Effect of Sowing Density and Sowing Method on the Productivity of Sesame (Sesamum Indicum L)

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Abstract

In a rural environment, the decrease of sesame (Sesamum indicum L) production is the result of suitable growing system absence mainly sowing density and sowing method. Thus, to improve production of these crops, some investigations were undertaken on experimental site of University of Jean Lorougnon Guédé. In order to reach these objective two sowings methods (flat soil and mound soil) were tested in random design with three repetitions. Also, inside of each sowing method three sowing densities were tested mainly low density, medium density and high density. It results from statistical analysis that the values of yield and its components were recorded on flat soil with low density.

Keywords: Sesamum indicum, sowing density, sowing method, food security.

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INTRODUCTION

Farming sector provides essential of food for human being and animals. Indeed, it takes up two thirds of world population and constitutes a main source of income and job for the local community [1]. In Africa, food security remains the main objective to reach by government [2]. In this context, agricultural policy of government must be turn towards the crops diversification. Thus, Sesamum indicum L owing to it ease adaptation in breeding ground and it request on the market could constituted an opportunity for farmers [3]. For that purpose, a large area is done the groundwork by farmers to increase the production of sesame on Asian and Africa. In spite of efforts made by farmers, the production of this plant is still very low by hectare. According to Haruna et Abiniiki [4] the yield per hectare exceeds rarely 500 kg/ha. In Côte d’Ivoire, production of sesame is well under this value. In ivorian territory, sesame breeding is essentially concentrated in bafing region clearly in Touba. In this locality, the traditional practice better absence of the control of the growing system particularly sowing density and sowing methods are justified the level of production of farmers. The sowing density plays a cardinal role in the determination of crops yield [5]. Indeed, when the density is under or over the optimum density that lead to an intra specific competition between crops to share nutrients in soil [6]. Thus, that will result to a production decrease. In this condition, determination of optimum density for each variety becomes vital. However, to increase and keep the production of sesame optimum density must be associated with a correct sowing method. The current study is realized in this context to improve crop production and the income of household rural area. Specifically, it will be about study effect of sowing density and sowing method on the productivity of sesame.

MATERIAL AND MÉTHODS

Study site

Experimental were conducted on university Jean Lorougnon Guédé (latitude : 06°53'56"N and longitude : 06°26'30" W) located in Daloa[7].

MATERIAL AND METHODS

Experimental material biology was constituted with 756 plants for two sowing methods (sowing on flat soil and on mound). Those plants come from white seed of S. indicum (Figure 5).

Experiméntal design and treatment

Field experiences took place on an area measured 12 x 7 m. After weeding, the plots were divided into two parts according to sowing methods: sowing on flat soil and sowing on mound. Separated with 2 m each one of plots was divided into three
blocks. Inside of each block three elementary plots were step up corresponding to three densities: Low density, medium density and high density. In practice, plots with low densities comprised 24 sowing points with 30 cm apart on lines and 20 cm apart between lines. Concerning medium density plots, they comprised 36 sowing points with 20 cm apart on lines and 20 cm apart between lines. The highest density comprised 66 plants respecting 10 cm apart on lines and 20 cm apart between lines.

Cultural practice

Sowings were realized in December 2017. After sowing, plants were watered each three days until the crops maturity. Watering was done each afternoon. At seedling stage, vigourless plants were removed per hole in order to maintain only one. Any fertilizer was used during trial. Three treatments of insecticide “Décis fort” were applied to protect plants against insect pests. A fungicide was also used to protect against crops diseases. Two weeding treatments were realized during trial to prevent weeds competition. The harvest started 18 April 2018 with crops having capsules colored yellow.

DATA COLLECTED

Data collected, have concerned six vegetatifs, four biomass and four production parameters. Vegetatifs are made up of ramifications number (RN), ramification number bearing fruits (RNF), ramification number without fruits (RNWF), diameter at collar (DC), plant stem length (PSL), number of dead plants (NDP). The four biomasses are made up of dry leaves biomass (DLB), dry capsules biomass (DCB), dry stems biomass (DSB) and dry roots biomass (DRB). Production parameters have concerned date of first flower emerged (DFFE), date of first capsule emerged (DFCE), number of capsules per plant (NCP), weight of seed per density (WS).

The harvest started 18 April 2018 with crops having capsules colored yellow.

Effect of sowing density on vegetatif parameters of Sesamum indicum

Results

Except of stem length and number of dead plants other parameters have been influenced by sowing density (P≤ 0.05). Thus, plants coming from a low density produced several ramifications (10.80±3.12) than the two others. It is also with the same density ramifications bearing more fruits have been observed (8.70±6.70). Plants with less ramifications without capsules (2.10±2.19) come from low density. However, the number of ramifications without capsules observed in low density is nearest of values recorded in medium density (2.20±1.73). Plants with the biggest diameters on collar (20.67±5.82) have been recorded on low density plots (Table 1).

Table 1. Effect of sowing density on vegetatif parameters of Sesamum indicum

| Parameters | Sowing densities | Statistical |
|------------|-----------------|-------------|
|            | Low             | Medium      | High (control) |
| RN         | 10.80±3.12 a    | 8.18±2.99 b | 7.35±2.67 b   |
| RNF        | 8.70±6.70 a     | 6.00±2.21 ab| 3.86±1.96 c   |
| RNWF       | 2.10±2.19 b     | 2.20±1.73 ab| 3.48±1.81 b   |
| DC (mm)    | 20.67±5.82 a    | 17.85±6.35 b| 14.09±3.32 a  |
| PSL (m)    | 1.39±0.31 a     | 1.41±0.25 a | 1.44±0.26 a   |
| NDP        | 1.33±0.57 a     | 2.66±1.35 a | 2.00±1.04 a   |

Ramifications number (RN), ramification number bearing fruits (RNF), ramification number without fruits (RNWF), diameter at collar (DC), plant stem length (PSL), number of dead plants (NDP). F : F-statistical of Fischer et P : Probability associated with test. On the line, each parameter bearing the same letters are statistically similar (P ≥ 0.05).

Effect of sowing density on biomass parameters of Sesamum indicum

Statistical analysis shows that all parameters of biomass have been influenced by the sowing density (P≤ 0.05). Plants from low density produced more leaf biomass than the two other densities. However, this amount of biomass is nearest to those produced in medium density (12.31±1.39). It also, plants come from to low density which produced more stem (21.07±4.76) and root (5.50±1.53) biomasses. Important quantity of capsule biomasses (8.80±7.10) has been obtained with plants from medium density than those of the two other densities (Table 2).
Table-2: Effect of sowing density on biomass parameters of Sesamum indicum

| Parameters | Sowing densities | Statistical | \(F\) | \(P\) |
|------------|----------------|-------------|-------|-------|
| DLB (g)    | Low 17.84±5.56 | Medium 12.31±3.99 | High (control) 7.77±0.56 | 6.88 | 0.02 |
|            |                 |             |       |       |
| DCB (g)    | 21.07±4.76      | 17.53±5.24  | 14.01±2.43 | 3.99 | 0.02 |
| DSB (g)    | 5.50±1.53       | 2.86±1.20   | 2.45±0.11 | 6.42 | 0.03 |
| DRB (g)    | 6.66±3.09       | 8.80±2.10   | 5.66±0.65 | 0.038 | 0.04 |

Dry leaves biomasses (DLB), dry capsules biomasses (DCB), dry stems biomasses (DSB) and dry roots biomasses (DRB); \(F\): F-statistical of Fischer et \(P\): Probability associated with test. On the line, each parameter bearing the same letters are statistically similar \((P \geq 0.05)\).

Effect of sowing density on production parameters of Sesamum indicum

Data recorded in the table 3 indicates that production parameters tested have been influenced by sowing density \((P \leq 0.05)\). Plants from high (51.66±4.58) and low (51.91±3.82) sowing densities flower early than come from medium density (53.05±5.34). It is a same to appearance of the first capsule. Indeed, capsules appear early on plants sown in high (54.63±4.58) and low (54.85±3.74) densities than those from medium density (55.06±8.34). Concerning capsules number per plant, the sowing from low density recorded the best value (261.98±159.03 capsules/plant) against (201.81±131.13 capsules/plant) and (120.26±77.34 capsules/plant) respectively for plants of medium and high densities. Also, plants grown in low density have a better yield (170.42 g) than those of medium (137.57 g) et high (110.57 g) densities (Table 3).

Table-3: Effect of sowing density on production parameters of Sesamum indicum

| Parameters | Sowing densities | Statistical | \(F\) | \(P\) |
|------------|----------------|-------------|-------|-------|
| DFJE       | Low 51.91±3.82 | Medium 53.05±5.34 | High (control) 51.66±4.58 | 4.52 | 0.02 |
| DFCE       | 54.85±3.74     | 55.06±8.34  | 54.63±4.58 | 0.08 | 0.92 |
| NCP        | 261.98±159.03  | 201.81±131.13 | 120.26±77.34 | 18.78 | 0.00 |
| WS (g)     | 170.42±54.61   | 110.57±40.61 | 137.57±49.74 | 6.137 | 0.03 |

Date of first flower emerged (DFJE), date of first capsule emerged (DFCE), number of capsules per plant (NCP), weight of seed per density (WS). \(F\): F-statistical of Fischer et \(P\): Probability associated with test. On the line, each parameter bearing the same letters are statistically similar \((P \geq 0.05)\).

Effect of sowing methods on vegetatif parameters of Sesamum. indicum

Except stem length, all vegetatif parameters have been influenced by sowing method \((P \leq 0.05)\). Plants grown on flat soil have many branchs (8.77±3.27) than those from mound soil (7.95±3.09). Also, plant grown on flat soil have more branches with fruits (3.54±1.96) than those from bed (2.55±1.85). In consequence, plants from flat soil recorded less branches without capsules. Plants sown on the mound soil have developed the biggest diameter on collar (28.48±125.9 mm). Also, plants grown on bed are very sensitives to fungi attacks (5.77±2.29 dead plants) than those of flat soil (2.00±0.39 dead plants) (Table 4).

Table-4: Effect of sowing methods on vegetatif parameters of Sesamum. indicum

| Parameters | Sowing methods | Statistical | \(F\) | \(P\) |
|------------|----------------|-------------|-------|-------|
| RN         | Flat soil (control) 8.77±3.27 | Mound soil 7.95±3.09 | 5.99 | 0.01 |
| RNF        | 7.23±2.41       | 5.40±2.24   | 3.46 | 0.04 |
| RNWF       | 1.54±1.96       | 2.55±1.85   | 24.37 | 0.00 |
| DC (mm)    | 17.54±5.95      | 28.48±5.99  | 5.35 | 0.02 |
| PSL (m)    | 1.41±0.27       | 1.42±0.20   | 0.06 | 0.80 |
| NDP        | 2.00±0.39       | 5.77±2.29   | 5.17 | 0.03 |

Ramifications number (RN), ramification number bearing fruits (RNF), ramification number without fruits (RNWF), diameter at collar (DC), plant stem length (PSL), number of dead plants (NDP). \(F\): F-statistical of Fischer et \(P\): Probability associated with test. On the line, each parameter bearing the same letters are statistically similar \((P \geq 0.05)\).

Effect of sowing methods on biomass parameters of Sesamum. indicum

Statistical analysis presented by table 5 show that only capsules biomass has been affected by sowing method on the four parameters tested \((p \leq 0.05)\). In other words, plants from flat soil and mound soil have produced similar value of leaf biomass, stem biomass and root biomass. About capsules biomass the greatest quantity has been produced with plant on mound soil (17.00±30.36 g).
Table 5: Effect of sowing methods biomass parameters of Sesamum indicum

| Parameters | Sowing methods | Statistics |
|------------|----------------|------------|
|            | Flat soil (control) | Mound soil | F  | P     |
| DLB (g)    | 12.6±5.23*       | 15.89±6.32*| 1.40 | 0.25  |
| DCB (g)    | 17.54±4.83*      | 16.14±9.04*| 0.16 | 0.68  |
| DSB (g)    | 3.60±1.73*       | 4.31±1.49* | 0.86 | 0.36  |
| DRB (g)    | 7.04±4.12*       | 17.00±30.36*| 3.95 | 0.03  |

Dry leaves biomasses (DLB), dry capsules biomasses (DCB), dry stems biomasses (DSB) and dry roots biomasses (DRB) ;

\( F \): F-statistical of Fischer et \( P \): Probability associated with test. On the line, each parameter bearing the same letters are statistically similar (\( P \geq 0.05 \)).

Effect of sowing methods on production parameters of Sesamum indicum

Data written in table 6 show that all production parameters tested have been affected by sowing method (\( p \leq 0.05 \)). The first flowers (52.21±4.63) and first capsules (54.85±5.87) have been observed on plant from soil flat. Plants from bed have produced more capsules on branches (205.01±123.88) comparatively to plants from soil flat. It is plants from soil flat which have recorded the best value seed weigh (139.52±49.50 g/m²).

Table 6: Effect of sowing methods production parameters of Sesamum indicum

| Parameters | Sowing methods | Statistics |
|------------|----------------|------------|
|            | Flat soil (control) | Mound soil | F  | P     |
| DFFE (Das) | 52.21±4.63*       | 55.07±4.64*| 34.16 | 0.00  |
| DFCE (Das) | 54.85±5.87*       | 57.96±4.63*| 31.23 | 0.00  |
| NCP        | 194.68±139.16*    | 205.01±123.88*| 3.55 | 0.04  |
| WS (g)     | 139.52±49.50*     | 104.36±35.81*| 4.98 | 0.00  |

Date of first flower emergence (DFFE), date of first capsule emergence (DFCE), number of capsules per plant (NCP), weight of seed per density (WS). \( F \): F-statistical of Fischer et \( P \): Probability associated with test. On the line, each parameter bearing the same letters are statistically similar (\( P \geq 0.05 \)).

Effect of block on vegetative parameters of Sesamum indicum

Analysis of table 7 show that only collar diameter and stem length have been affected the block on the five parameters tested (\( P \leq 0.05 \)). Thus, plants with big diameter have been observed in block 3 (18.77±5.74 mm). However, plants of similar diameter have been found in block 2 (17.72±5.97 mm). It is also plants from block 3 which have developed a longer stem (1.52±0.29) comparatively to those of two blocks.

Table 7: Effect of block methods on vegetative parameters of Sesamum indicum

| Parameters | Blocks | Statistics |
|------------|--------|------------|
|            | Block 1 | Block 2 | Block 3 | F  | P     |
| RN         | 8.48±3.76*  | 8.66±2.85* | 9.18±3.14* | 0.73 | 0.48  |
| RNF        | 5.00±2.68*  | 5.01±2.02* | 5.70±2.45* | 1.65 | 0.19  |
| RNNF       | 3.48±2.34*  | 3.65±1.87* | 3.50±1.63* | 0.12 | 0.87  |
| DC (mm)    | 16.12±5.93* | 17.72±5.97* | 18.77±5.74* | 3.10 | 0.04  |
| PSL (m)    | 1.30±0.25*  | 1.42±0.24* | 1.52±0.29* | 9.62 | 0.00  |
| NDP        | 2.66±1.42*  | 2.10±1.06* | 1.10±0.21* | 1.28 | 0.34  |

Ramifications number (RN), ramification number bearing fruits (RNF), ramification number without fruits (RNNF), diameter at collar (DC), plant stem length (PSL), and number of dead plants (NDP). \( F \): F-statistical of Fischer et \( P \): Probability associated with test. On the line, each parameter bearing the same letters are statistically similar (\( P \geq 0.05 \)).

Effect of block on biomass parameters of Sesamum indicum

Analysis of variance shown that biomass parameters have not been affected by block. Indeed, all probabilities associated to four parameters are superior to probability \( P > 0.05 \) (Table 8).
Effect of block on production parameters of Sesamum indicum

All production parameters tested have been significantly affected by block \((P \leq 0.05)\). Thus, it with block 3 first flowers \((50.33\pm4.05)\) and capsules \((53.31\pm4.06)\) have been observed. At the same period some plants from block 2 produced capsules \((55.11\pm4.19)\). It plants from block 2 \((202.55\pm150.66)\) and block 3 \((236.71\pm143.81)\) which produced more capsules. But plants of block 3 recorded the best value of seed weight \((186.05\pm42.69)\) (Table 9).

| Parameters | Blocks | Statisticala |
|------------|--------|--------------|
| DLB (g)    | Block 1: 11.24±4.30<sup>a</sup> | Block 2: 11.52±2.82<sup>a</sup> | Block 3: 15.16±8.28<sup>a</sup> | \(F\) | \(P\) |
| DCB (g)    | 16.14±3.45<sup>b</sup> | 15.94±1.37<sup>b</sup> | 20.53±7.72<sup>b</sup> | 0.82 | 0.48 |
| DSB(g)     | 3.07±1.23<sup>a</sup> | 3.89±2.92<sup>a</sup> | 3.84±1.14<sup>a</sup> | 0.16 | 0.85 |
| DRB (g)    | 5.40±1.28<sup>a</sup> | 5.13±1.31<sup>a</sup> | 10.59±6.03<sup>a</sup> | 2.13 | 0.19 |

Dry leaves biomasses (DLB), dry capsules biomasses (DCB), dry stems biomasses (DSB) and dry roots biomasses (DRB) ; \(F\) : F-statistical of Fischer et \(P\) : Probability associated with test. On the line, each parameter bearing the same letters are statistically similar \((P \geq 0.05)\).

### DISCUSSION

Determination of optimum density constitutes an important step to increase production of any crops [8, 9]. In this context, a present study has been undertaken to improve the growing system and increase sesame production. It results for investigations that sesame plants sown on the plots with low density recorded the best value of yield and its components. A low density is characterized by a population with a few individuals on a unity of surface. What means an absence of competition for space, water, light and nutrients [10]. Availability of nutrients in quality for plants allows them to carry out their function physiological and reproduction which is necessary for space, water, light and nutrients [10]. Availability of nutrients in quality for plants allows them to carry out their function physiological and reproduction which is necessary for space, water, light and nutrients [10].

In addition, results from the current study shown that plants realized on flat soil recorded the best value of yield and its components than plants from mound soil. Earthing up consist to break up soil in order to allow plants take roots easily. This way of growing is frequently used for tuber crops and those with pod mainly yam, sweet potato, groundnut and others[13]. Because of climate change or disturbance of rainy regime this practice spreads progressively to others crops today. A trial has been taken during the dry season particularly December, January, February and March which obliged experimenter to water plants each three days. In this condition, frequency and excess of water brought to plants could explain this result. This opinion is supported by[14]. Indeed, the fast water seepage and its difficult flow on mound soil favoured a damp environment around plants. Sesame is tropical crop and indicated by several authors as very sensitive to water excess. Thus, soil humidity has probably favoured diseases proliferation. During experimentation a death number of plants due to fungi infection have been observed on the plot with mound soil. On farm observations agree with results of Romain et al. [15]. According to them, heavy rain or soil very humid lead to proliferation of pathogens mainly sesame fungi which attack stems, leaves and capsules which provoke a decrease of yield.

Our results also shown that yield and its components have not been influenced by the blocks. That could be justified by soil homogeneity with nutritious. Indeed, experiment site had previously used to grow together several crops such as maize, tomato, okra and soybean. Thus, after harvest, crops waste decomposition by soil microorganism had probably contributed to soil restoration in minerals. In addition, soybean is a leguminous plant fixative of nitrogen which could also justified the homogeneity of the soil. Indeed, according to Teame et al.[16] the provision of organic matter in the soil improve fertility level which favoured development and productivity of crops.

### Table-8: Effect of block methods on biomass parameters of Sesamum indicum

| Parameters | Blocks | Statisticala |
|------------|--------|--------------|
| DSB (g)    | Block 1: 3.07±1.23<sup>a</sup> | Block 2: 3.89±2.92<sup>a</sup> | Block 3: 3.84±1.14<sup>a</sup> | \(F\) | \(P\) |
| DRB (g)    | 5.40±1.28<sup>a</sup> | 5.13±1.31<sup>a</sup> | 10.59±6.03<sup>a</sup> | 2.13 | 0.19 |

Dry leaves biomasses (DLB), dry capsules biomasses (DCB), dry stems biomasses (DSB) and dry roots biomasses (DRB) ; \(F\) : F-statistical of Fischer et \(P\) : Probability associated with test. On the line, each parameter bearing the same letters are statistically similar \((P \geq 0.05)\).

### Table-9: Effect of block methods on production parameters of Sesamum indicum

| Parameters | Blocks | Statisticala |
|------------|--------|--------------|
| DFFE (Das) | 54.21±4.87<sup>a</sup> | 52.08±4.17<sup>a</sup> | 50.33±4.05<sup>a</sup> | 11.82 | 0.00 |
| DFCE (Das) | 56.11±8.15<sup>b</sup> | 55.11±4.19<sup>b</sup> | 53.31±4.06<sup>b</sup> | 4.60 | 0.02 |
| NCP        | 144.80±104.81<sup>a</sup> | 202.55±150.66<sup>a</sup> | 236.71±143.81<sup>a</sup> | 7.14 | 0.00 |
| WS (g)     | 109.24±26.48<sup>c</sup> | 123.27±47.53<sup>c</sup> | 186.05±42.69<sup>c</sup> | 4.14 | 0.01 |

Date of first flower emergenced (DFFE), date of first capsule emergenced (DFCE), number of capsules per plant (NCP), weight of seed per density (WS). \(F\) : F-statistical of Fischer et \(P\) : Probability associated with test. On the line, each parameter bearing the same letters are statistically similar \((P \geq 0.05)\).
CONCLUSION

It emerges from this study that a production of sesame is affected by sowing density and sowing method. Concerning the first production factor, the best value of yield come from plants grown on plot with low density. With second factor, the highest value of yield has been recorded with sowing on flat soil. Base on this result it has been recommended to sesame producers to grow this crop on flat soil with a low density.

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