.07 g and a coefficient of variation of 4.52%.

The line KVx775-33-2G gave the highest hundred-seed weight (20.53g) while the lowest one-seed weight (11.37g) was obtained with the KVx745-11P. The lines KVx771-10G, $BC_3F_{10}P_{34\text{-}3}$ and $BC_3F_{10}P_{34\text{-}1}$ had respective values 17.57; 13.43 and 12.47 g.

3.4. Study of Correlations

An examination of the correlation matrix presented in Table 4 reveals three observations. The first is the strong positive and highly significant correlation between seed weight and grain yield (r = 1) on the one hand and between the weight and the yield of the fodder (r = 1) on the other hand. The second is the strong positive and significant correlation (r = 0.72) established between TC and grain yield on the one hand and between TC and seed weight (r = 0.72) on the other hand. The third is the significant but negative correlation (r = - 0.7616) observed between the hundred seed weight and the number of days to 95% maturity of the pods.

Table 2. Results of variance analysis of chlorophyll content

Lines	Chlorophyll content (%)	95% maturity (JAS)
$BC_3F_{10}P_{34\text{-}1}$	57,23	74
$BC_3F_{10}P_{34\text{-}3}$	49,4	75
KVx745-11P	47	77
KVx771-10G	47,3	67
KVx775-33-2G	55,9	71
Minimal	42,2	66
Maximal	62	78
Grand mean	51,38	73
Coefficient of variation (%)	8,2	2,15
Probability (5%)	0,045*	0,001**

* : P<0,05, ** : P<0,001.

Table 3. Results of the analysis of variance of the weight of one hundred seeds

Lines	PCG (Kg)
$BC_3F_{10}P_{34\text{-}1}$	12,47
$BC_3F_{10}P_{34\text{-}3}$	13,43
KVx745-11P	11,37
KVx771-10G	17,57
KVx775-33-2G	20,53
Minimal	10,90
Maximal	21,30
Grand mean	15,07
Coefficient of variation (%)	4,52
Probability (5%)	0,001**

** : P<0,001.

Table 4. Matrix of correlations between the different variables studied.

Variables	50% Flo	Rdt G	95% mat	PF	PG	Rdt F	PCG	TC
50% Flo	1							
Rdt G	-0,3203	1						
95% mat	-0,1838	-0,1425	1					
PF	-0,3665	0,3504	0,1329	1				
PG	-0,3203	1,0000**	-0,1425	0,3504	1			
Rdt F	-0,3665	0,3504	0,1329	1,0000**	0,3504	1		
PCG	0,5429	0,1139	-0,7616*	0,1592	0,1139	-0,1592	1	
TC	-0,0938	0,7272*	-0,0946	0,3568	0,7272*	0,3568	0,2856	1

Flo = flowering; Rdt G = grain yield; Mat = maturity; PF = cloves weight; PG = seed weight; Rdt F = cloves yield; PCG = weight of one hundred seeds; TC = chlorophyll content; **= strong positive and highly significant correlation; * = strong and significant correlation.

4. Discussion

This study was conducted with the aim of evaluating the on-station agronomic performances of five cowpea lines with regards to some variables of interest in the process of varietal creation.

The existence of significant difference among the lines for the chlorophyll content shows that, at the flowering and pods initiation stage, these lines did not contain the same chlorophyll contents. It shows that the level of chlorophyll contained in the plants is function of the lines. In addition, chlorophyll contents fairly high for all lines at flowering time allow them to perform photosynthesis. This is related to Heller, [8] who asserted that during the flowering phase, the photosynthesis rate of the plants is higher, in order to be able to satisfy the needs of the plant to elaborate substances and necessary for the formation of grains. In addition, the dual purpose (grain and fodder) lines seem to show a higher chlorophyll content than the one whose main objective is to produce grains. As for as the 95% maturity parameter of the pods is concerned, the highly significant difference between the lines could be explained by maturity at different dates by the lines tested. According to Cissé *et al.*, [8], the development cycle of cowpea varies according to lines. Thus, the KVx771-10G and KVx775-33-2G lines that had a physiological maturity of pods of 67 JAS and 70 JAS would be the earliest. The lines KVx745-11P (77 JAS), $BC_3F_{10}P_{34\text{-}1}$ (74 JAS) and $BC_3F_{10}P_{34\text{-}3}$ (75 JAS), however, would be longer cycle. These results are similar to those obtained by N'gbesso *et al.*, [10] on other varieties of cowpea. These authors considered that the varieties IT86-D400, IT88DM-363, IT96D-666 and IT86F-2014-1 with physiological maturity of the pods of 67 to 70 days are early and varieties IT96D-733 and IT83S -889 with 74 and 77 days, have a cycle a little longer. The highly significant difference between the lines for the weight of one hundred seeds parameter would reflect their level of diversity and that the weight of the grains would vary from one variety to another. The KVx771-10G and KVx775-33-2G lines, which have respectively weights of one hundred grains of 17.57 g and 20.53 g, possess large seeds. Compared to these two, the seeds of lines KVx745-11P, $BC_3F_{10}P_{34\text{-}1}$ and $BC_3F_{10}P_{34\text{-}3}$ are small with respectively one seed weight of 11.37 g, 12.47 g and 13.43 g. These results corroborate Tignegré's ones [5], who considered as large seeds, any seed whose weight of one hundred seeds is greater than 17 g. In addition to grain size, Khan *et al.* [11] state that the accumulation of reserves in seeds depends on the type of genotype but also climatic factors. However, the weight of one hundred grain $BC_3F_{10}P_{34\text{-}1}$ and $BC_3F_{10}P_{34\text{-}3}$ lines developed for an improvement of KVx745-11P seems to achieve this goal. These two lines therefore have a weight of one hundred grains greater than that of the KVx745-11P. The study of correlations yielded significant results between certain parameters. Thus the strong positive, highly significant correlation (r = 1) observed between seed weight and seed yield indicates that a high seed weight would necessarily induce a high grain yield. Likewise, a high clove weight would increase the yield.

The strong positive and significant correlation (r = 0.72) between TC and seed weight; then between the TC and the grain yield (r = 0.72) indicates that a high chlorophyll content of the plants at the time of flowering, would induce a high seed weight, thus a high grain yield. Thus the $BC_3F_{10}P_{34\text{-}1}$ line that had the highest chlorophyll content, gave the highest seed weight and the highest grain yield.

The significant but negative correlation (r = - 0.7616) between the weight of one hundred seeds and the date 95% maturity is explained by the fact that the weight of one hundred seeds is independent of the degree of maturity of the seeds.

5. Conclusion

This study made it possible to highlight the agronomic performances of the five cowpea lines studied at the station. The lines tested gave not only different grain yields but also clove. The lines $BC_3F_{10}P_{34\text{-}1}$ and $BC_3F_{10}P_{34\text{-}3}$ gave the best grains and cloves yields and improved significantly compared to their parent KVx745-11P. These improved lines thus reflect the potential for mixed use of cowpea on farms without any competition between humans and animals to ensure food security and substantial income.

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Statement of Competing Interests

The authors declare that they have no competing interests.

References

[1] Pasquet, R. S., Baudoin J. P, "Le niébé, *Vigna unguiculata*, in: Charrier, A., Jacquot, M., Hammon, S., Nicolas, D.", *L'amélioration des plantes tropicales*, CIRAD-ORSTOM, Montpellier, France, pp. 483-505. 1997.

[2] FAOSTAT. Agricultural production, crop primary database. Food and Agricultural Organization (FAO) of the United Nations, Rome, Italy. http://faostat.fao.org/faostat. 2013.

[3] Barro, A., Sawadogo, M., Kiébre, Z. and Neya, B. J, "Evaluation de la résistance de quelques lignées et écotypes de niébé (*Vigna unguiculata* (L.) WALP.) au *Cowpea Aphid-Borne Mosaic Virus* au Burkina Faso ", *International Journal of Innovation and Applied Studies,*15 (2): 387-394. 2016.

[4] Reeves, W. H, *Le niébé*. IITA, Ibadan Nigeria, 170 p. 1983.

[5] Tignégré, J. B. S. *Genetic study of cowpea (Vigna unguiculata (L.) walp.) resistance to Striga gesnerioides (Willd.)Vatke in Burkina Faso*. Thèse de Doctorat (PhD), University of KwaZulu-Natal Republic of South Africa, 170 p. 2010.

[6] Guinko, S. Végétation de la Haute-Volta. Thèse de Doctorat ès Sciences Naturelles. Université de Bordeaux III (France).Tome l, 318 p. 1984.

[7] Zougmoré, R., Mando, A., Stroosnijder, L, "Effect of soil and water conservation and nutrient management on the soil-plant water balance in semi-arid Burkina Faso", *Agricultural Water Management*, 65: 103-120. 2004.

[8] Heller R, "Abrégé de Physiologie Végétale. Développement". *Masson*, *Paris*, 315 p. 1995.

[9] Cissé, N., Ndiaye, M., Thiaw, S., Hall, A. E, "Registration of “Mouride” cowpea ", *Crop Science*, 35: 1215-1216. 1995.

[10] N’gbesso, F. P. M., Fondio, L., Dibi, B. E.K., Djidji, H. A., Kouamé, C. N, "Etude des composantes du rendement de variétés améliorées de niébé", *Journal of Applied Biosciences*, 63: 4754-4762. 2013.

[11] Khan, A., Bari, A., Khan, S., Shan, N. H., Zada, I, "Performance of cowpea genotypes at higher altitude of NWFP ", *Pak. J. Bot.*, 42 (4): 2291-2296. 2010.