*Asian Journal of Advances in Agricultural Research*

***Volume 23, Issue 4, Page 26-32, 2023; Article no.AJAAR.108674***
***ISSN: 2456-8864***

# Effects of Vermicompost and Inorganic Fertilizers on Growth and Yield of Sesame

**Kamrun Nahar [a*], Md. Azizul Haque [a], Md. Khan Jahan Ali [b] and Sharmin Ara Jannat [a]**

*[a] Soil Science Division, Bangladesh Institute of Nuclear Agriculture, BAU Campus, Mymensingh-2202, Bangladesh.*
*[b] Sub-Station, Ishwardi, Bangladesh Institute of Nuclear Agriculture, BAU Campus, Mymensingh-2202, Bangladesh.*

***Authors' contributions***

*This work was carried out in collaboration among all authors. Author KN designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors MAH and MKJA managed the analyses of the study. Author SAJ managed the literature searches. All authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/AJAAR/2023/v23i4475

**Open Peer Review History:**
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/108674

***Original Research Article***

***Received: 10/09/2023***
***Accepted: 14/11/2023***
***Published: 29/11/2023***

## ABSTRACT

A field experiment was conducted at the BINA substation farm, Ishwardi, Pabna during 2021- 2022 to see the combined effects of vermicompost and inorganic fertilizer (Urea, TSP, MoP, gypsum, zinc and boron) on sesame growth and yield. Five treatments combination were used in the experiment. The treatments were $T_1$=Native soil fertility (No fertilizer and manure), $T_2$=100% Chemical Fertilizers (CF), $T_3$= Vermicompost (VC) @ 5 ton/ha, $T_4$=50% CF + 2.5 ton/ha VC, $T_5$=70%CF + 1.5 ton/ha VC. Yield and yield contributing characters of sesame were significantly influenced with the different treatments. The treatment $T_4$ (50% CF + 2.5 $tha^{-1}$ VC) gave the highest seed yield of sesame. The results indicated that treatment $T_4$ enhanced more crop growth which

**Corresponding author: Email: naharmitubau@gmail.com;*

influenced on greater seed yield of sesame. The lowest seed yield was recorded at $T_1$ treatment. However, considering maximum yields the treatments $T_4$ could be used for more production of sesame with less use of chemical fertilizers.

*Keywords: Vermicompost; inorganic fertilizers; crop growth; sesame yield.*

## 1. INTRODUCTION

"Sesame (*Sesamum indicum L*.) is an annual, self-pollinated, indeterminate minor oil crop which belongs to the family Pedaliaceae. It is a significant oil-producing crop which grows widely in different parts of the world" [1]. "Sesame production in Bangladesh is 500-600 $kgha^{-1}$ which can be increased to 1200 $kgha^{-1}$ by practicing improved variety and production technology" [2]. "Among the various oil crops grown in Bangladesh, sesame ranks next to mustard in respect of both cultivated area and production. The crop is grown in both Rabi and Kharif seasons in Bangladesh but the Kharif season covers about two-thirds of the total sesame area" [3]. "For the perfection and improvement of market economy, chemical fertilizers are used indiscriminately which decreases soil fertility and nutrient quality of crops. Organic matter, the primary attributes of the sustainable cultivating frameworks is lost by the excessive use of chemical fertilizers" [4]. "The use of inorganic fertilizer to maintain cropping was found to increase yield just for exactly couple of years, however, on a long run, it has not be effective and prompts soil degradation" [5]. "Uses of only inorganic sources of fertilizers, unplanned disposal of wastes, use of pesticides and their run-off etc. are also detrimental for the ecosystem and create pollution to the environment" [6-8].

"Vermicompost is a natural materials prepared by collaborations between smaller microorganism and earthworms. It is a completely balanced with low C:N proportion" [9]. "Earthworm which excretes beneficial soil organisms and secretes polysaccharides, proteins and different nitrogenous compound into the dirt and thus enhance soil fertility and raise crop productivity" [10-11]. "Vermicompost also contains some plant growth hormones and humic acids which improve the growth and yield of plant crops" [12]. "Vermicomposting is one of the biological process in which the organic wastes has been converted into nutrient rich manure by the action of earthworms. The characteristic feature of vermicompost such as high porosity and moisture holding capacity increases the growth of pathogen free plants" [13].

"The combined use of vermicompost and chemical fertilizers aids in yield stability through correction of micronutrients deficiency and providing favorable soil physical conditions" [14]. It has been shown that vermicompost stimulates plant flowering, increases the number and biomass of the flowers [15] as well as increases fruit yield [16]. "Application of vermicompost increases the commercial value and agricultural sustainability" [17].

## 2. MATERIALS AND METHODS

A field experiment was conducted at the BINA substation farm, Ishwardi, Pabna during 2021-22 to see the effects of various fertilizer doses with vermicompost on sesame. The experiment site lies between 25-27°N latitude, 8.5°E Longitude and 98 meters altitude. The climate is characterized by the alternate hot rainy season. The treatments were $T_1$=Native soil fertility (No fertilizer and manure), $T_2$=100% Chemical Fertilizers (CF), $T_3$= Vermicompost (VC) @ 5 ton/ha, $T_4$=50% CF + 2.5 ton/ha VC, $T_5$=70%CF + 1.5 ton/ha VC.Nutrient contents of vermicompost are given at Table 1.

**Table 1. Nutrient contents in vermicompost**

| Items | Percent |
|---|---|
| Organic Carbon | 15.2 |
| N | 1.42 |
| P | 1.45 |
| K | 1.52 |
| S | 0.35 |

The experiment was carried out in a Randomized Complete Block design with three replications. Unit plot size was 12 $m^2$(3m × 4m). At sowing time soil moisture was 45% in the experimental field. So, the condition of germination for seed of sesame was well in field condition. Seeds of sesame var.(Binatil-2) were sown on 10 March 2022. Fertilizers were applied on the soil and the rates of fertilizer have been given in the Table 3. TSP, MoP, gypsum, zinc and boron were applied before the sowing of sesame seeds. Urea was top dressed in two equal splits i.e. 14 days after sowing (DAS) and 30 DAS. Weeding, thinning, irrigation, application of pesticide etc. were

done when necessary. The sesame crop was harvested on the 15 June 2022. Yield and yield contributing characters were recorded from 5 randomly selected plants from each plot. Data were then analyzed by analysis of variance (ANOVA) using Statistix10 package and the means were compared according to Least Significant Different Test at 1% level of significance. Different physio-chemical properties of soil samples determined with the following procedure.

### 2.1 Textural Class

Particle size analysis was carried out by hydrometer method [18] and finally textural class was determined by fitting the %sand, % for silt and % clay to the Marshall's Triangular Coordinates following USDA system.

### 2.2 Soil pH and EC

"Soil pH and EC were measured by a glass electrode pH and EC meter using soil: water suspension of 1:2.5 (10 g soil and 25 ml distilled water) as described by Jackson" [19].

### 2.3 Organic Matter

"Organic carbon was determined by wet oxidation method as described by Black" [18]. "The underlying principle was used to oxidize the organic matter with an excess of 1N K2Cr2O7 in presence of conc. H2SO4 and conc. H3PO4 and to titrate the excess K2Cr2O7 solution with 1N FeSO4.To obtain the organic matter content the amounts of organic carbon were multiplied by Van Bemmelen factor 1.73. The results were expressed in percentage" [20].

### 2.4 Total Nitrogen

"Total N content was determined following micro-Kjeldahl method as described by Jackson" [19]. "Soil sample was digested with H2O2, conc. H2SO4 and catalyst mixture (K2SO4:CuSO4.5H20: Se in the ratio of 100:10:1). After completion of digestion, made the volume to 100ml. Distillation was performed with adding of 40% NaOH into the digest. The distillate was received in 2% boric acid (H3BO3) solution and 4 drops of mixed indicator of bromocresol green and methyl red solution. Finally the distillate was titrated with standard H2SO4 (0.01N) until the color changed from green to pink. Then amount of N was calculated" [19].

### 2.5 Available Phosphorus

"Available phosphorus was extracted from the soil samples by shaking with 0.5 M NaHCO3 solutions at pH 8.5 following the method of" [21]. "The extracted phosphorus was determined by developing blue color by SnCl2 reduction of phosphomolybdate complex and measuring the intensity of color calorimetrically at 660 nm wave length and the readings were calibrated to the standard P curve" [21].

### 2.6 Exchangeable K

Exchangeable K was extracted from the soil samples with 1N NH4OAC (pH 7) and cations were determined from the extract by flame photometer [18] and calibrated with a standard curve.

### 2.7 Available Sulphur

"Available S content was determined by extracting with 0.15% CaCl2 solution (1:5 soil extractant ratio) and estimated by turbidimetric method using spectrophotometer at 535 ηm wavelength" [22].

## 3. RESULTS AND DISCUSSION

Sesame yield was significantly affected by combined effect of vermicompost and inorganic fertilizers. The results stated that highest sesame yield was found at T4 treatment (1.47 ton/ha) and lowest yield was found at control (0.93 ton/ha) which was statistically similar with other three treatments (Table-5). Pandiyan, [23] reported that vermicompost used properly with other fertilizers considerably improves the plant's development and yield parameters. In addition, adding vermicompost increases the soil's porosity, ability to hold water, and macronutrient content. Yield contributing characters of sesame were also influenced with the combined application of chemical fertilizers and vermicompost. The results showed the significant variations for plant height, among the five treatments, $T_4$ produced the tallest plant (129.06 cm), which is statistically different from other treatments. Plant height at 30 days interval is given in Fig.1. Number of branch/plant, number of leaves/plant and pod length were not significantly affected by five different treatments (Table 4). Here the number of branch was higher in $T_4$ treatment (3.83) than other treatments. Lower number of branch was obtained in $T_5$ treatment (3.06). The sesame plant obtained

higher leaves at $T_5$ treatments (80) and lower leaves were $T_1$ treatments (63). Longer pod length of sesame was found at $T_3$ treatments (2.63) and smaller pod length was observed at $T_5$ treatments (2.33). "In the current analysis, the plots treated with 50% chemical fertilizers and 2.5 t $ha^{-1}$ Vermicompost showed the significant results on growth of the plants compared to the plots treated with other treatments" [24]. In case of spinach, Syed, [25] found that vermicompost and NPK fertilizers significantly improved vegetative growth parameters.

Yield attributes such as number of seed/pod, number of pod/plant and 1000 seed weight of sesame plants were positively affected by the use of vermicompost with chemical fertilizers. In Table 5, the results show that $T_4$ treatment produced more pod in sesame plant (74.11) than other treatments. Less pod number was found in $T_5$treatment (53.45). Similar trend was found in case of seed/pod which significantly affected by five treatments. In $T_5$ treatment, 62 seed was found on one sesame pod which was higher than other four treatments. 1000 seed weight of sesame was not significantly affected by five different treatments. Higher 1000 seed weight was found at $T_4$ treatments (4.02) and lower 1000 seed weight was seen at $T_2$ treatments (2.90).

**Table 2. Physico-chemical properties of initial soil**

| | Texture | pH | O.C (%) | Total N (%) | P (µgg$^{-1}$) | K (meq %) | S (µgg$^{-1}$) |
|---|---|---|---|---|---|---|---|
| Soil analysis interpretation | Silt loam | 7.1 Alkaline | 0.87 Low | 0.11 Low | 17.0 Medium | 0.13 Low | 14.0 Low |

**Table 3. Rates of fertilizer applied in the experiment (gm/12m$^2$ plot)**

| Treatments | Urea | TSP | MoP | Gypsum | Zinc oxide | Boric acid | Vermicompost |
|---|---|---|---|---|---|---|---|
| T1= Native soil fertility | - | - | - | - | - | - | - |
| T2= 100% CF | 23.50 | 20 | 13.6 | 20 | 1.45 | 1.18 | - |
| T3= 5 tha-1 VC | - | - | - | - | - | - | 2000 |
| T4= 50% CF+2.5 tha-1 VC | 11.75 | 10 | 6.8 | 10 | 0.75 | 0.59 | 1000 |
| T5= 70% CF+1.5 tha-1 VC | 16.45 | 14 | 9.52 | 14 | 1.01 | 0.83 | 600 |

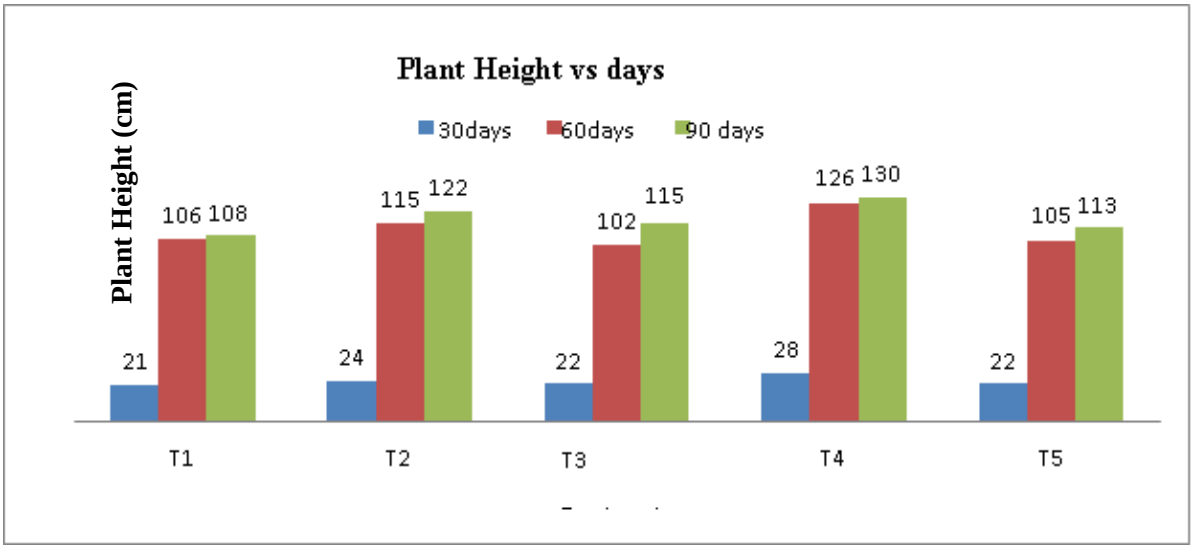


**Fig. 1. Plant height at 30, 60 & 90 days**

**Table 4. Combined effect of vermicompost and inorganic fertilizers on growth attributes on Sesame plant**

| Treatments | Plant Height (cm) | No. of Branch/plant | No. of leaves/plant | Pod Length (cm) |
|---|---|---|---|---|
| $T_1$=Native soil fertility | 107.39 c | 3.22 | 63 | 2.39 |
| $T_2$=100% CF | 118.40 b | 3.22 | 72 | 2.37 |
| $T_3$=5 t $ha^{-1}$VC | 112.11 bc | 3.44 | 69 | 2.63 |
| T4=50% CF + 2.5 t $ha^{-}$VC | 129.06 a | 3.83 | 78 | 2.43 |
| $T_5$=70%CF + 1.5 t $ha^{-1}$VC | 110.11 c | 3.06 | 80 | 2.33 |
| CV (%) | 3.65 | 9.08 | 1.95 | 5.92 |
| Level of significance | * | NS | NS | NS |

*In a column, the values having same letter do not differ significantly at 5% level by DMRT NS= Non significant, CV= Co-efficient of variation, CF= Chemical Fertilizer, VC= Vermicompost*

**Table 5. Combined effect of vermicompost and inorganic fertilizers on yield attributes on Sesame plant**

| Treatments | No. of Pod/plant | No. of Seed/Pod | 1000 seed weight (gm) | Yield (t/ha) |
|---|---|---|---|---|
| $T_1$=Native soil fertility | 62.33 | 56.00 b | 3.42 | 0.93 b |
| $T_2$=100% CF | 58.89 | 57.00 b | 2.90 | 1.03 b |
| $T_3$=5 t $ha^{-1}$VC | 65.22 | 55.00 b | 3.98 | 0.97 b |
| $T_4$=50% CF + 2.5 t $ha^{-}$VC | 74.11 | 62.00 a | 4.02 | 1.47 a |
| $T_5$=70%CF + 1.5 t $ha^{-1}$VC | 53.45 | 55.00 b | 4.00 | 0.97 b |
| CV (%) | 21.69 | 3.22 | 6.04 | 5.89 |
| Level of significance | NS | * | NS | * |

*In a column, the values having same letter do not differ significantly at 5% level by DMRT NS= Non significant, CV= Co-efficient of variation, CF= Chemical Fertilizer, VC= Vermicompost*

## 4. CONCLUSION

The study demonstrates the effect of vermicompost with combination of inorganic fertilizers on the growth and yield components of the plant (*Sesamum indicum L*). The results conclude that the proper mixture of vermicompost with other chemical fertilizers enhances the growth and yield parameters of the plant significantly. 50% chemical fertilizer (CF) + 2.5 ton/ha Vermicompost (VC) produces the highest yield of sesame.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Akhtar J, Baqa S, Khan S, Kakar AK, Abro BA, Baloch PA. Effect of different levels of Nitrogen and Phosphorus on growth and yield of sesame. International Journal of Biology and Biotechnology. 2015;12(3):493-498.
2. Azad AK, Miaruddin M, Wohab MA, Sheikh MHR, Nag BL, Rahman MHF. Krishi Projukti Hatboi (Handbook of Agro-Technology), 9th Edition, Bangladesh agricultural research institute, Gazipur-1701, Bangladesh. 2020;102-103.
3. BARI. (Bangladesh Agricultural Research Institute). Annual report for 2003. BARI. 2004;28.
Available:http://www.bari.gov.bd/
[Accessed 11 July 2016]
4. Liu M, Hu F, Chen X, Huang Q, Jiao J, Zhang B, Li H. Organic amendments with reduced chemical fertilizer promotes soil microbial development and nutrient availability in a subtropical paddy field: the influence of quantity, type and application time of organic amendments. Appl. Soil Ecol. 2009; 42:166–175.
5. Satyanarayana V, Murthy VRK, Vara Prasad PV, Boote KJ. Influence of

integrated use of farmyard manure and inorganic fertilizers on yield and yield components of irrigated lowland rice. J. Plant Nutr. 2002;25(10):2081–2090.

6. Hanif MA, Miah R, Islam MA, Marzia S. Impact of Kapotaksha river water pollution on human health and Environment. Progressive Agriculture. 2020;31(1): 1-9.
7. Islam MA, Nuruzzaman M, Das RR, Afrin N. Contamination of heavy metals in water, sediments and fish is a consequence of paddy cultivation: focusing river pollution in Bangladesh. Ministry of Science and Technology Journal. 2020; 1(1):48-59.
8. Rahman MM, Islam MA, Khan MB. Status of heavy metal pollution of water and fishes in Balu and Brahmaputra rivers. Progressive Agriculture. 2016;27(4):444-452.
9. Ramasamy PK, Suresh SN. Effect of vermicompost on root numbers and length of sunflower plant (*Helianthus annuus* L.). J. of pure and applied microbiology. 2011;4(1): 297-302.
10. Hatti SS, Londonkar RL, Patil SB, Gangawane AK, Patil CS. Effect of Eisenia fetidavermiwash on the growth of plants. J. Crop Sci. 2010;1(1):6–10.
11. Rekha GS, Valivittan K, Kaleena PK. Studies on the influence of vermicompost and vermiwash on the growth and productivity of black gram (*Vigna mungo*). Adv. Biol. Res. 2013;7(4):114–121.
12. Atiyeh RM, Lee S, Edwards CA, Arancon NQ, Metzger JD. The influence of humic acids derived from earthworm processed organic wastes on plant growth. Bioresour. Technol. 2002;84: 7–14.
13. Yadav A, Garg VK. Biotransformation of bakery industry sludge into valuable product using vermicomposting. Bioresource technology. 2019;274:512-517.
14. Gill JS, Walia SS. Influence of FYM, brown manuring and nitrogen levels on direct seeded and transplanted rice (*Oryza sativa* L.) A review. Res. J. Agr. Env. Sci. 2014;3(9):417–426.
15. Arancon NQ, Edwards CA, Babenko A, Cannon J, Galvis P, Metzger JD. Influences of vermicomposts, produced by earthworms and microorganisms from cattle manure, food waste and paper waste, on the germination, growth and flowering of petunias in the greenhouse. Applied soil ecology. 2008; 39(1):91-99.
Hilly M, Adams ML, Nelson SC. A study of digit fusion in the mouse embryo. Clin Exp Allergy. 2002;32(4):489-98.
16. Singh KP, Suman A, Singh PN, Srivastava TK. Improving quality of sugarcane-growing soils by organic amendments under subtropical climatic conditions of India. Biology and Fertility of Soils. 2007;44:367-376.
17. Arancon NQ, Edwards CA, Bierman P. Influences of vermicomposts on field strawberries: Part 2. Effects on soil microbiological and chemical properties. Bioresource Technology. 2006;97(6):831-840.
18. Black CA. Methods of Soil Analysis. Part I and II. American Soc. of Agron. Inc. Pub. Madison, Wisconsin, USA; 1965.
19. Jackson ML. Soil chemical analysis. Constable and Co. Ltd. London; 1962.
20. Page AL, Miller RH, Keeney DR. Methods of soil analysis part II. 2nd ed. Amer. Soc. Agron. Inc. pub. Madison, Wisconsin, USA; 1989.
21. Olsen SR, Sommers LE. Phosphorus. In: A. L. Page, et al. (eds.) Methods of soil analysis: Part 2. Chemical and microbiological properties. Agron. Mongr. 9. 2nd ed. ASA and SSSA, Madison, WI. 1982;403-430.
22. Williams CJ, Steinbergs A. Soil sulfur fractions as chemical indicates of available sulfur in some Australian soils. Aust. J. Agric. Res. 1959;10:340-352.
23. Pandiyan CV, Balaji K, Saravanan S, Shylaja G, Ragavendra G, Saghana PRK, Lecturer G. Effect of vermicompost application on soil and growth of the plant *Sesamum indicum* L. Preprints; 2020.
DOI: 10.20944/preprints202002. 0080. v1
24. Chanda GK, Bhunia G, Chakraborty SK. The effect of vermicompost and other fertilizers on cultivation of tomato plants. Journal of Horticulture and Forestry. 2011;3(2):42-45.
25. Syed M, KTM, Sadi R, Uddin AK Devnath, Rahman MK. Integrated effects of

vermicompost, npk fertilizers, cadmium and lead on the growth, yield and mineral nutrient accumulation in spinach (*Spinacia oleracea* L.). J. Biodiver. Conserv. Bioresou. Manage. 2022;8(2): 13-24.



*Peer-review history:*
*The peer review history for this paper can be accessed here:*
*https://www.sdiarticle5.com/review-history/108674*