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Effects of sawdust and poultry manure on growth and yield of sesame (*Sesamum indicum* L.)

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Abstract

It will be hard to face food insecurity and malnutrition in sub-Saharan Africa without appropriate application of fertilizers mainly organic fertilizers. Thus, for sustainable production of sesame (*Sesamum indicum* L.), an investigation on sawdust and poultry manure effects were conducted at Daloa. Four treatments (T0 = Control, T1 = Sawdust, T2 = Poultry manure, T3 = Sawdust + poultry manure) were tested in a randomized complete three blocks design. Statistical analysis indicated that treatment T3 boosted significantly growth, seed yield and its components. The fertilizing effect of poultry manure was superior to that of sawdust. The fertilizing effect of the mixture sawdust + poultry manure boosted seed yield and its components more than for sawdust and poultry manure considered separately. A synergistic action between these two organic fertilizers is the basis of that effect. This mixture is recommended to farmers.

Keywords: *Sesame, Sawdust, Poultry manure, Food security*

1. Introduction

One of the solutions to food insecurity and malnutrition in Sub-Saharan Africa is to promote local crops, improve their traditional system of production, and so diversify subsistence crop. The crop diversification towards selective high value crops including fruits and vegetables, compatible with the comparative advantage of the region, is recommended as an effective strategy in raising incomes, generating employment opportunities and alleviating poverty among small and marginal households (De and Chattopadhyay, 2010; Sharma, 2011). Sesame (*Sesamum indicum* L.), a member of the *Pedaliaceae* family, is one of the ancient cultivated plants, mainly for its seeds as oil and food sources : oil (44 - 58 %), protein (18 - 25 %), carbohydrate (13,5 %) and ash (5 %) (Akbar et al., 2011; Kanu, 2011) . It is an economically important crop widely cultivated in several countries (Ogbonna and Umar-Shaaba, 2011). In West Africa, it is well-known in Nigeria, Mali, Senegal and Burkina-Faso. While it is classified neglected crop in Ivory Coast, due to its absence in national agronomic research program. Its traditional cultivation is restricted to Touba zone, in the west of the country, on marginal and less fertile soils and so its yield remains low. The non-application of fertilizer is the most important factors responsible for this low productivity. In order to maximize the production of sesame and the incomes of farmers, it has become necessary to look for other alternative strategies of production technology, mainly the adoption of proper fertilization (Ibrahim et al., 2008). Chemical fertilizers have been used for decades to increase crop yield. However, due to diverse socio-environmental constraints relative to chemical fertilizers uses, current trends in sustainable agriculture are focused on (Timan et al., 2002; Scotti et al., 2015).

Apart from the ordinary capacities of fertilizers on soil physical, chemical and biological properties, organic manure has also been reported to greatly improve water holding capacity, nutrient retention cations exchange capacity and microbial activity (Amanullah et al., 2010); (Bolan et al., 2010). Organic fertilizers such as sawdust and poultry manure are easily available for farmers in agro-ecological zone of sesame production. The ability of both fertilizers to promote crop production has been shown in Nigeria (Ayeni et al., 2008; Dong et al., 2012) and in China (Dong et al., 2012). The enhancing effect of manure is attributed to a gradual and more lasting release of a wide range of nutrient elements (N, P, K, micronutrients, etc.) to the soil (Amanullah et al., 2007). Poultry manure creates a favorable environment for root development. Zhen et al. (2014) also noted that large population of microorganisms are introduced to the soil through organic manure which promoted N fixation and P solubilization. Furthermore, the mixture sawdust and poultry manure contributed to reduce the population of fungi in the soil (Shaikh and Ghaffar, 2004).

The objective of this study was to determine the effects of sawdust and poultry manure on growth and yield of sesame.

2. Materials and methods

2.1. Study site

Field experiments were conducted in 2014 and 2015 at Daloa (latitude: 06° 53´ 58´´ N and longitude: 06° 26´ 32´´W) (Ivory Coast). This site is characterized by two rainy seasons separated by a short dry period (from mid-

July to mid-September) and a long dry season (December-March). Annual rainfall varies from 1000 to 1500 mm. The zone receives abundant sunshine with an annual maximum mean temperature ranging between 21-and 35^{o}C. Its vegetation is largely constituted by the dense forest. The soil in the experimental area is classified as ferallitic well drained sandy loam (Koffi et al., 2014; Morel, 2014).

2.2. Plant material and experimental design

The seed of sesame was obtained at the market of Gohitafla (Ivory Coast). In order to improve the growth and production of capsules, two organic fertilizers [sawdust (S) and poultry manure (PM)] were applied during the sowing. In that respect, four treatments T0, T1, T2 and T3) were considered: T0 (Control): no fertilizer, T1: 10 kg of sawdust (S), T2: 10 kg of poultry manure (PM), T3: mixture of 5 kg of sawdust (S) and 5 kg of poultry manure (PM). Thus, the experimental design consisted of three complete randomized blocks. Each block was composed of four plots representing, each treatment. To ensure proper stand, five seeds per hole were sown directly and thinned to one plant per hole at the two-leaf stage. That led to 20 plants per 2.24 m^2 in each plot. All plants per treatment including control were studied. No irrigation was applied during the trials. Weeds were manually controlled, but the insecticide (Cypercal EC 50) was used to protect the crop against insects identified in the locality.

2.3. Data collections and statistical analysis

Four growth parameters (plant height, stem girth, number of branches, days to first flowering) and 6 yield parameters (number of branches with capsule, number of capsule per plant, weight of capsule per plant, , number of seed per plant, weight of seed per plant and seed yield) were measured in 2014 and 2015, from sowing in 3 April to harvesting in 7 July. Significant effect of organic fertilizer, year and their interaction were tested by MANOVA. When a significant effect is detected for a factor, each parameter was examined by using the SAS statistical package. In case of a significant difference the Least Significant Difference (LSD) multiple range-tests were used to identify the means which differed. Also, in case of non-significant effect of a given factor, all data relative to it are considered together.

3. Results

3.1. MANOVA results for effect of organic fertilizer and year on the ten agronomic parameters studied

The **table 1** indicates that organic fertilizer (sawdust and poultry manure) had significant effect on the ten sesame agronomic parameters studied. Neither significant year effect nor fertilizer and year interaction effect was observed .Thus, for the following statistical analysis we will put together the data of both years.

Table 1. MANOVA results, for effect of organic fertilizer and year on the ten sesame agronomic parameters studied

Factors	**Statistics**	
	F	*P*
Year	1.356	0.568
Organic fertilizer	5.658	0.026
Year *Organic fertilizer	1.256	0.671

3.2. Effects s of sawdust and poultry manure on growth parameters of sesame

Data in **table 2** show that the four growth parameters tested were boosted by organic fertilizers. The highest values of plant height, stem girth were obtained after adjunction of 10 kg of poultry manure (PM) alone or of a mixture of 5 kg of sawdust (S) and 5 kg of poultry manure (PM). Those of number of branches (ramifications) were obtained with 10 kg of poultry manure (PM). The earliest flowers appeared when plants received organic fertilizers [sawdust (S), poultry manure (PM) or sawdust (S) + poultry manure (PM)].

Table 2. Effects of sawdust and poultry manure on the four sesame growth parameters evaluated.

Fertilizers	Plant height (m)	Stem girth (mm)	Number of branches	Days to first flowering
S	1,383±0,009b*	12,416±0,157b	3,868±0,182b	44,687±1,118a
PM	1,502±0,005a	15,097±0,360a	6,183±0,207a	44,200±1,064a
S+PM	1,534±0,019a	14,414±0,257a	4,360±0,155ab	42,578±0,801a
Control	1,335±0,010b	11,358±0,306c	3,527±0,137c	50,300±1,094b
F	2,328	7,771	3,645	2,551
P	0,049	0,000	0,013	0,041

*For a given parameter, values followed by the same letter(s) were not significantly different at $P = 0.05$, on the basis of the Least Significant Difference (LSD) test ;. S = Sawdust, PM = Poultry manure: F = Fischer

3.3. Effects of sawdust and poultry manure on yield parameters of sesame

Seed yield and its five components (number of branches with capsules, number of capsules per plant, weight of capsules per plant, number of seeds per plant, weight of seeds per plant) studied, were significantly boosted by organic fertilizers at $P = 0.05$. The highest value of each of these parameters was recorded on plants having grown on soil supplemented with the mixture sawdust (S) and poultry manure (PM) (**Table 3**).

Table 3. Effects of sawdust and poultry manure on the six sesame yield and its parameters evaluated

Fertilizers	Number of branches with capsule	Numbers of capsules per plant	Weight of capsules per plant (g)	Number of seed per plant	weight of seed per plant (g)	Seed yield (t/ha)
S	2,557±0,012b*	20,918±1,31bc	7,182±0,424bc	3,960±0,402b	0,446±0,018bc	0,446±0,018bc
PM	2,633±0,008b	24,616±2,036b	8,363±0,131b	4,526±0,506b	0,619±0,008b	0,619±0,008b
S+PM	3,278±0,042a	42,836±1,3a	14,316±0,524a	7,315±0,302a	1,068±0,022a	1,068±0,022a
Control	2,290±0,192b	17,527±3,44c	5,532±0,668c	2,416±0,228c	0,274±0,029c	0,274±0,029c
F	2,826	15,341	15,963	22,932	34,340	34,340
P	0,039	0,000	0,000	0,000	0,000	0,000

*For a given parameter, values followed by the same letter(s) were not significantly different at $P = 0.05$ on the basis of the Least Significant Difference (LSD) test. S = Sawdust, PM = Poultry manure; F = Fischer

4. Discussion

The results of the current study showed that in vegetative phase data obtained under poultry manure (PM) are superior to those under sawdust (S). Also the best values of vegetative parameters were obtained on plots containing the organic fertilizer either 10 kg of poultry manure alone or the mixture of 5 kg of sawdust + 5 kg of poultry manure. Such result demonstrates that the enhancement of growth parameters could be due to poultry manure alone. The ability of poultry manure to enhance vegetative growth was reported in maize (Boateng et al., 2006; Tiamiyu et al., 2012) and okra (Tiamiyu et al., 2012) . According to (Ayeni and Adetunji, 2010) this

ability could be explained to the rapid decomposition of poultry manure in the soil which leads to the availability of nutrients such as N, P, K and micronutrients to sesame crop. Manure apart from releasing nutrient to the soil also improves the soil structure, pH, and cation exchange capacity of the soil, and provides better environment for root development and aeration (Zainab et al., 2016).

In the reproductive phase, where sawdust microelements are supposed to be released by late decomposition, poultry manure is more efficient than sawdust. This superior ability of poultry manure is expressed in both stages. Also, comparatively to vegetative stage, the mixture of sawdust and poultry manure recorded better values of seed yield and its components than poultry manure alone. The increasing of sesame yield under this stage is attributable to a synergy of actions between both organics fertilizers. The similar result was observed by (Okonmah, 2012) with poultry manure and cow manure in maize. The authors had explained this phenomenon by the difference speed of decomposition of manure. In our study, the late and slow release of nutriments of sawdust during reproductive phase of this crop could be justify this synergy between poultry manure and sawdust (Ayeni et al., 2008; Abd El Halim and El Baroudy, 2014). Because of the slow release of nutrients sawdust, it is not recommended for direct application (Ayeni et al., 2008; Abd El Halim and El Baroudy, 2014).

5. Conclusion

Appropriate fertilizer application is an important management practice to improve soil fertility and crop production. The study showed the benefic effects of the two organic fertilizers (sawdust and poultry manure) via different rates and combinations on growth and yield of sesame. The four growth parameters tested (plant height, plant girth and number of branches or ramifications) were significantly improved by the adjunction of 10 kg of poultry manure (PM) alone and of a mixture of 5 kg of sawdust (S) and 5 kg of poultry manure (PM). The earliest flowers appeared when plants received sawdust (S), poultry manure (PM) or the mixture sawdust (S) + poultry manure (PM). In addition, seed yield and its five components (number of branches with capsules, number of capsules per plant, weight of capsules per plant, number of seeds per plant, weight of seeds per plant) studied were significantly boosted by the mixture sawdust (S) and poultry manure (PM). On the basis on these findings the mixture of 5 kg of sawdust (S) and 5 kg of poultry manure (PM) is an efficient fertilizer whose use needs to be recommended and encouraged.

References

F. Akbar, M. A. Rabbani, M. S. Masood and Z. Shinwari, K. Genetic diversity of sesame (*Sesame indicum* L.) germplasm from pakistan using RAPD markers, Pakistan Journal of Botany, 43, 4, 2011, 2153-2160.

M. M. Amanullah, S. Sekar and P. Muthukrishman. Prospects and potential of poultry manure, Asian Journal of Plant Sciences, 9, 4 2010, 172-184.

M. M. Amanullah, E. Somasundaram, K. Vaiyapuri and K. Sathyamoorthi. Poultry manure to crops -a review, Agric. Rev, 28, 3, 2007, 216-222.

L. S. Ayeni and M. T. Adetunji. Integrated application of poultry manure and mineral fertilizer on soil chemical properties, nutrient uptake, yield and growth components of maize, Nature and Science, 8, 1, 2010, 60-67.

L. S. Ayeni, O. M. Ayeni, O. P. Oso and S. O. Ojeniyi. Effect of sawdust and wood ash applications in improving soil chemical properties and growth of cocoa (Theobroma cacao) seedlings in nurseries, Agricultural journal, 3, 5, 2008, 323-326.

S. A. Boateng, J. Zickermann and M. Kornahrens. Poultry manure effect on growth and yield of maize, West Africa Journal of Applied Ecology, 9, 2006, 12-18.
N. S. Bolan, A. A. Szogi, T. Chuasavathi, B. Seshadri, M. J. Rothrockbjr and P. Pannneerselvam. Uses and management of poultry litter, World's Poultry Science Journal, 66, 2010, 673-698.
U. K. De and M. Chattopadhyay. Crop diversification by poor peasants and role of infrastructure: evidence from West Bengal, Journal of Development and Agricultural Economics, 2, 10, 2010, 340-350.
W. Dong, X. Zhang, H. Wang, X. Dai, X. Sun, W. Qiu and F. Yang. Effect of different fertilizer application on the soil fertility of paddy soils in red soil region of southern China, Plos One, 7, 9, 2012, 1-9.
M. Ibrahim, A. Ul-Hassan, M. Iqbal and E. E. Valeem. Response of wheat growth and yield to various levels of compost and organic manure, Pakistan Journal of Botany, 40, 5, 2008, 2135-2141.
P. J. Kanu. Biochemica analysis of black and white sesame seeds from china, American journal of Biochemistry and Molecular Biology 1, 2, 2011, 145-157.
M. Koffi, J. Anoh, M. N'djetchi, T. Konan and Y. Djè. Genetic-based investigation of three prevalent waterborne protozoa parasites in drinking water sources in Daloa district in Côte d'Ivoire, J. Appl. Biosci., 77, 2014, 6534-6542.
R. Morel. Le climat et l'implication des hommes : le cas de la Côte d'ivoire, Climatologie., 1, 2014, 117-132.
P. E. Ogbonna and Y. G. Umar-Shaaba. Yield responses of sesame (Sesamium indicum L) to rates of poultry manure application and time of planting in a derived savannah ecology of south eastern Nigeria, African Journal of Biotechnology, 10, 66, 2011, 14881-14887.
L. U. Okonmah. Effect of various organic manure on the growth and yield of maize in Asaba agro-ecological zone, Asian Journal of Science and Technology, 4, 11, 2012, 6-9.
R. Scotti, G. Bonanomi, R. Scelza, A. Zoina and M. A. Rao. Organic amendments as sustainable tool to recovery fertility in intensive agricultural systems, Journal of Soil Science and Plant Nutrition, 15, 2, 2015, 333-352.
A. H. Shaikh and A. Ghaffar. Effect of poultry manure and sawdust on survival of sclerotia of macrophomina phaseolina in soil, Pakistan Journal of Botany, 36, 2, 2004, 425-428.
H. R. Sharma. Crop diversification in himachal pradesh: patterns, determinants and challenges, Indian Journal of Agricultural Economics, 66, 1, 2011,
R. A. Tiamiyu, H. G. Ahmed and A. S. Muhammad. Effect of sources of organic manure on growth and yields of okra (Abelmoschus esculentus L.) in Sokoto, Nigeria, Nigerian Journal of Basic and Applied Science, 20, 3, 2012, 213-216.
D. Timan, K. G. Cassman, P. A. Matson, R. Naylor and S. Polasky. Agricultural sustainability and intensive production practices, Nature, 418, 2002, 671-677.
M. A. Zainab, E. C. Vincent, O. S. Ayodele, Y. L. Gayus and S. O. Kehinde. Effects of organic and inorganic fertilizers on the growth of NH-Ae 47-4 variety of Okra, Journal of Applied Sciences and Environmental Management, 20, 1, 2016, 201-206.
Z. Zhen, H. Liu, N. Wang, L. Guo, J. Meng, N. Ding, G. Wu and G. Jiang. Effects of manure compost application on soil microbial community diversity and soil microenvironments in a temperate cropland in China, Plos One, 9, 10, 2014, 12.