

EFFECTS OF VERMICOMPOST AND INORGANIC FERTILIZERS ON GROWTH AND YIELD OF SESAME

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 T₁=Native soil fertility (No fertilizer and manure), T₂=100% Chemical Fertilizers (CF), T₃=Vermicompost (VC) @ 5 ton/ha, T₄=50% CF + 2.5 ton/haVC, T₅=70%CF + 1.5 ton/haVC. Yield and yield contributing characters of sesame were significantly influenced with the different treatments. The treatment T₄ (50% CF + 2.5 tha⁻¹ VC) gave the highest seed yield of sesame. The results indicated that treatment T₄ enhanced more crop growth which influenced on greater seed yield of sesame. The lowest seed yield was recorded at T₁ treatment. However, considering maximum yields the treatments T₄ 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. MATERIAL 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 T₁=Native soil fertility (No fertilizer and manure), T₂=100% Chemical Fertilizers (CF), T₃= Vermicompost (VC) @ 5 ton/ha, T₄=50% CF + 2.5 ton/ha VC, T₅=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 m² (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.

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.

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].

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].

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:CuSO₄.5H₂O: 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].

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]

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.

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 nm wavelength" [22].

Table 2. Physico-chemical properties of initial soil

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

Table 3. Rates of fertilizer applied in the experiment (gm/12m² 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

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, T₄ 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 T₄ treatment (3.83) than other treatments. Lower number of branch was obtained in T₅ treatment (3.06). The sesame plant obtained higher leaves at T₅ treatments (80) and lower leaves were T₁ treatments (63). Longer pod length of sesame was found at T₃ treatments (2.63) and smaller pod length was observed at T₅ 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 T₄ treatment produced more pod in sesame plant (74.11) than other treatments. Less pod number was found in T₅ treatment (53.45). Similar trend was found in case of seed/pod which significantly affected by five treatments. In T₅ 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 T₄ treatments (4.02) and lower 1000 seed weight was seen at T₂ treatments (2.90).

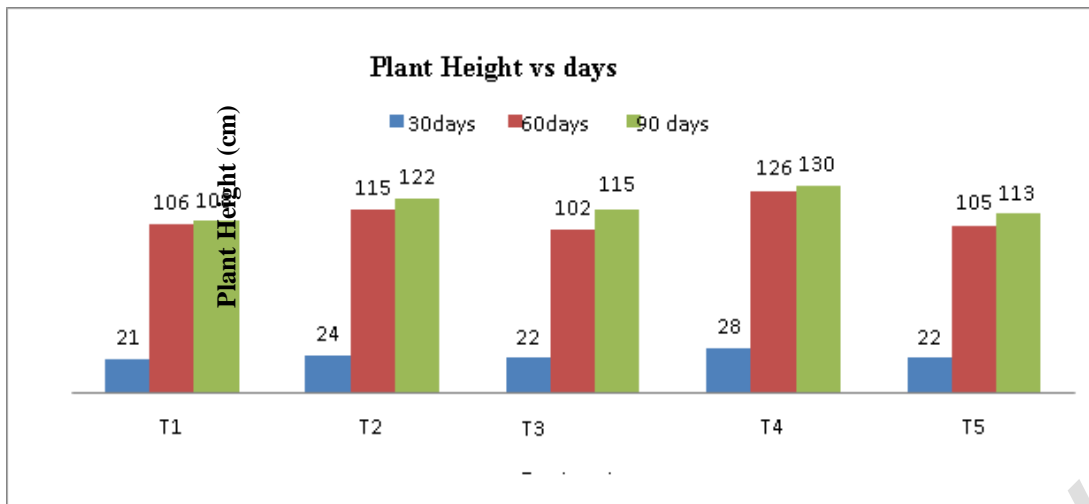


Fig. 1: Plant height at 30, 60 & 90 days

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
T ₄ =50% CF + 2.5 t ha ⁻¹ 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 ⁻¹ 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.

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