International Journal of Zoology and Applied Biosciences **ISSN: 2455-9571**
Volume 9, Issue 4, pp: 59-67, 2024
https://doi.org/10.55126/ijzab.2024.v09.i04.010 **http://www.ijzab.com**

Research Article

INFLUENCE OF NUMBER OF SEEDLING PER PLANTING HOLE ON NIEBE (*VIGNA UNGUICULATA* L. WALP) AGRONOMIC PARAMETERS CULTIVATED IN DALOA, CÔTE D'IVOIRE

***Gnamien Y G, Kouassi N J, Nanti B T J-I, Kouame N, Ayolié K, Kouadio Y J**

Laboratory for the Improvement of Agricultural Production, UFR Agroforestry, Jean Lorougnon Guédé University, BP 150 Daloa, Côte d'Ivoire

Article History: Received 8th May 2024; Accepted 22nd July 2024; Published 4th August 2024

ABSTRACT

Cowpeas (*Vignaunguiculata* (L) walp) are one of the important plants in most African communities where they are grown. Cowpeas represent an easily transportable source of protein. Despite its importance, it confronted with numerous cultural constraints. This work was undertaken to evaluate the influence of number of plants per sowing point and seeding spacing on the growth and production of cowpea with a view to increasing cowpea yield. The trial was set up in a three replicates plot block design. The main plots consisted of the number of plants per sowing point (one plant per sowing point, two plants per sowing point and three plants per sowing point) at three spacing resulting in the following stand : Plots with a density of 20cm x 20cm had (225 ;450 ; 675) plants per sowing point, those with a density of 30cm x 30cm had (100 ;200 ; 300) plants per sowing point and finally those with a density of 40cm x 40cm had (56 ;112 ; 168) plants per sowing point. Observations were made on growth and yield parameters. The results showed that three plants per plot at high densities resulted in lower yields. Sowing two plants per sowing point at different spacing resulted in a 50% decrease in yield compared to sowing one plant per plot. On the other hand, the highest yield was obtained with the one plant per sowing point at low-density. On the other hand, the different spacing adopted induced significant effects for eight tenths of the observed parameters. The sowing of cowpea at 40 cm x 40 cm spacing with one plant per sowing point would effectively increase the yield of this crop in the city of Daloa.

Keywords: Cowpea, Number of plants, Sowing point, Yield, Density.

INRODUCTION

Legumes, a subgroup of vegetable crops, are plant species that belong to the leguminosae family (commonly known as the pea family) that produce edible seeds used in food and feed (Gnamien *et al.*, 2023). Legumes have many agronomic benefits. They play a role in protecting soils from degradation and controlling weeds. They fix and use atmospheric nitrogen, to improve soil fertility, especially its nitrogen status and increase gross income by consequently reducing chemical fertilizer loads (Bado, 2002; Carsky *et al.*, 2003). They exert a favorable influence on soil fertility through nitrogen-fixing symbiosis with rhizobium strains, thus playing an important role in crop rotation (Baudoin *et al.*, 2001). Among these legumes, cowpea (*Vigna unguiculata* (L) walp) is one of the most important plants in most African communities where it is grown (Taffouo *et al.*, 2008). This plant plays a major role in human nutrition because of its protein quality contained in the seed (Archimèdes *et al.*, 2018). Its nutritional qualities are great. Indeed, they represent an easily transportable source of protein that can be used by humans without special processing. Cowpea is consumed in several forms: green beans (green pods), dried grains and even green leaves (Doudje *et al.*, 2009), which is rare among legumes. Cowpea seeds are an important source of plant vitamins. Because of their high protein, calcium, iron, and nicotinic acid content, the seeds contribute to meeting the dietary needs of populations in tropical countries (Boyé *et al.*, 2016). The trade in fresh products and foods derived from cowpeas offers populations in rural and urban areas of sub-

*Corresponding Author: Dr Gnamien Y G, Laboratory for the Improvement of Agricultural Production, UFR Agroforestry, Jean Lorougnon Guédé University, BP 150 Daloa, Côte d'Ivoire, Email: gwladysgnamien@gmail.com, Mobile: +225 0708783621.

Saharan Africa an opportunity for a substantial source of income. It occupies a prominent position due to the fact that it is an important source of protein and energy for humans and animals in developing countries (Kouassi *et al.*, 2016). This possibility of using the plant in food and feed makes it a very attractive crop in regions where arable land is increasingly scarce and is often a source of conflict between farmers and herders. Despite its importance, it is clear that this crop, which contributes to food security, generates foreign exchange for the population and improves land fertility, is still confronted with numerous cultivation constraints. In Africa, cowpea yields rarely exceed 400 to 500 kg of seeds per hectare under traditional cultivation (Langyintuo *et al.*, 2003). This is due to the absence of improved varieties that are truly adapted to local growing conditions. The presence of numerous parasites that are very active during the different stages of the plant's development is also observed (N'Gbesso *et al.*, 2013), but above all due to unsuitable cultivation techniques. In addition, failure to use the correct cultivation technique prevents the plant from expressing its full production potential.

In view of all the above, the aim of this study is to optimise the production of a cowpea accession grown in the Haut Sassandra region. It is to help improve cowpea productivity. Particularly, the objectives of the present work are to: (i) identify the number of plants per sowing point that will enable us to optimise cowpea production; (ii) identify the sowing density that will enable us to optimise cowpea production; (iii) establish the appropriate cultivation technical itinerary for a cowpea accession cultivated in the Haut Sassandra region.

MATERIALS AND METHODS

Presentation of the study area

The study was carried out on an experimental plot in the town of Daloa. The city of Daloa is located in the Upper Sassandra region in the central west of Côte d'Ivoire between 6° and 7° north latitude and 7° and 8° west longitude (Figure 1). The climate has four seasons. The main rainy season runs from April to mid-July, the short dry season from mid-July to mid-September, the short rainy season from mid-September to mid-November and the long dry season from December to March. The dry and wet seasons alternate with temperatures ranging from 24.65°C to 27.75°C on average. The soil substrate of Daloa belongs to the old Precambrian basement composed of granite. The soils of the region are mostly ferralitic. They are generally very deep with a high level of organic matter. They are ferralitic soils of granitic origin, moderately to slightly denature. These ferralitic soils have good agricultural aptitudes and are suitable for all types of crops (Atlas, 2007).

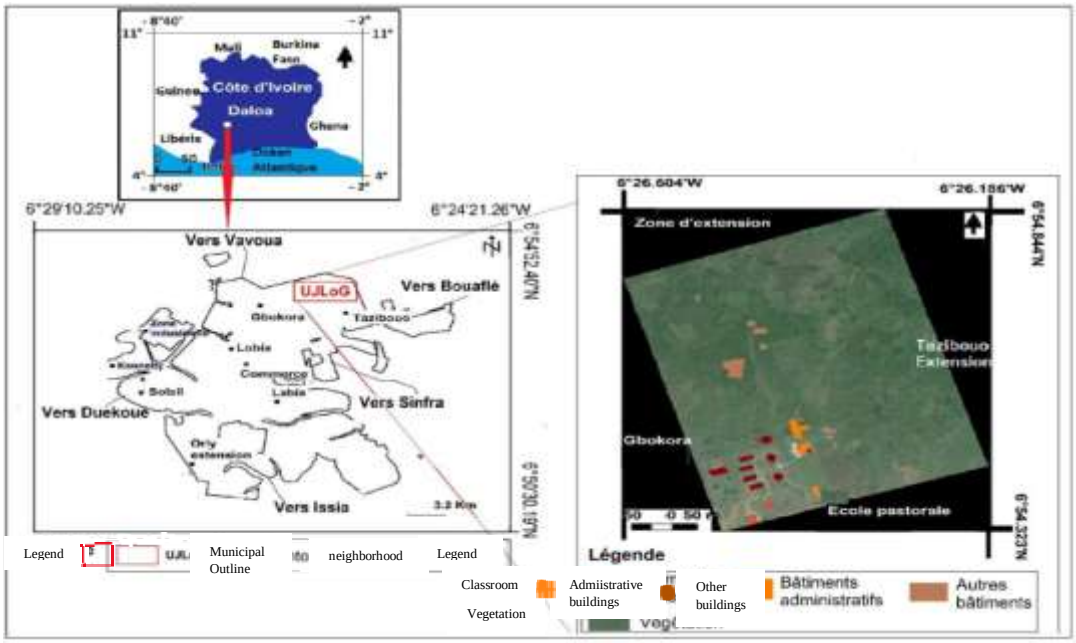

Figure 1. Location of the study area (Akoguhi *et al.*, 2020)

MATERIAL AND METHODS

The plant material used in this study consists of seeds from an accession of cowpea *Vigna unguiculata* (L.) walp; purchased on the local market of Daloa (Figure 2).

Choice and preparation of the experimental plot

The plot chosen for the experiment was a fallow land. As for the preparation of the plot, it consisted of clearing and leveling the cultivation soil. Thus, the delimitation of the experimental plot consisted of tracing the dimensions required for the realization of the various blocks with the help of a rope and a metricmeter. The delimitation of the plot was carried out by the method of a right-angled triangle.

Experimental device

The experimental set-up used is that of the completely randomized blocks of Ficher with three repetitions (Figure 3). A plot of 611 m² (26 m x 24.5 m) consisting of three blocks was set up. The spacing between two neighboring blocks is 2 m. Each block consisted of six elementary plots spaced 1 m apart. Each elementary plot measured 9 m² (3 m x 3 m). The different treatments are:

-T1 (d1p1): one plant per sowing point at 20 cm x 20 cm spacing;

- T2 (d1p2): two plants per sowing point at 20 cm x 20 cm spacing;

- T3 (d1p3): three feet per sowing point at 20 cm x 20 cm spacing;

- T4 (d2p2): two feet per sowing point at 30 cm x 30 cm spacing;

- T5 (d2p3): three feet per sowing point at 30 cm x 30 cm spacing;

- T6 (d2p1): one foot per sowing point at 30 cm x 30 cm spacing;

- T7 (d3p1): one foot per sowing point at 40 cm x 40 cm spacing;

- T8 (d3p2): two feet per sowing point at 40 cm x 40 cm spacing;

- T9 (d3p3): three feet per sowing point at 40 cm x 40 cm spacing.

Figure 2. Seeds of red cowpea

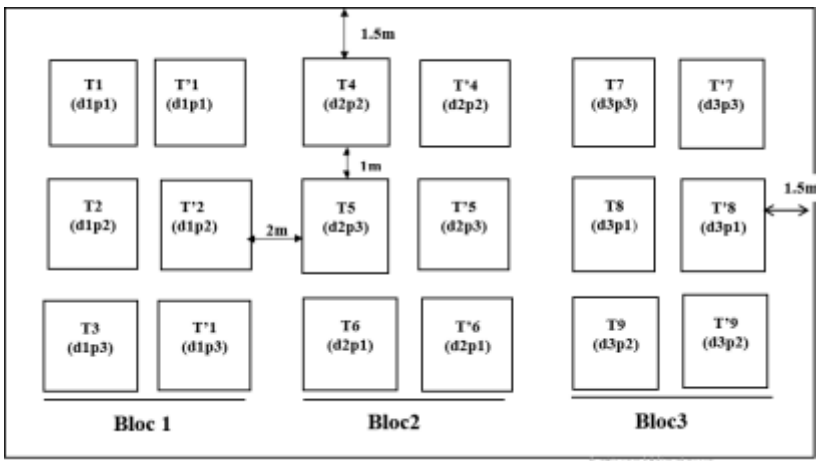

Figure 3. Experimental device

Conduct of the trial

Sowing was done at the start of rainy season, on April. They were made at a rate of three seeds per sowing point at a depth of 3 cm more or less. Ademariage was carried out one month later in order to obtain plots with one plant per sowing point and two plants per sowing point, but those with three plants per sowing point were kept. The plots of density 20 cm x 20 cm correspond respectively to (225; 450; 675) plants per sowing point (Figure 4a), those of 30 cm x 30 cm give densities (100;200 ; 300) plants per sowing point (Figure 4b) and finally those of 40 cm x 40 cm give densities of (56 ;112 ; 168) plants per sowing point according to the number of plants per sowing point (Figure 4c). The trials were conducted without any fertilization of the plots. Manual weed control was the method used for plot maintenance. It consisted of weeding cowpeas once with a hoe and by hand, first 2 weeks after sowing and 5 weeks later to ensure field cleanliness. A third weeding was done just before flowering.

Measured parameters

Data collection started with the measurement of vegetative parameters. Fifteen plants were selected based on their performance. After pod maturation, the yield parameters were evaluated. All the parameters evaluated and the measurement methods are described in Table 1.

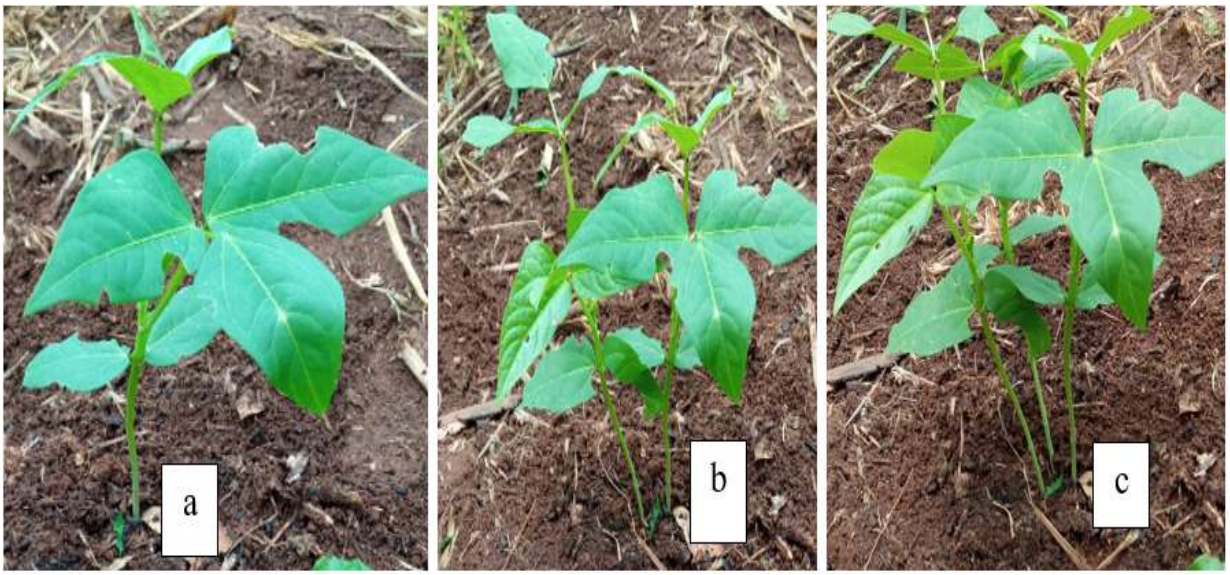

Figure 4. Different plants per cluster
a:One plant per sowing point; **b:** Two plants per sowing point; **c:** Three plants per sowing point

Table 1. Measurementmethodsof vegetative and yield parameters.

Plant parameters	Codes	Measurement methods
Fresh biomass (g)	FrB	Measurement of the fresh mass of each plant
Wingspan(cm)	Wip	Measurement of the distance between the two most extreme leaves
Height of the plant(cm)	HeP	Measurement of the distance between the farthest leaf and the collar
Nodulation rate	NoR	Number of all the nodules of each plant
Number of leaves : Nfe	NbL	Number of all the leaves of each plant
Branching	Brg	Number of all the branches of each plant
Number of pods	NbP	Number of all pods of each plant
Fresh weight of pods (g)	FwP	Mass of pods harvested the same day per plant
Dry weight of pods(g)	DwP	Mass of harvested and dried pods on each plant
Seed weight	SeW	Mass of seeds on each plant

Statistical analysis of the experimental data

The data processing was done by the Statistica 7.1 software by a descriptive analysis and a comparative study of the different means obtained. A two-factor analysis of variance (ANOVA 2) was performed to evaluate the effect of the number of plants per sowing point and the seeding density on the agronomic variables. When a significant difference was observed ($P < 0.05$) between the different factors studied for a given parameter, multiple comparisons were performed using the Smallest Significant Difference (SSD) test to determine the different homogeneous groups.

RESULTS AND DISCUSSION

The studied characters show that the quantitative variables present important differences between the minimum and maximum values. Indeed, the fresh biomass of the plants with the average of 125.58 and the height of the plants for an average of 100.58 showed very important differences. On the other hand, the number of ramification and the weight of seeds gave the weakest variations (Figure 5). The most significant correlations were observed between the number of pods, fresh weight of pods (r = 0.95), dry weight of pods (r = 0.91) and seed weight (r = 0.79). Fresh pod weight was positively correlated with dry pod weight (r = 0.85) and seed weight (r = 0.73). In terms of positive correlations, the analysis showed that seed weight was positively influenced by pod dry weight (r = 0.84). No correlation was observed between yield and vegetative parameters (Table 2). Significant differences were observed in the three types of plants per sowing point (Table V). Of eight of the ten parameters studied, the one- and two-plant sowing point had the highest averages for the number of branches. Leaf number, spread, and fresh biomass had the highest values in the one-footed clusters. In contrast, the three-stalked clusters had the lowest leaf count, branching, fresh biomass and span. For yield parameters, results showed that pod number, pod fresh weight, pod dry weight, and seed weight were significantly higher in one plant per sowing point. These yield parameters yielded a low average at the three plants per sowing point. No significant effects were observed for plant height and nodule number.

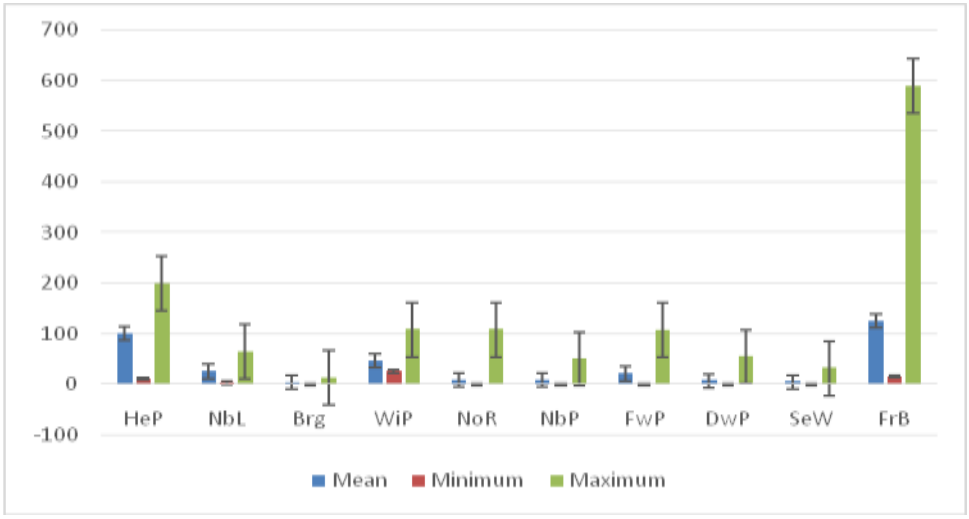

Figure 5. Descriptive and quantitative analysis of plant parameters HeP : Plant height ; NbL : Number of leaves ; Brg : Branching ;Wip : Wingspan ; NoR : Nodulation rate ; NbP : Number of pods ; FwP : Fresh weight of pods ; DwP : Dry weight of pods ; SeW : Seed weight ;FrB : Fresh biomass.

Table 2. Correlationbetween quantitative traits.

Variable	HeP	NbL	Brg	Wip	NoR	NbP	FwP	DwP	SeW	FrB
HeP	1.00									
NbL	0.36	1.00								
Brg	0.20	0.38	1.00							
Wip	0.32	0.36	0.24	1.00						
NoR	0.14	0.11	0.14	0.00	1.00					
NbP	0.21	0.49	0.28	0.26	-0.04	1.00				
FwP	0.25	0.51	0.31	0.32	-0.03	**0.95**	1.00			
DwP	0.18	0.46	0.27	0.21	-0.08	**0.91**	**0.85**	1.00		
SeW	0.14	0.38	0.08	0.15	-0.13	**0.79**	**0.73**	**0.84**	1.00	

FrB	0.13	0.57	0.16	0.22	0.05	0.30	0.32	0.24	0.23	1.00

NB: Values in bold represent significant (> 0.7) and positive correlations. HeP : Plant height ; NbL : Number of leaves ; Brg : Branching ; Wip : Wingspan ; NoR : Nodulation rate ; NbP : Number of pods ; FwP : Fresh weight of pods ; DwP : Dry weight of pods ; SeW : Seed weight ; FrB : Fresh biomass.

Table 3. Vegetative and yield parameters of cowpea depending on the number of plant per sowing point.

	Mean (± Standard deviation)			Statistics	
Variable	1 P per sowing point	2 P per sowing point	3 P per sowing point	**F**	**P**
HeP	98.44±33.04[a]	104.23±41.02[a]	100.08±33.94[a]	0.69	0.5015
NbL	33.62±11.49[a]	23.17±10.55[b]	19.38±7.98[c]	47.75	<0.0001
Brg	4.42±1.29[a]	4.62±2.08[a]	3.43±2.31[b]	9.61	<0.0001
Wip	49.08±8.81[a]	45.88±9.67[b]	43.73±10.45[c]	6.98	0.0011
NoR	6.84±16.40[a]	7.68±21.82[a]	6.68±7.99[a]	2.94	0.0542
NbP	10.92±10.04[a]	7.47±5.62[b]	5.38±6.25[c]	12.28	<0.0001
FwP	27.62±22.01[a]	20.30±16.18[b]	14.93±16.80[c]	10.64	<0.0001
DwP	10.41±10.49[a]	5.67±4.75[b]	4.87±5.51[c]	14.90	<0.0001
SeW	6.00±6.45[a]	3.08±2.43[b]	2.50±1.28[c]	9.77	<0.0001
FrB	167.67±87.94[a]	103.52±65.45[c]	105.55±79.24[b]	20.04	<0.0001

For each character, values with the same letters in rows are statistically equal. HeP : Plant height ; NbL : Number of leaves ; Brg : Branching ; Wip : Wingspan ; NoR : Nodulation rate ; NbP : Number of pods ; FwP : Fresh weight of pods ; DwP : Dry weight of pods ; SeW : Seed weight ; FrB : Fresh biomass.1p : one plant ; 2p :two plants ; 3p :three plants

Table 4. Vegetative and yield parameters of cowpea depending on the spacing.

	Mean (± Standard deviation)			Statistics	
Variable	20cm x 20 cm	30cm x30 cm	40cm x40 cm	**F**	**P**
HeP	103.37±32.41[a]	94.95±36.18[a]	103.43±39.24[a]	1.64	0.1944
NbL	22.47±9.23[c]	24.38±12.38[b]	29.32±12.37[a]	8.59	0.0002
Brg	3.41±1.93[b]	4.33±1.68[a]	4.73±2.16[a]	11.02	<0.0001
Wip	43.48±9.49[c]	46.34±10.61[b]	48.87±8.81[a]	6.99	0.0010
NoR	4.22±18.01[a]	5.85±12.95[a]	6.14±20.86[a]	0.94	0.3898
NbP	3.94±0.41[c]	5.14±0.54[b]	9.93±1.04[a]	44.20	<0.0001
FwP	8.30±1.19[c]	22.34±14.76[b]	32.21±22.29[a]	44.59	<0.0001
DwP	3.42±0.36[c]	4.91±0.51[b]	10.55±1.11[a]	30.87	<0.0001
SeW	2.93±2.56[c]	4.46±3.12[b]	6.18±6.39[a]	12.47	<0.0001
FrB	109.31±67.77[c]	125.36±97.39[b]	142.07±77.34[a]	3.61	0.0287

For each character, values with the same letters in rows are statistically equal. HeP : Plant height ; NbL : Number of leaves ; Brg : Branching ; Wip : Wingspan ; NoR : Nodulation rate ; NbP : Number of pods ; FwP : Fresh weight of pods ; DwP : Dry weight of pods ; SeW : Seed weight ; FrB : Fresh biomass.

The analysis of variance shows that the parameters studied were influenced by the different spacings. Eight out of ten of the parameters had significant differences for all spacings. No significant differences were obtained for plant height and nodulation rate (Table 3). The 40 cm x 40 cm spacing resulted in an increase in wingspan, number of leaves and fresh plant biomass. The 30 cm x 30 cm and 40 cm x 40 cm spacings gave the highest statistically identical means for number of branches. High values for number of pods were obtained with the 40 cm x 40 cm spacing. Therefore, the 20 cm x 20 cm spacing resulted in a decrease in fresh pod weight, dry pod weight and seed weight.

The results of the analysis of variance showed that the density-number of plants per sowing point interaction significantly influenced all the parameters studied (Table 4). Indeed, the highest number of pods, fresh weight of pods, dry weight of pods and seed weight were observed at the level of the one plant per sowing point at 40 cm x 40 cm spacing. On the other hand, these same parameters gave the lowest values with the three plants per sowing point at

the 20 cm x 20 cm spacing. On the other hand, the one plant per sowing point at the 40 cm x 40 cm spacing and the 30 cm x 30 cm spacing recorded more branching, number of leaves as well as the spread. The high number of nodules was observed for the one plant per sowing point at 40 cm x 40 cm spacing.

Table 5. Interaction between the number of plants per sowing point and sowing density.

Variable	Mean (± Standard deviation)									Statistics	
	20 cm x 20 cm			30 cm x 30 cm			40 cm x 40 cm				
	1 PP	2 PP	3 PP	1 PP	2 PP	3 PP	1 PP	2 PP	3 PP	F	P
HeP	106.30±28.38^{d}	109.06±36.27^{b}	104.76±31.37^{e}	99.43±35.51^{f}	76.86±34.07^{i}	108.56±32.33^{c}	89.60±3374^{h}	93.93± 36.98^{g}	126.76±36.95^{a}	9.13	<0.0001
NbL	29.20±8.09^{c}	18.63±7.97^{f}	19.6±7.88^{e}	36.40±12.19^{a}	18.96±6.85^{e}	18.00±7.13^{e}	35.92±12.65^{a}	32.13±20.56^{b}	20.56±8.89^{d}	6.78	0.0003
Brg	4.03±1.15^{b}	3.50±1.77^{c}	1.70±1.11^{d}	5.03±1.32^{a}	4.63±2.02^{b}	4.33±1.64^{b}	5.20±1.81^{a}	4.73±1.25^{b}	4.26±2.80^{b}	12.00	<0.0001
Wip	47.70±11.85^{b}	42.33±6.44^{d}	40.43±8.06^{e}	51.13±7.49^{a}	42.86±7.58^{d}	45.03±13.92^{c}	50.43±05.92^{a}	42.46±10.99^{d}	45.73±7.67^{c}	3.90	0.0042
NoR	3.36±3.6^{f}	2.56±4.55^{g}	0.33±1.29^{h}	10.00±5.80^{b}	6.70±4.17^{d}	5.46±4.99^{e}	19.40±11.40^{a}	10.23±6.80^{b}	8.36±7.38^{c}	8.41	<0.0001
NbP	10.31±10.04^{g}	8.58±6.66^{h}	1.00±4.03^{i}	29.76±15.95^{c}	15.98±10.30^{e}	14.27±14.42^{f}	42.78±24.60^{a}	31.33±19.79^{b}	22.51±18.44^{d}	4.64	0.0012
FwP	4.03±4.36^{e}	3.65±2.69^{f}	0.27±0.90^{g}	8.31±4.59^{b}	5.92±4.58^{d}	4.16±5.32^{e}	18.88±13.29^{a}	7.46±5.67^{c}	6.10±5.44^{d}	11.33	<0.0001
DwP	1.68±1.64^{e}	0.26±1.93^{f}	0.83±2.84^{f}	4.83±2.84^{b}	3.57±2.65^{c}	2.97±3.69^{d}	11.45±8.10^{a}	3.41±2.52^{c}	3.68±3.23^{c}	19.25	<0.0001
SeW	2.29±8.86^{d}	2.99±8.23^{d}	2.99±4.56^{d}	5.99±4.93^{b}	4.56±7.00^{c}	4.35±8.63^{c}	14.48±3.76^{a}	4.35±19.83^{c}	4.99±6.86^{c}	2.66	0.0361
FrB	114.28±78.88^{e}	84.00±51.14^{g}	83.67±47.34^{f}	202.92±8.86^{a}	129±67.69^{d}	99.49±97.95^{f}	185.83±72.04^{b}	142.89±68.37^{c}	97.49±67.83^{c}	8.66	<0.0001

For each character, values with the same letters in rows are statistically equal. HeP : Plant height ; NbL : Number of leaves ; Brg : Branching ; Wip : Wingspan ; NoR : Nodulation rate ; NbP : Number of pods ; FwP : Fresh weight of pods ; DwP : Dry weight of pods ; SeW : Seed weight ; FrB : Fresh biomass.1pp : one plant per sowing point ; 2pp : two plants per sowing point ; 3pp : three plants per sowing point

Analyses of variance performed to compare the three different numbers of plants per sowing point showed a significant difference in the eight out of ten parameters studied. One plant per sowing point stood out for their high means in number of pods, fresh weight of pods, dry weight of pods as well as seed weight compared to the two and three plants per sowing point. This difference could be explained by the fact that the spacings are not the same. In fact, the high number of plants in each sowing point negatively influences the yield. These results differ from those obtained by Useni *et al.* (2014), working on cowpea plants, recommending three plants per sowing point. Also, plants with one plant per sowing point obtained good fresh biomass and span. Indeed, the averages of one plant per sowing point were high compared to those of two and three per sowing point. This is consistent with the results of work done by Kilolo *et al.* (2015). However, the lack of competition for light, water, nutrients and living space would justify the good performance of one plant per sowing point. In addition, illumination promotes floral induction, triggers photosynthesis, as well as dry matter. The results show that the number of nodules does not depend on the three plants per sowing point. In sum, the nodulation capacity remains constant according to the number of plants per sowing point. This result could be explained by the soil condition, which can affect the soil microbial community. An increase in the microbial population would lead to an increase in the number of nodules (Dong *et al.*, 2014). This result, could also be related to the abiotic conditions of the growing environment such as temperature and water. The results show that the number of pods, pod weight, seed weight decreased at the spacing of 20cm x 20cm at three plants per sowing point. These results differ from Badoy *et al.* (2015) who reported that cowpea yields are inversely proportional to spacing. Low yields were obtained at wide spacings and high yields at narrow spacings. The observations also corroborate with those of Taffouo *et al.* (2008) who reported that cowpea seed yield increases at high spacings.

The results obtained in this study show that the number of leaves produced decreases significantly at low spacing associated with high number of plants per sowing point. It appears that when the spacing is closer, the plants create more and more shade. Thus, the leaves towards the base of the plant are deprived of light. They can no longer participate in the photochemical act. The quantity of substances elaborated by the plant decreases, making tunable to initiate the formation of new leaves by branching. The analyses showed that the highest heights were found with the three plant per sowing point and high density. These results are consistent with those of N'dri *et al.* (2017). Indeed, high densities generate rapid plant growth. This rapid growth would be explained by the high density which generates competition for their energy source. The plants, in order to take advantage of it as much as possible, direct their growth towards the light source. These same findings were observed in Cameroon on cowpea (Mellendorf and Yield, 2011). This study showed

that cowpea height at very high density (250,000 plants/hectare) increased significantly than at low-density (27777.77 plants/hectare). The 20cm x 20cm spacing associated with three plants per sowing point gave a low average for the branching parameter (1.70 ±1.11). Indeed, a very high density reduces the development of the number of branches. A study conducted on soybeans showed that too narrow a spacing delays flowering and reduces the number of branches, thus reducing yield. (Mellendorf and Yield, 2011).

CONCLUSION

The study of the influence of the number of plants per sowing point at different spacing's on growth and yield parameters highlighted cowpea production performance in the Daloa zone. The aim of our study was to determine the appropriate number of plants per sowing point at different spacings (20 cm×20 cm ; 30 cm×30 cm ; 40 cm×40 cm), with a view to improving yield. The different spacing adopted for the different plants per sowing point significantly influenced eight out of ten parameters observed. Nevertheless, the study revealed that yields were high when one plant was planted per sowing point in 40 cm x 40 cm spacing. In view of the results of this research, were commend that farmers adopt it in order to increase their production, and hence their income.

ACKNOWLEDGMENT

The authors express sincere thanks to the head of the Laboratory for the Improvement of Agricultural Production, UFR Agroforestry, Jean Lorougnon Guédé University, BP 150 Daloa, Côte d'Ivoire for the facilities provided to carry out this research work.

REFERENCES

Archimède H., Bastianelli D., Fanchone A., Gourdine J.L.&Fahrasmane L. (2018).Aliments protéiques dans les systèmes mixtes intégrés polycultures-élevage en régions tropicales. In : Ressources alimentaires pour les animaux d'élevage. Baumont. Dossier, *Inra Productions Animales,* 31, 221-236.

Akoguhi N. P., Adja M.G., Akpetou K. L., Mamadou D.& Kouamé K. F.(2020). Cartographie aéroportée de l'espace universitaire de l'UJLoG par la méthode de classification dirigéeorientée objet et réalisation du parcellaire des infrastructuresd'enseignement. *International Journal of Engineering Science Invention*, 9 (9), 1-14.

Atlas (2007). *Le département de Daloa. Géologie et pédologie,* 12 p.

Bado V. B. (2002). *Rôle des légumineuses sur la fertilité des sols ferrugineux tropicaux des zones guinéenne et soudanienne du Burkina Faso. Thèse de doctorat. Département des sols et de génie agroalimentaire*. Faculté des Sciences de l'Agriculture et de l'Alimentation. Université Laval (Québec, Canada).

Baboy L. L., Kidinda K. L., Kilumba K. M., Langunu. S., Mazinga K. M.,Tshipama T. D.&Nyembo. K.L. (2015). Influence du semis tardif sur la croissance et le rendement du soja (Glycine max Merril) cultivé sous différents écartements à Lubumbashi, RD Congo. *International Journal of Innovation and Applied Studies,* 12 (1), 104-109.

Baudoin J. P., Camarena F., Lobo M.& Mergeai G. (2001).Breedingphaseolus for intercrop combinations in Andean highlands. *In* HD. Cooper C.,SpillaneT., Hodgkin (Eds). *Broadening the genetic bases of crop*. Wallingford, UK : CAB International, 373–384.

Boyé M. A. D., Yapo S. E. S., Koffi N. B. C., Kouassi N. J., Tonessia D. C., Soko D. F., Ballo E. K., Seu J. G., Ayolié K.& Kouadio Y. J. (2016).Etude dela qualité agronomique et biochimique de quelques variétés de niébé (*VignaUnguiculata*(L) Walp (*Fabaceae*) provenant de la Côte d'Ivoire.*European Scientific Journal*, 12(24),362-375.

SangingaN.,DashiellK.E.,DielsJ.,VanlauweB.,LyasseO.,Ca rskyR.J.,TarawaliS.,Asafo-

AdjeiB.,MenkirA.,SchulzS.,SinghB.B.,ChikoyeD.,Keatinge D. D.&OrtizR.(2003). Sustainableresource management coupled to resilientgermplasm to provide new intensive cereal grain legume-livestocksystems in the dry savana. *Agriculture, Ecosystems& Environement,* 100, 305-314.

Dong W.I., Zhang X.Y., Dai X.Q., Fu X.L., Yang F.T., Liu X.Y., Sun X.M., Wena X.F.& Schaeffer S. (2014). Changes in soil microbial community composition in response to fertilization of paddy soils in subtropical China *Applied Soil Ecology*, 84, 140-147.

Dougje I.Y., Omoigui L.O., Ekeleme F., Kamara A.Y.&Ajeigbe H. (2009**)**. *Production du niébé en Afrique de l'Ouest : Guide du paysan*. Institut International d'AgricultureTropicale (lITA), Ibadan, Nigeria.

Gnamien Y. G., Nanti B. T. J., Kouassi N. J., Kouame N., Ayolié K.& Kouadio Y. J. (2023). Influence of seedingdensity on agronomicparameters of cowpea (*Vignaunguiculata* L.) accession grown in Daloa, west center of Côte d'Ivoire. *GSC Biological and Pharmaceutical Sciences*, 22(03), 039–048.

Kilolo, K. (2015). *Evaluation des effets résiduels du* Tithoniadiversifolia *sur le rendement des cultures en rotation*,TFE/UOM.

Kouassi N. J., Koffi A. M. H., Yah N. M., Kouakou Y.I.J.& Kouadio J. (2017). Influence de la densité de semis sur les paramètres agronomiques de trois variétés de niébé

(*Vigna unguiculata* (L.) Walp, *Fabaceae*) in Côte d'Ivoire. *Afrique science1, 3*(4), 327- 336.

Langyin-tuo A.S., Lowenberg-Debeer J., Faye M., Lambert D., Ibro G., Moussa B., Kergna A., Kushwaha S., Musa S.&Ntoukam G. (2003).Cowpea supply and demand in West, and Central Africa. *Field Crops Research*, 82 (2-3), 215-231.

Mellendorf N.E.(2011).Soybeangrowth,yieldresponse to interplant competition relief in various plant densityenvironments. Thesis for the degree of Master of Science in Crop Sciences, University of Illinois at Urbana-Champaign, Urbana, Illinois.

N'Gbesso M.F.D.P., Zohouri G.P., Fondio L., Djidji H.A.& Konate D. (2013**)**. Etude des caractéristiques de croissance et de l'état sanitaire de six variétés améliorées de niébé [*Vignaunguiculata*(L.) Walp] en zone centre de Côte d'Ivoire. *Journal of Applied Biosciences*, 7 (2), 457-467.

N'dri J. K., Ahébé M. H., KOFFI., N'Guettia M. Y.,Yao I. J. & Kouadio J. Y. (2017). Influence de la densité de semis sur les paramètres agronomiques de trois variétésde niébé (*Vignaunguiculata* (L.) Walp, *Fabaceae*) in Côte d'Ivoire. *Afrique Science*, 13(4), 327- 336.

Taffouo V.D., Etamé J., Din N., Nguelemeni M.L.P., Eyambé Y.M., Tayou R.F.&Akoa A. (2008). Effets de la densité de semis sur la croissance, le rendement et les teneurs en composés organiques chez cinq variétés de niébé (*Vignaunguiculata* L. Walp). *Journal of Applied Biosciences*, 12, 623- 632.

Useni S.Y., Mayele K., Kasangij K.P., Nyembo K.L.&Baboy L.L. (2014). Effets de la date de semis et des écartements sur la croissance et le rendement du niébé (*Vignaunguiculata* L. Walp) à Lubumbashi. *International Journal of Innovation and Applied Studies*, 1(6), 40-47.