Influence of chicken dung compost on cowpea (*Vigna unguiculata* L.) field production in the South Cameroon region

ABSTRACT

The objective of the present field work in southern Cameroon was to test the effect of chicken dung compost on growth parameters and yield of cowpea. Two cowpea varieties (Lori and Komcalle) and four treatments (T= control; C= compost; CF= chemical fertilizer; CCF= mixture of compost and chemical fertilizer) were used in a completely randomized block design with three replications. Seed emergence rate, height, number of leaves, leaf area, crown diameter, number of nodules per plant and grain yield were evaluated. The results show that the Komcalle variety recorded an emergence rate of 94.85% and the Lori variety a washout rate of 91%. At 60 DAS, the chicken droppings compost shows the optimum values on height of (60.6±11.73 and 63.93±9.39 cm), number of nodules (73.63±1.60 and 72.7±1.62 nodules) and number of leaves (76.13±23and 60.41±18 leaves) for Lori and Komcalle variety respectively. The best seed yields were provided by chicken droppings compost (230±3.7 and 243±2 kg/ha) for Lori and Komcalle varieties respectively, compared to synthetic chemical fertilizer which recorded values of 217±4.7 and 214±2 kg/ha for Lori and Komcalle respectively. Based on the results, it appears that chicken dung compost is beneficial for cowpea cultivation due to improved growth and yield in the Southern Cameroon region.

Key words: *Vigna unguiculata,* chicken dung compost, agronomic parameters.

1. Introduction

Hunger and malnutrition remain a scourge that affects nearly 800 million people in the world, the majority of them in Africa [1] because the problem of food deficit is acute there [2]. Henao and Baanante [3] suggest that the decline in land productivity is related to poor agricultural practices including intensive slash-and-burn agriculture, overuse of synthetic chemical fertilizers, lack of crop rotation, and anarchic exploitation that lead to soil nutrient depletion. In order to intensify agriculture, farmers are turning to the use of chemical fertilizers which provide an immediate solution to the problems of declining soil fertility. However, these chemical inputs are not within the reach of everyone because of their high costs [4 ; 5]. The exclusive and abusive use of chemical inputs leads to many negative consequences for the environment resulting in increased acidity, degradation of physical status and a decrease in soil organic matter, and therefore agricultural yield [6]. Faced with this situation, it is now very urgent to make today's agriculture an important factor in human health, food security and environmentally friendly for sustainable development. The research of alternative agricultural practices to the use of chemical fertilizers aiming at increasing the agricultural production and based on the respect of the ecological functions are to be promoted. Many studies have already shown the beneficial effect of organic fertilization on cowpea production [7]. Ngakou et al [8] evaluated the effect of composts derived from cow dung and household waste on beans. It is in this context that the effect of chicken dung compost on cowpea growth and development in Southern Cameroon was initiated. The general objective of this work is to test the effect of chicken droppings compost on growth parameters and yield of cowpea.

2. Material and methods

2.1. Study site

The present study was carried out in the South Cameroon region of geographical coordinates 2° 30" N and 11°45'E which belongs to the agroecological zone 5. The experiment was carried out more precisely in the locality of Mvamessakoe located 5 km north of the town of Ebolowa. The climate in this area is of the Guinean type, characterized by constant temperatures of 24 to 27°C, abundant rainfall of 1,633 mm/year, with a long rainy season from March to June and a long rainy season from August to November.

2.3. Experimental set-up and cultivation practices

The experimental design is a complete randomized block with 3 replications including seeds of two cowpea varieties (Lori and Komcalle) obtained at IRAD of Foumbot (Cameroon). These varieties are semi-erect and erect with a development cycle of 60 to 70 days. The seeds of both varieties are white in color. The fertilization was made from compost made from 100% chicken droppings, very solicited for its richness in organic elements and chemical fertilizer NPK. The combination of varieties and treatments was constituted as follows: TV1= Control soil and Lori; CV1= Soil with 40g of compost and Lori; CFVl= soil with 20g of NPK fertilizer and Lori; CCFV1 = soil with 40g of compost and 20g of NPK fertilizer and Lori; TV2=Control soil and Komcalle; CV2= Soil with 40g of compost and Komcalle; CFV2= soil with 20g of NPK fertilizer; CCFV2= soil with 40g of compost and 20 g of NPK fertilizer and Komcalle. The experiment design was spread over an area of 200 m². Each experimental plot has an area of 5 m² and contains 50 cm between rows and 30 cm between plants. The blocks are spaced of 1 m and the distance between the experimental plots is 50 cm.

Sowing was directly carried out in the field on October 22, 2021. Each poquet contained three seeds at a depth of 3 cm, in order to increase the chance of emergence, to promote the good rooting and the good emergence of the young seedlings [8]. According to the treatments, compost was applied at 14 days after sowing (DAS).

2.4. Studied parameters

2.5. Emergence rate

Emergence rate was assessed at 14 days after sowing (DAS) by counting emerged plants in the different treatments. The formula used by Mboutga [9] was used to calculate the emergence rate

ER = Number of emerged seeds ×100/Number of seeds sown.

2.6. Evaluation of growth parameters

Growth parameters were measured at 14 days after sowing. Plant height was measured with a decameter on 30 plants from the ground to the plant apex. The number of leaves was assessed by simple counting. Diameter at the collar was measured with a caliper on 30 randomly labeled plants.

Leaf area was estimated by calculation using the formula of Peksen et al. [10].

$$LA = 2/3 \times [(L1 \times W1) + (L2 \times W2) + (L3 \times W3)]$$

Where LA: leaf area, L1, L2, and L3 are the length of leaves 1, 2, and 3 respectively, and W1, W2, and W3 are the maximum width of leaves 1, 2, 3 respectively.

The number of nodules per plant per treatment was assessed at flowering at 45 days after sowing. Roots were gently washed with tap water to remove soil and make nodules visible. The nodules were gently detached from the roots and counted on 15 plants [11]. To assess nitrogen fixation activity, twenty fresh nodules per plant were split with a blade and the color was observed. The red or green color of the leghemoglobin is indicative of nitrogen fixation; while the white color is evidence of the absence of nitrogen fixation activity in the nodules [11].

2.7. Evaluation of cowpea yield parameters

The number of pods per plant and the number of seeds per pod were assessed by simple counting of 30 plants from each treatment at 60 and 70 days after sowing. The evaluation of the weight of 100 seeds per treatment was used to determine the yield in kg per hectare.

$$\text{Yield (kg/ha)} = 10000 \times P$$

Where P = seed weight and 10000 = estimated number of plants per hectare [12]

2.8. Statistical analyses.

The results were analyzed using Statgraphics 5.0 software that performs analysis of variance (ANOVA). The Microsoft Excel spreadsheet (2016) was used for data entry and graphing.

3. Results

3.1. Seed emergence rate of different cowpea varieties

Seed emergence was effective for both varieties at 14 DAS. Komcalle had the highest emergence rate (94.85%) compared to Lori which had an emergence rate of 91%. The analysis of variance revealed no significant difference between the two varieties (Fig.1).

3.2. Effect of different treatments on the number of leaves of the Lori variety

Figure 2 presents the evolution of the number of leaves of the cowpea plants of the variety Lori according to time. It appears that the number of leaves increases weekly. This number varies from 8 leaves from the 14th day after sowing to 59 leaves at the 49th day after sowing. Cowpea plants treated with compost and with the compost-chemical fertilizer mixture had a higher number of leaves (55.48±18.12 and 52±2.55 leaves), followed by plants treated with synthetic chemical fertilizer (45.73±2.38 leaves) compared to the control plants, which had a low number of leaves. The analysis of variance shows a significant difference ($P<0.05$) between the different treatments.

3.3. Effect of the different treatments on the number of leaves of the variety Komcalle

The evolution of the number of leaves of the plants of the variety Komcalle according to time is presented by figure 3. The analysis of variances shows a significant difference ($P<0.05$) between the treatments. The number of leaves increases from the 14th DAS to the 49th DAS with 8 to 57 leaves respectively and decreases from the 49th DAS to 60 DAS. Cowpea plants treated with compost (55.48±18.12 leaves) and compost-chemical fertilizer mixture (52±2.55 leaves) had higher number of leaves, followed by plants treated with synthetic chemical fertilizer (45.73±2.38) all compared to control plants.

3.4. Effect of the different treatments on the height of the plants of the variety Lori

The analysis of variance of plant height shows that there is a significant difference ($P<0.05$) between treatments (Fig.4). There is a general increase in plant height from 14 DAS to 60 DAS. Plants treated with chicken droppings compost show the highest heights (60.6±11.73 cm) followed by plants treated with compost-chemical fertilizer mixture (60.2±8.41 cm), and plants treated with synthetic chemical fertilizer (52.8±9.10 cm) compared to the control plants which record the lowest heights.

3.5. Effect of the different treatments on the height of the plants of the variety Komcalle

The data in figure 5 presents the evolution of the height of cowpea plants of the Komcalle variety. It appears that the height of the plants increases from the 14th day of the week to reach its optimum until the 60th day after sowing. During the whole period of the experiment, the cowpea plants treated with hen droppings compost have the highest heights (63.93±9.39 cm), followed by the plants treated with the compost-chemical fertilizer mixture (56.33±7.27 cm) and the plants treated with the synthetic chemical fertilizer (54.2±7.94 cm). The control plants had the lowest values (47.46±6.33 cm). The analysis of variances shows that there is a significant difference ($P<0.05$) between treatments.

3.6. Effect of treatments on the leaf area of Komcalle plants

Figure 6 presents the evolution of the leaf area of the plants according to time. It can be seen that the leaf area of the plants increases considerably each week. It varies from 30 cm^2 from the 14th day of the month to reach its optimum at the 28th day after sowing. At 28 DAS, cowpea plants treated with chemical fertilizer had the largest leaf area (82.26±27.68 cm^2), followed by plants treated with compost (60.4±18 cm^2) and plants treated with the compost-chemical fertilizer mixture (58.73±20.32 cm^2), compared to the control plants. The analysis of variance shows a significant difference between the treatments

3.7. Effect of the different treatments on the leaf area of the variety Lori

The leaf area of the plants of the variety Lori is presented in figure 7. At 35 DAS, the plants treated with chemical fertilizer and the plants treated with the compost-chemical fertilizer mixture recorded the best values. From 60 DAS, the plants treated with chemical fertilizer, followed by those treated with compost-chemical fertilizer and those treated with chicken droppings had the largest leaf areas (82.46±27.68 cm^2; 79.53±25.10 cm^2 ; 76.13±23 cm^2

respectively), all of them compared to the control plants. The analysis of variance shows that there is a significant difference (P=0.05) between treatments.

3.8. Effect of the different treatments on the diameter at the collar of the variety Lori

The analysis of variances shows that there is a significant difference (P=0,05) between the treatments. The diameter at the collar of cowpea plants of the Lori variety increases with time (Fig.8). It varies by 2 mm from the 14th day after sowing to reach its optimum at the 42nd day after sowing. At 42 DAS, cowpea plants treated with chicken dung compost had the largest diameters (8±2.27 mm), followed by plants treated with the compost-chemical fertilizer mixture (6.81±1.6 mm) and plants treated with chemical fertilizer (6.22±1.4 mm). The control plants had the lowest values (6.04±2.18 mm).

3.9. Effect of the different treatments on the diameter at the neck of the Komcalle variety

The data in figure 9 presents the evolution of the diameter at the collar of the plants of the variety Komcalle according to time. It appears that cowpea plants treated with chicken droppings had the largest diameter (7.86±1.33 mm) at 60 days after sowing, followed by plants treated with a mixture of compost and chemical fertilizer (6.86±1.29 mm), and plants treated with chemical fertilizer (6.58±1.12 mm) compared to the control plants (5.85±.1.09 mm). The analysis of variance shows a significant difference (p=0.0308) between the treatments used.

3.10. Effect of the different treatments on the number of nodulation of cowpea

The number of nodules of cowpea plants varies according to the treatments (Table 1). It appears from this table that the number of nodules per plant is between 22 and 54. A significant difference (p=0.0000) is recorded for the variety*treatment interaction. The number of nodules in the chicken droppings compost treatment of the Komcalle variety (54.6 ±1.65 nodules) and the Lori variety (52.67±1.62 nodules) is higher than the number of nodules in the Lori control (22.4±1.73 nodules).

3.11. Effect of different treatments on cowpea yield parameters

The different treatments have a very significant influence (p=0.000) on the yield of cowpea plants of both varieties (Table 2). Indeed, the seedlings from the compost treatment had a higher number of pods per plant (21±3), number of seeds per pod (17±1.76) and 100-seed weight (24±1.23 g) than the control plants, which had 9±2 pods/plant, 10.4±1 seeds/pod, and 18±0.32 g) respectively. Regarding the yield, the plants treated with compost obtained better values for the variety Lori (230±3.7 kg/ha) and the variety Komcalle (243±2 kg/ha) compared to the other treatments.

4. Discussion

The results showed that the seed emergence rate was effective (91% to 94%) for the two varieties Lori and Komcalle respectively suggesting that they would have a good germination capacity. Indeed, N'gbesso et al. [12] working on the growth and health characteristics of 6 improved cowpea varieties in Côte d'Ivoire showed that the emergence rate of the improved varieties used varied between 90% and 97%.

The number of leaves of the two varieties increased considerably between the 14th and 49th day of the week, with high values in the hen-dung compost treatment of the Lori variety (55.48±18.12 leaves) and the Komcalle variety (55.48±18.12 leaves). Ngakou et al. [8] reported that from 14 to 51 DAS, composts derived from cow dung and household waste improved leaf number in common bean plants. Similarly, Megueni et al. [7] showed a significant increase in cowpea leaf number in the Adamaoua region of Cameroon. The recorded peak in leaf number between 28 and 49 days of age could be explained by the synthesis of biofertilizers present in the chicken dung compost that would have promoted good plant nutrition. However, beyond 50 days, a decrease in the number of leaves was observed in all treatments. This decrease would be due to the senescence of the leaves marking the end of the development cycle of the plant. At this period, there would be an increased production of a hormone in the form of abscisic acid which would promote the aging and the fall of the leaves following a stop of the supply of water, mineral and carbon elements at the level of the various organs of the plant [13]. The appearance of these signs often marks the end of a growth cycle in annual plants [14].

Throughout the period of the experiment, cowpea plants treated with chicken droppings compost recorded a higher height for both the Lori and Komcalle varieties. These results are similar to those of Balbhim et al. [15] who report that compost increases the height of legumes. Strong height growth is observed in cowpea plants between 35 and 60 JAS. According to [12], the height growth of cowpea plants is generally slow in the first 30 days after sowing the seeds so much that between the 30th and 60th DAS, it is strongly accelerated with an average height of 57.63 cm. The delay in plant height in the other treatments compared to plants treated with compost can therefore be explained by excess nutrients.

The results showed that cowpea plants treated with chicken droppings compost recorded the largest leaf areas after chemical fertilizer for both varieties. These results are similar to those of Mboutga [9] and Djao [16] who reported that compost-treated plants had a 34% increase in leaf area compared to untreated plants.

The presence of numerous nodules on the roots would have favored a good fixation of atmospheric nitrogen that would have induced a significant development of fruiting branches and an abundant production of pods in both varieties. Indeed, according to Addam [17], nodulation causes rapid plant growth in cowpea and also has a positive effect on seed production. However, good nodulation is not always synonymous with good nitrogen fixation, as not all nodules observed are efficient. The increase in nitrogen levels observed in the results is thought to be due to the capacity of cowpea to fix atmospheric nitrogen and to the improvement of soil properties by the nitrogen-rich compost, which favors nodule development. The better nodulation in plants treated with compost suggests that these plants will be rich in protein because nitrogen is a precursor of protein synthesis.

The results show that compost increased all cowpea yield parameters by more than 100% compared to the control, whereas the increase was less than 100% for plants treated with chemical fertilizers. This optimal yield increase would be related to the root nodulation rate of cowpea as well as soil fertilization. Konate et al. [18] report that yield is strongly related not only to the ability of plants to fix atmospheric nitrogen, the potential of the plant to acquire nutrients but also to the bioavailability of these elements in the soil. Fluctuations in the number of pods per plant, number of seeds per pod, and 100-seed weight would underlie the significant differences observed between varieties at the treatment level. Thus, the high number of pods per plant would have contributed significantly to the yield increase in Lori and Komcalle varieties.

5. Conclusion

The overall objective of this study was to test the effect of chicken dung compost on growth parameters and yield of cowpea. It was found that hen dung compost had a positive and significant ($p<0.05$) influence on the different growth and seed yield parameters. The varieties Lori and Komcalle have a good emergence rate at 14 days after planting with values of 91% and 94% respectively. The plant height and number of leaves, leaf area, diameter at the collar, degree of nodulation of cowpea plants treated with compost obtained values of the order of (63.93±9.39 cm; 55.48±18.12; 60.4±18 cm^2; 73.63±1.60; 7.86±1.33 mm; 73.63±1.60 respectively) for the Komcalle variety and (60.6±11.73 cm; 55.48±18.12; 76.13±23 cm^2; 8±2.27 mm; 72.7±1.62 respectively) for the Lori variety compared to the controls. The highest yield (243 kg/ha) was obtained from Komcalle plants treated with chicken droppings compost. Chicken dung compost could be recommended as an alternative to chemical fertilizers for cowpea cultivation in the Southern Cameroon Region.

References

1. FAOSTAT. Crop statistics. Food and Agriculture Organization of the United Nation; 2020. Available: http://www.fao.org/faostat/en/#search/Potatoes.

2. Hacquemand J.,. World hunger and agricultural and food policies: Assessment and perspectives. Economic and Social Council, Paris, 2008.138 p.

3. Henao J. and Baanante C. A.,. Agricultural Production and Soil Nutrient Mining in Africa. Summary of IFDC Technical Bulletin, IFDC, Muscle Shoal, Alabama, USA, 2006. 75 p.

4. Mapongmetsem P. M., Nkongmeneck B. A, Rongoumi G., Dongock D. and Dongmo B., . Impact of land use systems on the conservation of Vitellaria paradoxa gaertn.f. (Sapotaceae) in the Sudano-Guinean region (savannas). International journal of environmental studies. 2005. 68(6): 51-72.

5. Timsina KP, Kafle K, Sapkota S. Economics of potato production in Taplejung district of Nepal. Agronomy Journal of Nepal. Agronomy Society of Nepal (ASoN) and Crop Development Directorate (CDD), Department of Agriculture (DoA), Kathmandu. 2011;2:173-181.

6. Mulaji K.C.,. Use of household biowaste composts to improve the fertility of acidic soils in the province of Kinshasa (Democratic Republic of Congo). Doctoral thesis, Organic and technological agriculture, Gembloux. 2011. 220 p.

7. Megueni C., Awono E. T. and Ndjouenkeu R., Simultaneous effect of dilution and

combination of Rhizobium and mycorrhizae on leaf production and physicochemical properties of young leaves of Vigna unguiculata(L) Walp. Journal of Applied Biosciences. 2011. 40: 2668-2676.

8. Ngakou A., Megueni C., Noubissie E. and Tchuenteu T. L., Evaluation of the Physico-Chemical Properties of Cattle and Kitchen Manures Derived Composts and Their Effects on Field Grown Phaseolus vulgaris L. American journal of Microbiological Research. 2008. 3(5): 13-22.

9. Mboutga O. Influence of compost and pyroclastite powder on the growth and development of common bean (Phaseolus vulgaris L.) grown in Dang (Adamaoua-Cameroon) 2019

10. Peksen, E.,C.Artik and Palabiyik, B. Determination of genotypical differences for leaf characteristics in cowpea(Vigna unguiculata L.Walp.) genotypes. 2005. Asian J. Plant Sci. 4:95-97..

11. Ngakou, A., Meguni C., ousseni H. & Massai A. Study on the isolation and characterization of rhizobia strains as biofertilizer tools for growth improvement of four grain vegetables in Ngaoundéré Cameroon. Int. J. Biol. Chem. Sci. 2009. 3(5):1078-1089

12. N'gbesso M. F. D. P., Zohouri G. P., Fondio L., Djidji A. H. and Konate D. Study of the growth characteristics and health status of six improved varieties of cowpea [Vigna unguiculata (L.) Walp] in the central zone of Ivory Coast. International journal of biological and chemical sciences, 2013. 7(2) 457-467.

13. Uarrota VG. Response of Cowpea (Vigna unguiculata L. Walp.) to Water Stress and 32 Phosphorus Fertilization. J. Agron., 2010. 9(3): 87-91.

14. Falalou H. Physiological, biochemical and agronomic parameters relevant for cowpea (Vigna unguiculata L. Walp) improvement and adaptation programs to water deficit. Doctoral thesis presented to UFRISVT of the University of Ouagadougou, 2006 p.189.

15. Balbhim L.C., Mangesh, M.V. and Bhimashankar R.P.,. Effects of organic and chemical fertilizers on cluster bean (Cyamopsis tetragonolobus). European Journal of Experimental Biology, 2015. 5 (1): 34-38.

16. Djao M. C., Effect of basaltic pyroclastites from Lake Tison on the growth and development of common bean (Phaseolus vulgaris L.) in Dang (Adamawa-Cameroon), Master's thesis, Department of Biological Sciences, Faculty of Sciences, University of Ngaoundéré, 2017. 82 p.

17. Addam KS.. Effect of nitrogen and phosphorus on the nitrogen nutrition of varieties of cowpea (Vigna unguiculata L. Walp) pre-selected in Niger. DEA dissertation in plant physiology, Agrophysiology option, UFR Biosciences, Abidjan, Ivory Coast, 1999. p.65

18. Konate Z, Gala BiT, Messoum FG, Sekou A, Yaokouame A, Camara M, Keli ZJ.. Alternatives to mineral fertilization of soils in rainfed upland rice farming: contributions of soybean and cowpea crops to soil fertility a hyperdystric ferralsol in the center-west of Côte d'Ivoire. J.Appl. Biosci. 2012. 54:3859–3869.

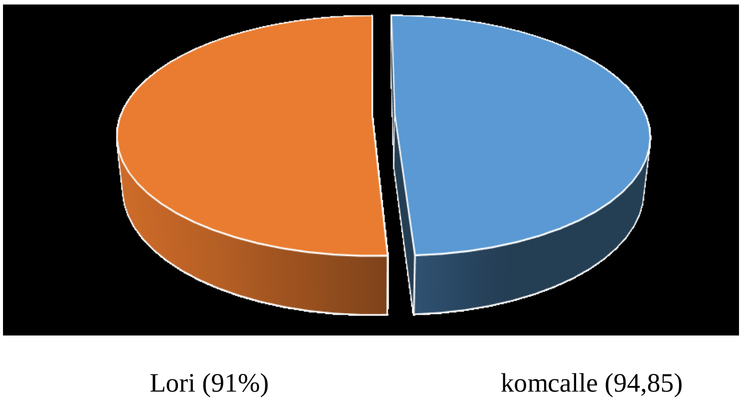

Figure 1. Seed emergence rate of different cowpea varieties

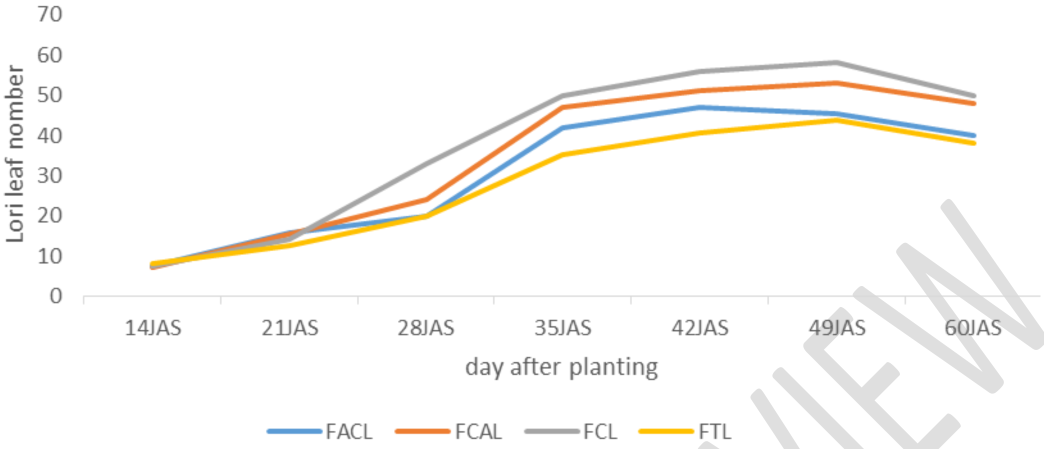

Figure 2. Effect of different treatments on the number of cowpea leaves (Lori variety)

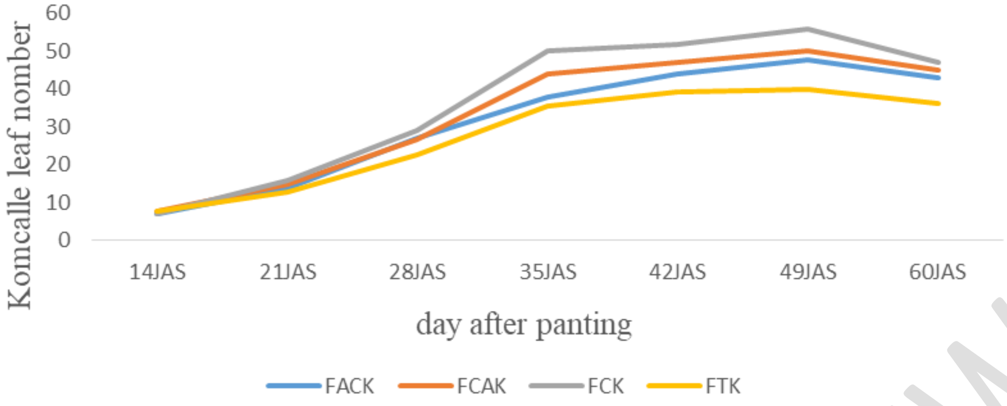

Figure 3. Effect of different treatments on the number of leaves (Komcalle variety)

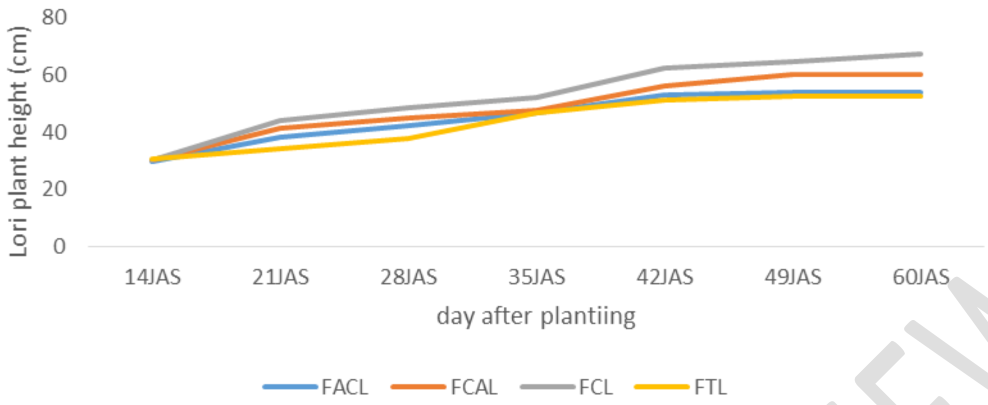

Figure 4. Effect of different treatments on plant height (Lori variety)

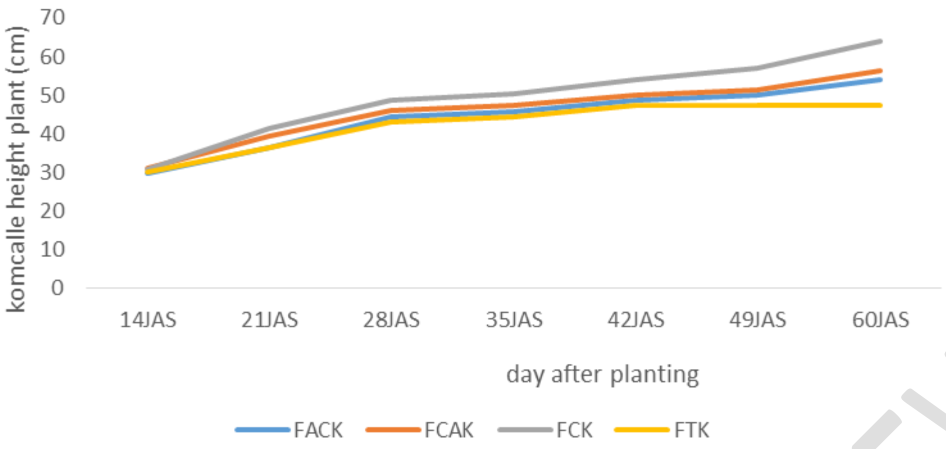

Figure. 5. Effect of different treatments on the height of the Komcalle variety

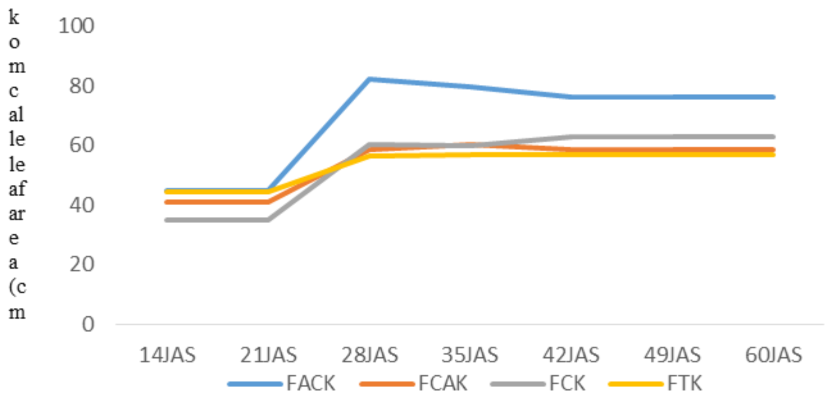

Figure. 6. Evolution of the leaf area of the variety Komcalle

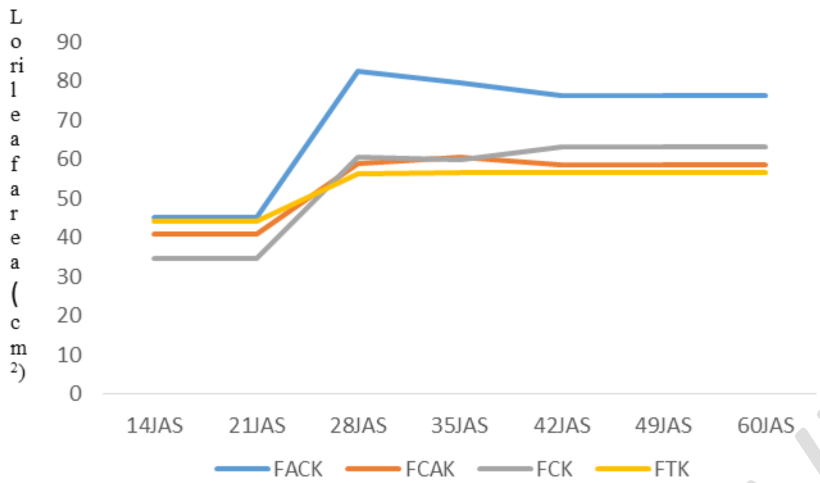

Figure. 7. Evolution of the leaf area of the variety Lori

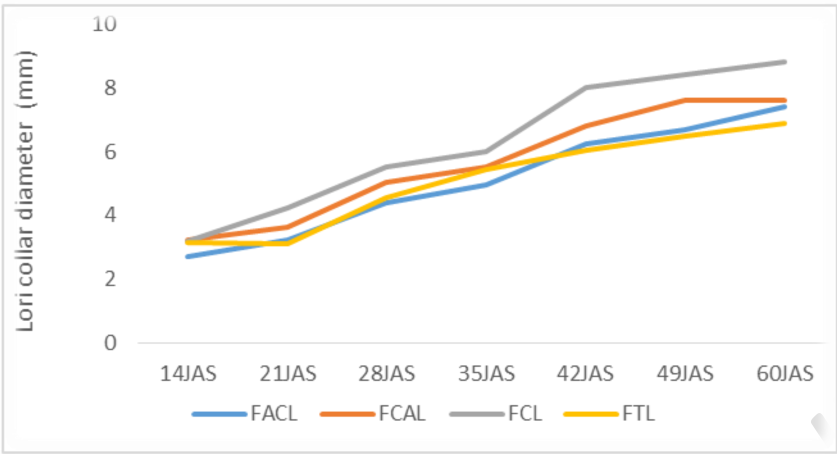

Figure. 8. Evolution of the diameter at the collar of the variety Lori

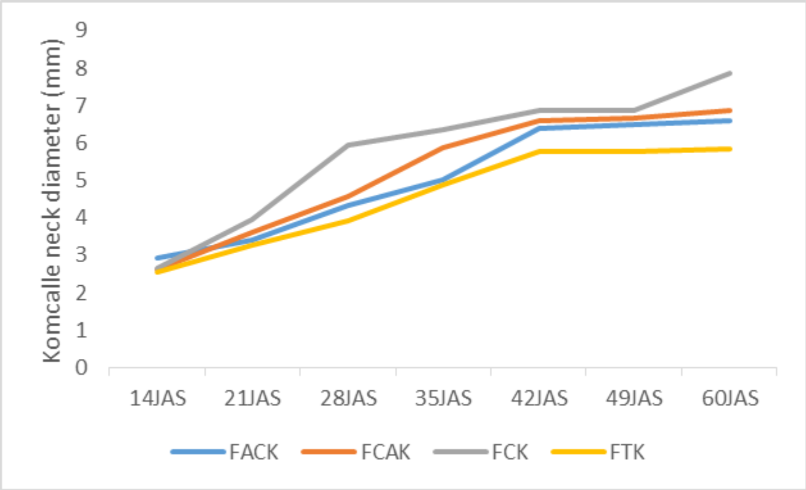

Figure 9. Evolution of the diameter at the neck of the Komcalle variety

Table 1: Effect of different treatments on the degree of nodulation of cowpea

variétés	Traitement	Nbre de nodule/plant	Eff des nodules (%)
	ACK	34,53 ± 1,69 ^{b}	48,13 ± 1,90^{b}
	CAK	49,73 ± 1,91^{a}	68,56± 2,32^{a}
Komcalle	CK	54,6 ± 1,65^{a}	73,63 ± 1,60^{a}
	TK	24,4 ± 1,73^{c}	38,73 ± 2,31^{c}
Valeur de P	0,0000	0,0000	
	ACL	32,43 ± 1,63^{c}	47,3 ±1,81^{b}
	CAL	47,7 ± 1,91^{b}	67,7± 2,32^{a}
Lori	CL	52,7 ± 1,62^{a}	72,7 ± 1,62^{a}
	TL	22,4 ± 1,73^{d}	37,4 ± 1,73^{c}
Valeur de P	0,0000	0,0000	

AC: chemical fertilizer NPK; CA: compost plus chemical fertilizer; C: compost; T: control, K: variety Komcalle; L: variety Lori; Nnod/plant: number of nodules per plant; P: probability. Values in the same column followed by the same letter are not significantly different at the 95% level.

Table 2: Effect of different treatments on cowpea yield parameters

Variétés	Traitements	Ngo/plant	NGr/gousse	PGr	Rdt (kg/ha)
Kamcalle	ACK	14± 2b	11±1,08c	19±0,70b	214±2b
	CAK	16 ± 2b	14±1,15b	24± 2,06a	221±7b
	CK	21± 3a	17± 1,76a	24± 1,23a	243±2a
	TK	9 ± 2c	9±1d	20±1,32b	190±1c
P value	0,000	0,000	0,000	0,000	
LORI	ACL	11±2c	11±1c	21±0,36	217±4,7c
	CAL	16± 3b	12±2b	22±1b	219 ±5,3b
	CL	19± 3a	15±1a	25±2a	230± 3,7a
	TL	9 ±2d	10,4±1c	18±0,32c	194 ± 3,3d
P value	0,000	0,000	0,000	0,000	

AC: NPK chemical fertilizer; CA: compost plus chemical fertilizer; C: compost; T: control, K: Komcalle variety; L: Lori variety; NGo/plant: number of pods per plant; NGr/plant: number of seeds per plant; PGr: weight of 100 seeds; Rdt: yield. P: probability. Values in the same column followed by the same letter are not significantly different at the 95% level.