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Impact of fertilizers and manures on morphological and growth characters of sesame (*Sesamum indicum* L.)

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ABSTRACT

A field experiment was carried out to study the effect of fertilizers and manures on morphological characters of sesame (Sesamum indicum L.) at University of Rajasthan, Jaipur during kharif season of 2017. The five treatments namely control (without fertilizer or manure), nitrogen (N) fertilizer, N+P, vermicompost and biofertilizer + vermicompost were evaluated in randomized block design with four replications. Results revealed that germination percentage (83.3%), plant height (33.4 cm.), number of leaves (13.6), flowers per plant (4.2), inter-nodal length (7.84 cm.), leaf length (7.78 cm.), leaf breadth (4.46 cm.), leaf area (23.25 cm^2) and capsule size (2.96 cm.) were found maximum in biofertilizer + vermicompost followed by vermicompost alone. Average number of nodes (7.2) and petiole length (2.46 cm.) were highest in vermicompost treated plants. All morphological characters were significantly influenced by combined application of biofertilizer and vermicompost than those of inorganic fertilizers. Application of vermicompost (T4) produced the maximum seed yield of 7.68 q ha^{-1} followed by T5 (biofertilizer + vermicompost) and minimum in control (4.8 q ha^{-1}).

Keywords: Fertilizers, manures, morphological characters, yield, *Sesamum indicum*

INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the important oilseed crop in India, It is grown mostly as kharif crop and also along with rabi and summer crops grown with irrigation. Sesame has an importance for its high content of oil, protein, calcium, iron and amino acid-methionine. Seeds are the edible part of sesame crop. Sesame seeds are rich in fatty acids like oleic, palmitic, linoleic and stearic acids, besides it, it also contains vitamins like vitamin E, vitamin A and B complex, niacin and some minerals (Choudhary *et al.* 2017). Sesamin and sesamolin main antioxidants present in sesame seeds, have a cholesterol lowering effect in human and useful for preventing high blood pressure. In Rajasthan, fertilizers are used to improve growth and yield of several crops because of poor soil quality. Farmers mainly use urea and DAP as inorganic fertilizer. They are not aware of biofertilizer application in crops for higher productivity. Bio-fertilizers and organic manures are cheap nutrient source that could serve as alternative to chemical fertilizers and improve crop production in low-input agriculture. Organic manures contain large amounts of organic material as compared to inorganic fertilizers. Organic matter increases the water holding capacity of sandy soil and drainage in clayey soil. Organic manure supplies nutrients for the soil micro-organisms and increases the activities of microbes in soil, which successively help to convert unavailable nutrients into available form for plant growth promotion. Biofertilizers are non hazardous, environmental friendly products. These have been used in sustainable agriculture to improve the plant nutrients in soil. Nitrogen fixing and phosphorus solubilizing bacteria take part in nitrogen mobilization and phosphorus solubilisation in soil for the benefit of plant growth.The present study was therefore, carried out to evaluate the effect of fertilizers, vermicompost and biofertilizer on growth and yield of sesame.

MATERIALS AND METHODS

A field experiment was conducted at University of Rajasthan, Jaipur (Rajasthan) located at 26°55' North latitude and 75°49' East longitude during rainy season of 2017. The experimental soil was clayey sand in texture, pH 8.5, water holding capacity 36%, organic carbon 2.2 g kg^{-1}, P 23 kg ha^{-1}, K 242 kg ha^{-1}. The experiment was laid out in a randomized block design with five treatments and four replications. Treatments were:- T1-control, T2- 20 kg. N ha^{-1} ,

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T3- 20 kg.N + 25 kg.P_2O_5 ha^{-1}, T4-Vermicompost 10t ha^{-1}, T5- Biofertilizer +vermicompost. Sesame seeds were sown by hand dibbling in July 2017. Urea was applied in two splits: first, at sowing and second at 30 DAS (days after sowing). Vermicompost was applied 15 days before the sowing. Biofertilizer was used in solid form and mixed with vermicompost and applied 15 days before the sowing and seed inoculation method was also applied. After flowering, five plants were collected randomly from each plot and morphological characters were recorded. Seed yield was recorded at maturity of the crop. The statistical analysis was done using R language version 3.5. One way ANOVA was used to check the significant difference between the treatments at $p<0.05$ significant level. T test were employed to test the difference between different variable in multiple treatments.

RESULTS AND DISCUSSION

Germination

The germination percentage was highest in biofertilizer + vermicompost treated plants (83.3%) followed by vermicompost (76%) and least in control (Figure 1). The reason ofimproved seed germination may be due to increased synthesis of phytohormone like gibberaline, which could activate specific enzymes like α amylase and promoted early germination, and would help in starch assimilation. Similar findings were also reported by Subash and Rafath, (2016) in sesame and Javed and Panwar, (2013) in *Glycine max*.

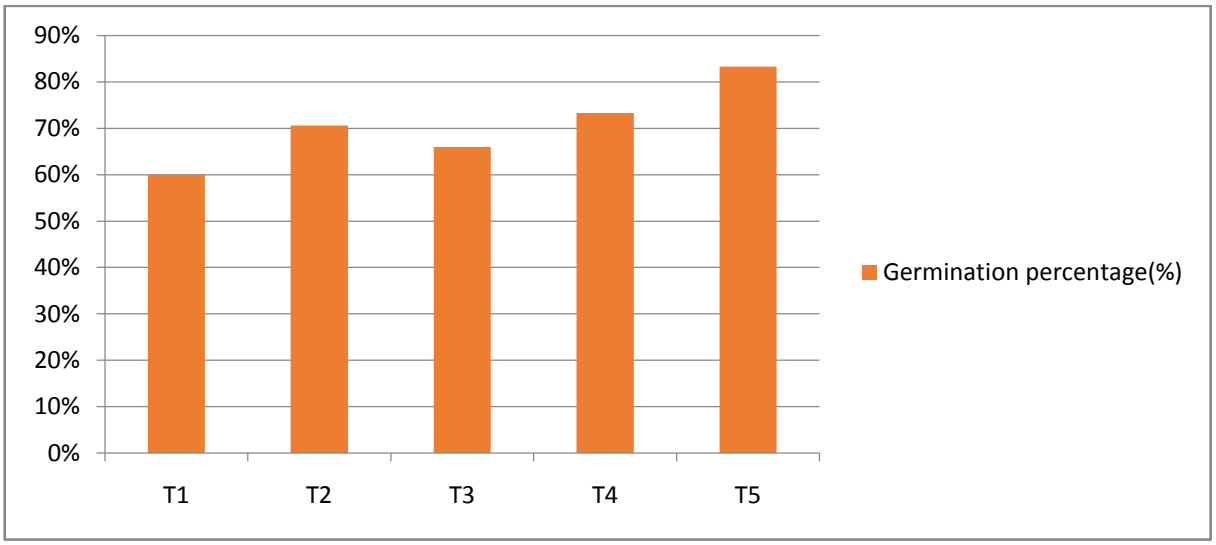

Figure 1: Effect of various treatments on germination

Growth parameters

The morphological and growth characters viz, plant height, number of leaves, number of flowers, and inter-nodal length were affected significantly due to biofertilizer + vermicompost application (Table 1). The maximum plant height (33.4 cm.), number of leaves (13.6), number of flowers (4.2)and inter-nodal length (7.84) were recorded at biofertilizer + vermicompost application while the minimum plant height (21.3 cm.), number of leaves (10), number of flowers (1.2) and inter-nodal length (4.3 cm.) were recorded with control. The increase in the growth components compared to the control might be due to the effect of micro-organisms in the biofertilizer which colonized the plant and soil thus directly releasing nutrients or by increasing availability of nutrients in the soils to plants as reported by Chandan *et al.* (2018). In our results, growth parameters were also significantly influenced by vermicompost alone, next to biofertilizer + vermicompost. This effect may be due to the availability of plant growth regulation and humic acid, which is produced by increasing the activity of microbes in vermicompost. Vermicompost highly influenced such growth parameters as compared to inorganic fertilizers (Sharma *et al.* 2017).

Table 1: Effect of different fertilizers on morphological characteristics 6 Weeks after Sowing

Treatments	Plant height (cm.)	Nodes per plant	Leaves per plant	Flowers per plant	Inter-nodal length (cm.)	Petiole length (cm.)	Leaf length (cm.)	Leaf breadth (cm.)	Leaf area (cm^2)	Capsule size (cm.)	Seed yield q ha^{-1}
T_1	21.3± 1.72	5.2± 0.20	10± 0.63	1.2± 0.48	4.3± 0.25	1.68± 0.29	6.0± 0.11	3.24± 0.35	13.68± 0.62	2.38± 0.19	4.80± 0.29
T_2	27.64± 1.67*	5.6± 0.24	11.2± 0.48	2.2± 0.20	5.52± 0.70	2.10± 0.23	6.62± 0.22	3.58± 0.04	16.93± 0.74	2.30± 0.05	6.20± 0.21 **
T_3	26.42± 0.72	5.4± 0.24	10.4± 0.40	2.4± 0.67	5.26± 0.56	2.14± 1.32	6.30± 0.27	3.40± 0.37	15.40± 1.23	2.28± 0.12	7.15± 0.24***
T_4	30.86± 1.85***	7.2± 0.37***	12.8± 1.35*	3.8± 0.66**	6.38± 0.91	2.46± 0.24	7.10± 0.54*	4.10± 0.32*	20.5±3 .10*	2.66± 0.09	7.89± 0.28 ***
T_5	33.4± 2.34 ***	6.8± 0.48 **	13.6± 0.74**	4.2± 0.80**	7.84± 0.90 **	2.4± 0.25	7.78± 0.35 **	4.46± 0.23**	23.25± 1.73***	2.96± 0.18**	7.68± 0.11 ***
SEm±	2.05	0.40	0.69	0.54	0.59	0.13	0.31	0.22	1.73	0.12	0.50
CD (p=0.05)	5.13	0.96	2.35	1.77	1.51	NS	0.98	0.74	5.13	0.41	1.51

*Level of significance:- *** = p≤0.001, ** = p≤0.01, * = p≤0.05, NS= Non-significant*

Leaf length, leaf breadth and leaf area were higher in biofertilizer + vermicompost (7.78±0.35, 4.46±0.23 cm. and 23.25±1.73 cm^2,respectively) followed by vermicompost treatment (7.10±0.54, 4.10±0.32 cm. and 20.5±3.10 cm^2) over control (6±0.11, 3.24±0.35 cm. and 13.68±0.62 cm^2). Kumar and Singh (2019) also reported similar findings. This could be due to *Azospirillum* biofertilizer producing phytohormones like indole acetic acid (IAA), gibberellins and cytokinins. Priya and Geetham (2015) also reported various morphological characteristics like the number of leaves, leaf length, leaf breadth, leaf area, shoot length, plant height were increased in co-inoculation of *Azospirillum* and PSB (Phosphate solubilizing bacteria) as compared to other treatments and control.These results may be due to uptake of nutrients like nitrogen and phosphorus made available by *Azospirillum* and phosphate solubilising bacteria.Petiole length and number of nodes were recorded higher in vermicompost treated plants (2.46±0.24 and 7.2±0.37 cm. respectively) and biofertilizer + vermicompost treated plants (2.4±0.25 and 6.8±0.48). Least values were observed in control (1.68±0.29 and 5.2±0.20 cm.). Similar result has also been reported by Mahboobeh *et al.* (2014). The use of vermicompost had positive role in improving soil physical and chemical properties by increasing water holding capacity and soil permeability and aeration. Thus, improving soil physical and chemical conditions by using of organic manure could ultimately led to a significant effect on improving plant growth and development (Basumatary *et al.* 2019).

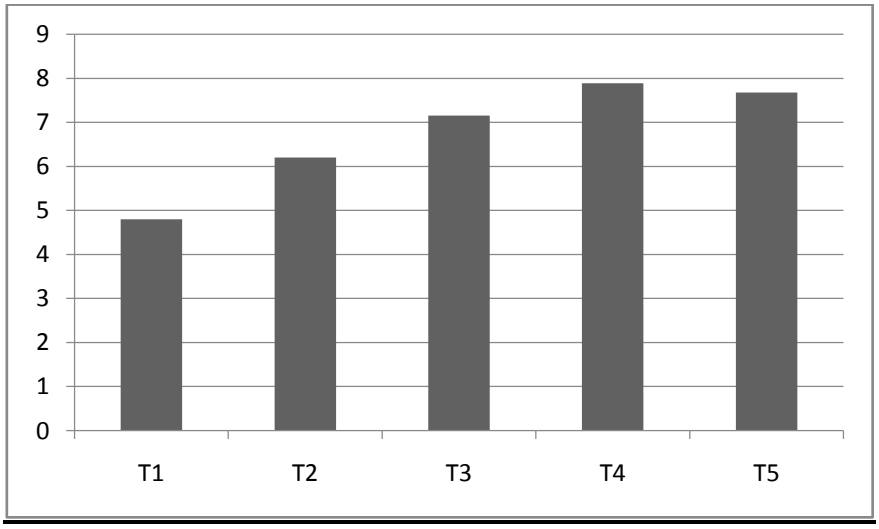

Figure 2: Effect of various treatments on seed yield

Yield attributes and yield

The size of capsule size was highest in biofertilizer + vermicompost; (2.96±0.18) followed by vermicompost (2.66±0.09 cm.). This may be due to bacterial phytohormones, the IAA content, which was increased in inoculated plants as compared to control and so increased other yield parameters. Inorganic fertilizers proved significantly inferior to vermicompost in respect of yield attributes (Sharma *et al.* 2014).Results revealed that the application of vermicompost and biofertilizer + vermicompost increased the yield of sesame crop (Table 1). Application of vermicompost recorded significantly higher seed yield (7.89 q ha^{-1}) followed by biofertilizer + vermicompost (7.68 q ha^{-1}) as compared to control and inorganic fertilizers (Figure 2). The minimum seed yield was recorded with control (4.80 q ha^{-1}). This increase in yield may be due to improved physio-chemical properties and nutrient availability with vermicompost, probably due to higher rate of mineralization and favourable condition for microbial and chemical activity, which in turn increased the yield. These results are in agreement with the findings of Sharma *et al.* (2014) and Sharma *et al.* (2017). From the results, it may be concluded that biofertilizers + vermicompost significantly increased morphological characters and its application is more beneficial for growth and seed yield of sesame than inorganic fertilizers. Therefore, they can be used as an alternative of inorganic fertilizers to obtain optimum growth and high yield of sesame under arid condition of Rajasthan.

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