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Test to evaluate the agrophenological parameters of sesame (*Sesamum indicum* L.) subjected to treatments of pigeon droppings and cow dung in Bongor, Chad

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ABSTRACT: The market gardening sector is a sector of activity admired by women and men. With a view to improving market gardening production, an experiment was carried out at the Superior Normal School of Bongor (ENS/B) the main objective of this work is to evaluate the effects of pigeon droppings and cow dung on the development parameters of sesame in order to determine the optimal dose of organic fertilizer provided to the plants for a better yield. For this to do so, the agro-phenological parameters were observed, noted and measured. From the result, it appears that the number of flowers and capsules per plant, the number of seeds per capsule, the weight of seeds per capsule, the yields in grams per plant and ton per hectare were obtained in the plants having received the combination 20 g of cow dung and 20 g of pigeon droppings.

KEYWORDS: morphological, phenological and agronomic parameters, *Sesamum indicum* L., fertilizers.

1 INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the basic agricultural products that can help solve the problem of hunger and malnutrition. Renowned for its nutritional quality and in terms of seed production, sesame is ranked ninth among the top thirteen oilseed crops capable of producing up to 90% of edible oil in the world [1]. Global production is estimated at five and a half million tonnes in 2014 [2]. Sesame production in Chad was estimated at 170,000 tonnes in 2015 [3]. It remains very weak in Mayo-kebbi/East.

This yield failure would be due to major constraints including climatic hazards, late sowing, unsuitability of certain varieties, soil infertility, edaphic factors and attacks from a wide range of harmful organisms that can cause damage economical especially at the seedling and flower bud stages. All of these constraints make production systems more vulnerable and pose problems for the intensification of this crop. Sesame, which was once grown in association with peanuts and reserved only for women, has today become a source of income for the entire population, both urban and rural. Hectares of forests are destroyed for the cause because a good part of the harvest is exported to neighboring Sudan for the manufacture of biscuits called “tania”. To increase yield, producers use all kinds of means, especially chemical fertilizers which are expensive and often unavailable. However, the use of organic fertilizers as an input could be one of the solutions to the problem linked to soil infertility, to environmental management where the main objective of this work is to evaluate the effects of pigeon droppings and cow dung on sesame development parameters in order to determine the optimal dose of organic fertilizer provided to the plants for better yield.

2 MATERIALS AND METHOD

2.1 STUDY MATERIALS

2.1.1 STUDY SITE

The present study was carried out within the Superior Normal School of Bongor (ENS/B) with geographical coordinate’s 10.280° North latitude and 15.370° East longitude, located in the town of Bongor. The town of Bongor is located on the banks of the Logone River oriented towards the South-East-North-West, bordering with the Republic of Cameroon. It is the capital of the Mayo-Kebbi Est province. The climate is Sahelo-Sudanian.

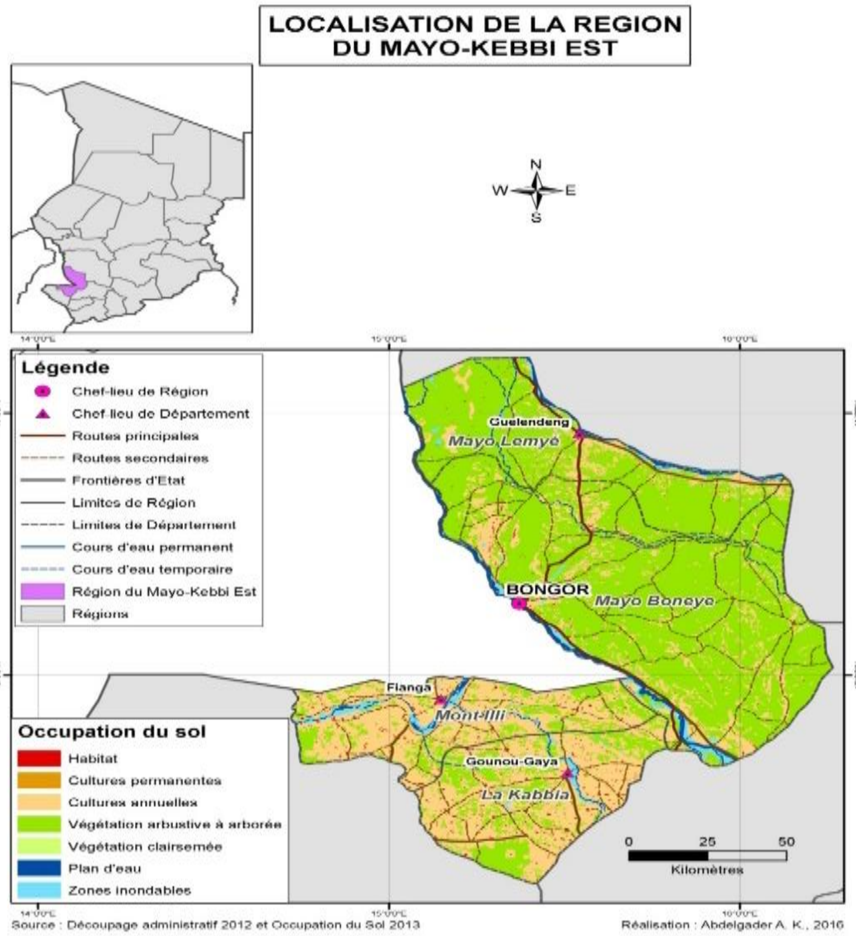

Fig. 1. Map of the Mayo-Kebbi East province

Source: National Research Support Center

2.1.2 SOIL

The result of the soil analysis of the study site is presented in the table below:

Table 1. results of the soil sample

Parameters	Soil sample
Clay (%)	12,65±0,85
Silt (%)	14,7±0,65
Sand (%)	74,47±0,65
Field capacity (%)	31,66 ± 3,05

Source: [4]

2.2 PLANT MATERIAL USED

The seeds used in this study consisted of seeds of the local variety of sesame most cultivated in the province of Mayo-Kebbi.

2.3 ORGANIC MATERIALS USED

The organic materials used consisted of pigeon droppings and dried cow dung. Dried cow dung and pigeon droppings were obtained from local breeders.

2.4 EXPERIMENTAL DESIGN

The trial was conducted during the rainy season from August to October 2021. The experimental design was that of the Fisher model in completely randomized blocks comprising three repetitions each with ten lines and ten treatments. The distance between rows in the block is 60 cm and the distance between plants in the rows is 20 cm. The blocks are separated from each other by a distance of 1 m. Each line was therefore made up of ten sesame pockets, or one hundred pockets per block. The length of the experimental field was 23.6 m and its width was 05 m, giving an area of 118 m^2.

2.5 WORKING METHODS

2.5.1 APPLICATION OF ORGANIC MATTER

The organic materials were applied in batches. A single application was made two (2) weeks after germination. The collected dry cow dung and pigeon droppings were selected and then dried in the sun for three (3) weeks and then pounded. The powders obtained were weighed according to the following doses: 20 g of cow dung (TV1), 20 g of pigeon droppings (Tf1), 10 g of cow dung and 10 g of pigeon droppings (TVf), 30 g of cow dung (TV2), 30 g of pigeon droppings (Tf2), 15g of cow dung and 15 g of pigeon droppings (TVf1), 40 g of cow dung (TV3), 40 g of pigeon droppings (Tf3), 20 g of cow dung and 20 g of pigeon droppings (TVf2).

2.5.2 PLANT CARE

The plants were watered during the onset of a slight drought. An Emir-fort 104 EC brand insecticide was also used to protect plants against pests.

2.6 MEASUREMENT OF LEAF LENGTH, WIDTH, RATIO AND LEAF AREA

The graduated tape measure was used to measure the length and width of the leaves. The measurements concerned the first three leaves of the plants chosen at random in the treatments constituting the blocks. The end of the tape measure was placed at the level of the petiole to the tip of the leaf. Thus, the values obtained made it possible to determine the Rlf/Lf ratio and the leaf area SF (cm2) = l ^{x} L. Five (5) measurements were carried out for the entire cycle of the plant.

2.7 DETERMINATION OF FRUIT DRY MATTER

The capsules from the different blocks were chosen at random then weighed and the weight was recorded. They were then placed in the sun for 72 hours until the net weight was obtained. The dry matter of the fruits is determined using the following formula:

MS = 100-% H20

Humidity rate is obtained by calculating the quantity of water contained in the fruits:

Humidity rate (% H2O) = (M1- M2) / (M1-M0) x100

With MO= weight of the empty container; M1= weight of the container containing the material to be dried; M2= weight of the entire container and dried product and MS = dry matter.

2.8 DETERMINATION OF THE WEIGHT OF THE CAPSULES

The harvested capsules were weighed and the fresh weight was recorded determination of the number of seeds per capsule. The capsules collected by treatment were kept in small bags then dried. After drying the seeds per capsule were counted.

2.9 DETERMINATION OF THE NUMBER OF FLOWERS AND CAPSULES PER PLANT

The flowers and capsules were counted regularly on the plants having been chosen at random in the treatments constituting the blocks and the number was also retained. The counting of flower buds took place 35 days after sowing and the counting of capsules took place 32 days after that of the flowers. Counts were carried out regularly every week. The operation was carried out five times during the plant's cycle. The values obtained made it possible to calculate the average number of flowers and that of capsules per plant.

2.10 DETERMINATION OF THE WEIGHT OF SEEDS PER CAPSULE AND THE WEIGHT OF 100 SEEDS

After determining the number of seeds per capsule, they were weighed and then the weights were recorded. Then, the weight of 100 seeds was also recorded. The dry matter of aerial biomass was determined by weighing the aerial part (stem and leaves). We note, F1 the fresh weight obtained. After drying for approximately 3 weeks, a series of weighings was carried out until the constant weight, noted F2, was obtained. The difference in weight noted ΔF represents the dry matter of the aboveground biomass. ΔF=F1-F2 Estimation of Yield The yield (Yield) was subsequently estimated by reducing plot production per hectare.

2.11 DATA PROCESSING

In order to determine the differences between the treatments, a statistical analysis of variance (ANOVA) was used on the data entered into the Excel spreadsheet with the XLSTAT 7.5.2 software. Fisher's test at the 5% threshold was used for separation of distinct groups.

3 RESULTS

3.1 PHENOLOGICAL PARAMETERS

The statistical results of the phenological parameters are recorded in table 2. From the table, we see that the parameters were significantly influenced by the different doses provided. Regarding the length of the leaves, it varied between 17.34 and 22.06 cm. The greatest length was noted in plants having received 40 g of pigeon droppings (Tf3) and the smallest length was noted in plants treated with 20 g of cow dung (TV1). Between the parameters there is a significant difference. For the width of the leaves, it varied between 6.50 and 7.49 cm. The highest leaf width was noted in the control (T0) i.e. 7.49 cm and the lowest was recorded in the plants treated with a combination of 20 g of cow dung and 20 g of pigeon droppings. (TVf) or 6.50 cm. There is no significant difference between the treatments (p=0.85) for this parameter. The Width/Length ratio of the leaf varied between 0.3 and 0.4. The greatest ratio was noted in plants receiving 20 g of cow dung and the lowest ratio was noted in plants receiving the combination of 20 g of pigeon droppings and 20 g of cow dung. A significant difference was noted between treatments.

The leaf area varied from 120.58 to 156.98 cm2. The highest value was observed in plants treated with 40 g of pigeon droppings and the lowest was recorded in plants given 20 g of cow dung. There is a significant difference between the treatments (P=0.60). The number of flowers varied between 86.33 and 353 per plant. The plants having received 20 g of cow dung and 20 g of pigeon droppings (Tvf2) had a high number of flowers, i.e. 353 flowers per plant. On the other hand, those having received 20 g of pigeon droppings (Tf1) had a low number of flowers per plant, i.e. 86.33. Between the treatments at the probability threshold P = 0.007, the difference is significant. Regarding the number of capsules per plant, it varied between 71 and 142 capsules per plant. The greatest number of capsules per plant was noted in plants treated with 20 g of cow dung and 20 g of pigeon droppings (TVf2) or 142 capsules. The lowest number of capsules was found in plants having received 20 g of pigeon droppings (Tf1) or 71 capsules per plant. For this parameter we note a significant difference between the treatments (P= 0.138). The weight of capsules varied between 1.02 and 1.64 g, the largest capsule was recorded in the control (T0) and the smallest was noted in the plants treated with 10 g of cow dung and 10 g of pigeon droppings (TVf). The difference is significant between the treatments at the probability threshold P = 0.398 for the parameter.

Table 2. Phenological parameters

Pa	F F	P. a	T0	Tv1	Tf1	TVf	Tv2	Tf2	Tvf1	Tv3	Tf3	Tvf2
LF	2,06	0,66	18,92^{bc}	17,34^{c}	19,92^{bc}	18,49^{bc}	19,14^{bc}	20,73^{ab}	20,11^{ab}	19,28^{bc}	22,06^{a}	20,86^{ab}
lF	0,50	0,85	7,49^{a}	6,96^{a}	7,05^{a}	7,23^{a}	6,75^{a}	6,67^{a}	7,45^{a}	7,07^{a}	7,11^{a}	6,50^{a}
lf/ LF	1,36	0,27	0,39^{ab}	0,40^{a}	0,35^{ab}	0,38^{ab}	0,35^{ab}	0,32^{ab}	0,37^{ab}	0,36^{ab}	0,32^{ab}	0,30^{b}
SF	0,81	0,60	142,92^{ab}	120,58 ^{b}	140,51^{ab}	133,70^{ab}	129,30^{ab}	139,98^{ab}	150,24^{ab}	135,57^{ab}	156,98^{a}	134,85^{ab}
Nfl/p	3,763	0,007	107,33^{c}	137,66^{bc}	86,33^{c}	89,33^{c}	105,33^{c}	172,33^{bc}	145,66^{bc}	258^{ab}	252^{ab}	353^{a}
Nc/p	1,771	0,138	77,66^{c}	83,66^{bc}	71^{c}	74^{c}	84^{bc}	96^{abc}	91,66^{abc}	116,33^{abc}	139^{ab}	142^{a}
PC	1,113	0,398	1,64^{a}	1,20^{ab}	1,22^{ab}	**1,02^{b}**	1,21^{ab}	1,09^{b}	1,10^{b}	1,13b	1,34^{ab}	1,37^{ab}

Legend: the averages to which the different letters are assigned are significantly different; lf: width of the sheet; LF: leaf length; lF/lF: width/length ratio of the sheet Pa: parameters; Nfl/p: number of flowers per plant; Nc/p: number of capsules per plant; PC: capsule weight; SF: leaf area; T0: Witness; TV1: 20 g of cow dung; Tf1: 20 g of pigeon droppings; TVf: 10 g of cow dung and 10 g of chicken droppings; TV2: 30 g of cow dung; Tf2: 30 g of pigeon droppings; TVf1: 15g of cow dung and 15g of pigeon droppings; TV3: 40 g of cow dung; Tf3: 40 g of pigeon droppings; TVf2: 20 g of cow dung and 20 g of pigeon droppings.

3.2 AGRONOMIC PARAMETERS

Table 3 presents the results of the statistical analysis of agronomic parameters. From this table, we see that the parameters studied are significantly influenced by the different doses received. The dry matter of the capsule varied from 25.14 to 40.31%. The greatest material was noted in the plants treated with the combination of 15 g of cow dung and 15 g of pigeon droppings (Tvf1), i.e. 40.31% and the lowest was recorded in the control plants, or 25.14%., there is no significant difference between the treatments (P = 0.975). The weight of seeds per capsule varied from 0.14 to 0.55g. The highest weight of seeds per capsule was noted in the plants having received 20 g of cow dung and 20 g of pigeon droppings (Tvf2) i.e. 0.55 g and the smallest was noted in the control i.e. 0. 14g. Between the treatments there is a significant difference. For the weight of 100 seeds, the values varied from 0.30 to 0.49 g. The highest weight of 100 seeds was noted in the plant having received 15 g of cow dung and 15 g of pigeon droppings (Tvf1), i.e. 0.49 g and the lowest was found in the control, i.e. 0.30 g. There is a significant difference between the treatments. Regarding the number of seeds per capsule, it varied between 140 and 342 seeds. The highest number of seeds was observed in the capsules from plants treated with 20 g of cow dung and 20 g of pigeon droppings (Tvf2) i.e. 342 seeds and the smallest was recorded in the control i.e. 140. Between the treatments there is a significant difference. The dry matter of aboveground biomass varied from 29.60 to 76.46%. The greatest material was noted in the plants having received a dose of 40 g of cow dung, i.e. 76.46%, and the lowest was observed in the plants treated with 10 g of cow dung and 10 g of cow droppings. Pigeon (Tvf) or 29.60%. There is no significant difference between the treatments for this parameter. The yield varied between 0.13 and 2.72 t/ha. The greatest yield was recorded in plants treated with 20 g of cow dung and 20 g of pigeon droppings (Tvf2) i.e. 2.72 t/ha and the smallest yield was observed in the control i.e. 0. 13 t/ha. Between the treatments, there is a significant difference (P = 0.11). For the yield in grams per plant, it varied between 4.32 and 82.05 g per plant of sesame. The highest yield in grams per plant was noted in plants treated with 20 g of cow dung and 20 g of pigeon droppings (Tvf2) and the lowest was recorded in control plants (T0). Between the treatments there is a significant difference.

Table 3. Agronomic parameters

Pa	F F	P. a	T0	Tv1	Tf1	TVf	Tv2	Tf2	Tvf1	Tv3	Tf3	Tvf2
MSC	0,273	0,975	25,14^{a}	29,79^{a}	28,98^{a}	28,79^{a}	27,29^{a}	33,04^{a}	40,31^{a}	28,83^{a}	38,14^{a}	26,32^{a}
PG/C	1,792	0,133	0,14^{c}	0,26b^{c}	0,25^{bc}	0,25^{bc}	0,28^{bc}	0,30^{bc}	0,38^{abc}	0,36^{abc}	0,40^{ab}	0,55^{a}
P100	1,554	0,196	0,30^{b}	0,43^{ab}	0,38^{ab}	0,43^{ab}	0,40^{ab}	0,46^{a}	0,49^{a}	0,44^{a}	0,47^{a}	0,48^{a}
NG/c	1,761	0,140	149,33^{b}	176,33^{b}	204,33^{b}	172^{b}	217,33^{b}	196^{b}	225^{ab}	235,33^{ab}	251,66^{ab}	342^{a}
MSBA	2,101	0,080	39,53^{bc}	41,83^{abc}	46,03^{abc}	29,60^{c}	42,40^{abc}	68,96^{ab}	66,90^{ab}	76,46^{a}	65,60^{ab}	75,26^{a}
RndG/p	1,889	0,113	4,32^{b}	14,81^{b}	12,86^{b}	9,23^{b}	16,22^{b}	24,32^{b}	31,72^{b}	30,32^{b}	50,21^{ab}	82,05^{a}
Rndt/ha	1,872	0,117	0,13^{b}	0,48^{b}	0,42^{b}	0,30^{b}	0,53^{b}	0,82^{b}	1,04^{b}	0,96^{b}	1,66^{ab}	2,72^{a}

Legend: the means having assigned the different letters are significantly different; Pa: parameters; P. a: associated probability; FF: Fisher's F; MSC: capsule dry matter; NG/c: Number of seeds per capsule; PG/C: weight of grains per capsule; P100: weight of one hundred seeds; MSBA: aboveground biomass dry matter; RndG/p: yield in grams per plant; Rndt/ha: yield in tonnes per hectare; T0: control; TV1: 20 g of cow dung; Tf1: 20 g of pigeon droppings; TVf: 10 g of cow dung and 10 g of chicken droppings; TV2: 30 g of cow dung; Tf2: 30 g of pigeon droppings; TVf1: 15g of cow dung and 15g of pigeon droppings; TV3: 40 g of cow dung; Tf3: 40 g of pigeon droppings; TVf2: 20 g of cow dung and 20 g of pigeon droppings.

4 DISCUSSIONS

The application of two types of organic fertilizers and their combination on sesame allowed us to evaluate the agro-phenological parameters. The results showed that the different doses of fertilizers applied significantly influenced the different parameters.

The length of the leaf was significantly influenced by the dose of fertilizer applied to the plants. This is why the plants that received 40 g of pigeon droppings had longer leaves compared to the others. This could be explained by the fact that the addition of pigeon droppings would have provided major elements for the growth of the plant and which would have favored the development of the leaf lengthwise. This result is similar to that of [5] obtained on pineapple in Benin. These authors, using increasing doses of cow dung, human urine and their combination, obtained a fairly significant growth rate in leaf length. On the other hand, the width of the leaves was not significantly influenced by the dose of fertilizer applied. Which means that, whatever the dose of manure added, the width of the leaves does not change. While [6] using the combination of fertilizer and compost on sesame found sesame plants with broad leaves. This difference may be linked to the culture environment. Furthermore, the leaf surface area was greater in plants which also received 40 g of pigeon droppings. The pigeon droppings provided enough nitrogen to the soil, promoting its absorption by the plant, thus increasing its vegetative and foliar growth. This illustrates the good growth of sesame. This result is in agreement with that obtained by [7] on okra. These authors using chicken droppings, sawdust and mineral fertilizer found different results. But compared to the other treatments and the control, chicken droppings provided the largest leaf surface area. They concluded that this important result obtained with chicken droppings would be due to the continuous mineralization as well as the continuous release of nutrients to the plant during its life cycle. The addition of organic matter improves the penetration of roots into the soil, the circulation of air and water in the soil as well as the formation and maintenance of the clay-humic complex [8].

However, an observation made, the plants having received as treatment the dose of the combination of 20 g of cow dung and 20 g of pigeon droppings (Tvf2) had an early floral initiation. This shows that this combination is useful for flowering. It would have provided necessary elements that could help accelerate the floral initiation process. Similar results were obtained by [9] on eggplant. These authors, using chicken droppings combined with potash from banana peels, found that flowering in eggplant was induced early. [6] also noticed early flowering in sesame by the application of compost and combined fertilizer. Poultry manure has significant agronomic value; 60 to 90% of the nitrogen found there is in mineral form and therefore directly available to the plant [10]. Nitrogen would play an important role in increasing leaf index and production as well as photosynthetic activity [9].

In addition, studies carried out by [11] have shown that the use of dry cow dung as fertilizer provides an amendment of nutrients to the plant and humus. The high number of flowers observed in plants having received the combination of cow dung and pigeon droppings attests to the significant presence of combined phosphorus and nitrogen. However, phosphorus is a major element necessary for fruit production. Our results are also in perfect agreement with those obtained by [12] on pepper in the DRC. These authors also found a high number of flowers when they applied the large dose of chicken droppings. Chicken droppings promoted flower production. A positive correlation was noted between the number of flowers and the number of capsules. The increase in the number of flowers significantly increases the number of capsules per plant. Which shows that a high dose of combination of organic fertilizers can lead to good fruiting. Similar results were obtained by [13] on lettuce. This author, by applying high doses of cow dung (30t/ha and 40t/ha) to lettuce, obtains significant leaf production per plant.

The average number of capsules varied depending on the dose applied. Thus the highest values were observed with the Tvf2 treatments (combination of 20 g of pigeon droppings and cow dung). These results are consistent with those obtained by [14] on okra in Ivory Coast. The author, by combining cow dung and peanut tops, obtained an average number of fruits estimated at 313.20 fruits per block, higher than the value obtained by the two fertilizers taken separately. Similar results were also obtained by [15] on tomatoes grown in Kolwezi in the DRC. These authors, using varying doses of compost, found that the number of fruits increases significantly with the increase in the dose given to the plants. This situation is explained by the fact that the quantity of fertilizing elements such as phosphorus provided by the compost is significant. In this specific case, the pigeon droppings used in the combination would also have provided such a large quantity of phosphorus which could influence the fruiting process. According to [16], phosphorus is an important element for fruit production. The richness of this element (Phosphorus) is recognized in poultry droppings.

For the weight of the capsules, the values obtained differ from the results obtained by [17] on zucchini. This author obtained fruits of 0.39 kg with chicken dropping compost compared to 0.2 kg for the control. In this case, the capsules from the control treatment have a heavier weight than those from the other treatments. This would explain the effect of the fertilizer dose on the weight of the capsules. The higher the dose of organic fertilizer, the more the weight of the sesame decreases. Seed yields varied depending on the doses and nature of the fertilizers. Among the fertilizers used, the 40 g of manure treatment (Tvf2) gave a very high seed yield with a very significant aerial biomass. Indeed, a correlation has been established between yield and dry matter of aboveground biomass. The greater the dry matter of the aboveground biomass, the higher the yield. This would explain a strong photosynthetic activity favoring significant organic matter. The plants resulting from the treatment based on 40 g of manure (20 g of cow dung and 20 g of pigeon droppings) presented significant vegetative development and a high useful yield compared to the others. The presence of pigeon droppings is indicative. According to [18], poultry droppings have a positive influence on plant yield. The yield is thus a function of the application dose of fertilizers. [19] working on Voadzou also showed that the application of chicken droppings and cow dung significantly increased production.

But contrary results were obtained by [20] on corn in Ivory Coast. These authors, by combining 70 g of cow dung and 70 g of sawdust, obtained production values lower than those obtained by dung and sawdust taken separately. This noted difference may be due to the type of soil and the environmental conditions in which the experiment was carried out. Our results are similar to those obtained by [21] on corn and cotton. This author, by studying the effect of combining compost and mineral manure in corn cultivation, obtained yields ranging from 950 to 1709 kg per hectare. Our results are also in agreement with those obtained by [22] on okra grown in Senegal. These showed that the application of the combination of cow dung and peanut hulls significantly increased okra production. The associative fertilization of the two fertilizers at high doses, however, prevented the deficiency of phosphorus, nitrogen and potassium on sesame, the content of these elements was reinforced. Taking these treatments separately, we see that the highest doses gave satisfactory results, their combination still gave very appreciable results. Which demonstrates the effectiveness of cow dung and pigeon droppings as an organic input. Thus the provision of a dose of 20g of pigeon droppings and 20g of cow dung would improve the quality of sesame yield, and it would constitute an optimal value for sesame production.

5 CONCLUSIONS

The agro-phenological parameters of sesame (*Sesamum indicum* L.) subjected to different organic treatments were evaluated. Statistical analyzes proved that plants having received 20 g of cow dung and 20 g of pigeon droppings combined (Tvf2) gave better performances in terms of number of flowers and capsules per plant, number of seeds per capsule, weight of seeds per capsule, yields in grams per plant and tonne per hectare compared to others. Pigeon droppings combined with cow dung seem to be a very good combination and can be used as an organic fertilizer for local producers. In any case, pigeon droppings could be used to complement the effect of cow dung, due to the valorization of organic waste and the sustainable and rapid fertilization of the soil. Therefore, the idea that fertilization with pigeon droppings and cow dung increases yield is confirmed.

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Conflict of interest

There is no conflict of interest between the authors.

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