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NUTRIENT MANAGEMENT AND ITS EFFECTS ON GROWTH AND YIELD ATTRIBUTES OF SESAME (*Sesamum indicum* L.) IN AMRITSAR CONDITIONS

Simranjeet Kaur[1] and Rakesh Kumar[2]

ABSTRACT

The field experiment focusing on the impact of nutrient management on growth and yield characteristics of Sesame (*Sesamum indicum* L.) under climatic conditions of Amritsar was conducted at the Students' Research Farm, Khalsa College, Amritsar during the *kharif* season of 2022. The experiment was laid out in three replications in factorial randomized block design, having a net plot size of 2.5 m X 4.5 m (11.25 m^2). The treatments comprised two sesame cultivars (Punjab Til No. 2 and RT 346) in factor A and seven nutrient management practices (control, RDF 100 %, Vermicompost 100 %, FYM 100 %, Poultry manure 100 %, Vermicompost 50 % + FYM 50 % and Vermicompost 50 % + Poultry Manure 50 %) in factor B. The analysis of variance illustrates the effect of different nutrient management practices on the growth and yield of sesame cultivars. Among the various sesame cultivars, RT 346 produced significantly higher plant height (141.96 cm), dry matter accumulation (10.07 g plant^{-1}), CGR (5.207 g m^{-2} day^{-1}), leaf area index (4.32), number of capsules plant^{-1} (33.30) , number of seeds capsule^{-1} (42.80), test weight (2.61 g), seed yield (8.26 q ha^{-1}), straw yield (24.32 q ha^{-1}) and biological yield (32.59 q ha^{-1}) than the other cultivar. Among the nutrient management practices, poultry manure 100 % gave significantly higher plant height (148.95 cm), dry matter accumulation (11.25 g plant^{-1}), CGR (5.919 g m^{-2} day^{-1}), leaf area index (4.69), number of capsules plant^{-1} (33.33), number of seeds capsule^{-1} (43.58), test weight (2.77 g), seed yield (8.91 q ha^{-1}), straw yield (26.11 q ha^{-1}) and biological yield (35.02 q ha^{-1})than the other treatments.

(Key words: Sesame, Punjab Til No.2, RT 346, FYM, vermicompost, poultry manure)

INTRODUCTION

Sesame (*Sesamum indicum* L.) is an annual diploid species which belongs to the Pedaliaceae family. It is known as the "Queen of Oilseeds" due to the high quality of its edible oil and protein content. Sesame has a oil content of 46-50 %, a protein content of 18-20 %, and a carbohydrate content of 14-20 % (Aslam *et al.,* 2021).

Sesame seed oil is widely recognized as a premium culinary oil due to its high cost and exceptional desirability among consumers. This oil exhibits a notable composition, containing 38.84 % oleic acid and 46.26% linoleic acid, both of which are abundant in unsaturated fatty acids, rendering it a highly favourable choice from health perspective.

In contemporary times, agriculture sector predominantly relies on the application of chemical fertilizers to facilitate growth and production of crops. However, rice-wheat cropping system mostly depends on conventional agricultural practices which have been observed to exert adverse effects on soil health. These practices contribute to soil degradation by causing soil acidification, degraded soil structure, multiple nutrient deficiencies and low organic carbon content etc. (Nawaz *et al*., 2019) etc. These factors may impact the development and productivity of subsequent crops, such as sesame, maize, peanut, and soybean. If sesame is cultivated on the same soil, it may be subjected to the negative effects of the previously employed pesticides. This is because sesame only requires 62.5 kg N ha^{-1} (Anonymous, 2023), which is far lower than the nutritional requirements of other cereal and plantation crops. On the other hand, it is exported to various countries and those chemicals might reduce the quality and yield of sesame by causing root burns, altering the pH of soil, etc. In the last twenty years, there has been a two-fold increase in the utilization of chemical fertilizers resulting in the pollution of both soil and ground water (Kukal and Aggarwal, 2003). However, if the oil-seeds or pulses are cultivated in the same soil, these chemicals may provide short-term benefits to the crop but lead to long-term degradation of the soil including acidification of soil and potential contamination of ground water, ultimately leading to the disruption of ecological equilibrium (Liu *et al*., 2021).

The incorporation of organic manures is believed to play a vital role in augmenting sesame crop productivity and alleviating the negative effects of chemical fertilizers (Ezung *et al.*, 2021). Organic manures contribute to the nutritional needs of plants by supplying primary, secondary and micro-nutrients in various forms, which are released as

1. P.G Student, Dept. of Agronomy, Khalsa College, Amritsar-143003, Punjab (India)
2. Assoc. Professor , Dept. of agronomy, Khalsa College, Amritsar-143003, Punjab (India) (Corresponding author)

result of mineralization process facilitated by a diverse range of micro-organisms. Within the domain of plant nutrition, a variety of organic alternatives are present, including farmyard manure (FYM), vermicompost and poultry manure. Vermicomposting is the process of converting complex organic compounds into stabilized humus like substance known as vermicompost. Vermicompost offers a broad variety of nutrients, such as nitrate, soluble P, exchangeable K, Ca and Mg in easily accessible form for plants (Ahilapuram *et al.*, 2023). Additionally, it aids in lowering the C:N ratio and raising the humus content of the soil such as N (1.65 %), P (0.30 %), K (0.56 %) (Kushwaha and Chauhan,2023). Poultry manure has been identified as the most favorable organic manure in sesame cultivation. It increases soil fertility by providing N, P and micro-nutrients, as well as improving moisture and nutrient retention. The average nutritional content is 2.5 % N, 1.85 % P, and 1.12 % K (Rasool and Ereisli , 2023). Farmyard manure is a degraded mixture of farm animal dung and urine, as well as litter and leftover material from roughage or fodder fed to cattle. The typical composition of , well-decomposed farmyard manure consists of 0.8 % N, 0.2 % P, and 0.5 % K (Bairwa *et al.*, 2021). As a result, the purpose of this research is to evaluate the growth and yield of sesame plants under varied amounts of organic manure including poultry manure, FYM, as well as vermicompost.

MATERIALS AND METHODS

Field experiments were carried out at the Student's Research Farm, P.G. Department of Agriculture, Khalsa College, Amritsar, during the *kharif* season of 2022. The experimental site is located at 31° 38' 2.40" North latitude, 74° 50' 7.39" East longitude and at an altitude of 236 m above sea level. The soil in the experimental field was classified as sandy loam.

Sesame was planted from July to October during 2022 *kharif* season. The factorial randomized block design was used to organize the field experiment. Factor A consists of two varieties, *viz*., V_1 (Punjab Til No. 2) and V_2 (RT 346). Factor B consists of seven nutrient management practices, *viz*., F_0 (Control), F_1 (RDF 100%), F_2 (Vermicompost 100%), F_3 (FYM 100%), F_4 (Poultry Manure 100%), F_5 (Vermicompost 50% + FYM 50%) and F_6 (Vermicompost 50% + Poultry Manure 50%). The row to row spacing was kept 30 cm and plant to plant spacing was kept 15 cm. The crop was sown on 11 July 2022 and harvested on 16 October 2022. All the recommended package of practices was followed to raise the crop. Five plants were tagged at random and data on plant height (cm), dry matter accumulation (g plant^{-1}), crop growth rate (g m^{-2} day^{-1}), leaf area index, number of capsules plant^{-1}, number of seeds capsule^{-1} were noted at 90 days after sowing of the crop. And the test weight of 1000 seeds (g), seed yield (q ha^{-1}), stalk yield (q ha^{-1}), biological yield (q ha^{-1}) and harvest index (%) were noted after harvesting of the crop.

The physical and chemical properties of soil (0-15 cm depth) at the experimental site were examined in the laboratory prior to the commencement of trial in 2022. The proportions of sand, silt and clay were determined to be 68.7, 14.9 and 15.2 %, respectively, resulting in soil texture classified as sandy loam . The electrical conductivity was observed to be 0.24 dS m^{-1}, pH was found to be 7.5 and the organic carbon content of the sample was determined to be 0.44 %. The concentrations of nitrogen, phosphorus and potassium were examined to be 227, 27.5 and 317 kg ha^{-1}, respectively. The measured bulk density of the soil sample was 1.53 mg m^{-3} while, particle density was 2.68 mg m^{-3} and porosity was calculated to 42.91 %. The data pertaining to the weather information (maximum and lowest temperatures, rainfall, and sunlight hours) was collected from the meteorological department in Amritsar. The maximum and minimum temperature recorded were 32.86 ^{0}C and 24.58^{0}C, respectively. The mean average relative humidity in the morning and evening was 88.16% and 70.89 %, respectively during the crop growth. The total rainfall received during the crop growth period was 728.5 mm and spread over 29 rainy days.

Observations on plant height, dry matter, CGR, leaf area index, number of capsules plant^{-1}, number of seeds calsule^{-1} were recorded at 90 DAS. Test weight, seed yield, stalk yield and biological yield were recorded after harvest. Harvest index was also calculated.

Table 1 shows the chemical composition of organic amendments used for the experiment. FYM has an alkaline composition. In contrast, NPK content (%) of poultry manure is higher than that of FYM and vermicompost. In incorporating organic manures into the soil, consideration was given to the nitrogen content of the nutrient sources.

Table 1. Chemical composition of the organic amendments used for the experiment

Parameters	FYM	Vermicompost	Poultry Manure
pH	8.1	6.9	7.9
Nitrogen (%)	0.8	0.69	2.5
Phosphorus (%)	0.2	0.3	1.85
Potassium (%)	0.5	0.56	1.12

The data was analyzed as per the standard procedure for "Analysis of Variance" (ANOVA) as described by Gomez and Gomez (1984). The significance of treatment was tested by an 'F' test (Variance ratio). The standard error of mean was computed in all cases. The difference in the treatment was tested by using Critical Difference (CD) at a 5% level of probability.

RESULTS AND DISCUSSION

Growth parameters

The data presented in Table 2 shows that the nutrient management practices influenced the sesame cultivars almost in all the growth attributes. In case of sesame cultivars, the cultivar RT 346 recorded significantly

Table 2.Effect of different sesame cultivars and different nutrient management practices on growth and yield parameters of sesame

Treatments	Plant height (cm) (90 DAS)	Dry matter accumulation (g plant^{-1}) (90 DAS)	CGR (g m^{-2} day^{-1}) (90 DAS)	Leaf Area Index (90 DAS)	Number of capsules plant^{-1} (90 DAS)	Number of seeds capsule^{-1} (90 DAS)	Test weight (g) after harvest	Seed Yield (q ha^{-1}) after harvest	Stalk Yield (q ha^{-1}) after harvest	Biological Yield (q ha^{-1}) after harvest	Harvest index (%) after harvest
Varieties											
V_1 : Punjab Til No.2	137.71	9.96	5.220	4.10	32.92	42.44	2.54	7.88	24.08	31.97	24.64
V_2 : RT 346	141.96	10.07	5.207	4.32	33.30	42.80	2.61	8.26	24.32	32.59	25.34
SE(m)±	1.19	0.03	0.003	0.04	0.11	0.11	0.02	0.08	0.07	0.20	0.21
CD (p=0.05)	3.57	0.09	0.009	0.12	0.33	0.33	0.06	0.24	0.21	0.60	0.63
Nutrient Management practices											
F_0 : Control	126.32	8.69	4.481	3.4	32.11	40.84	2.30	7.06	20.96	28.02	25.19
F_1 : RDF 100%	141.08	10.11	5.252	4.42	33.33	43.19	2.68	8.22	24.91	33.13	24.81
F_2 : VC100%	147.66	10.93	5.733	4.60	33.65	43.44	2.73	8.69	25.83	34.52	25.17
F_3 : FYM 100%	133.14	9.18	4.741	3.82	32.62	41.91	2.46	7.57	23.32	30.89	24.51
F_4 : PM 100%	148.95	11.25	5.919	4.69	33.73	43.58	2.77	8.91	26.11	35.02	25.44
F_5:VC 50%+FYM 50%	134.85	9.45	4.874	3.97	32.78	42.09	2.51	7.70	23.33	31.03	24.81
F_6 : VC 50% +PM 50%	147.13	10.52	5.489	4.57	33.53	43.35	2.71	8.39	24.96	33.35	25.16
SE(m)±	1.96	0.15	0.08	0.11	0.16	0.27	0.05	0.16	0.76	0.67	0.52
CD (p=0.05)	5.88	0.45	0.24	0.33	0.48	0.81	0.15	0.48	2.28	2.01	1.56

higher plant height (141.96 cm), dry matter accumulation (10.07 g plant^{-1}), CGR (5.207 g m^{-2} day^{-1}) and leaf area index (4.32) compared to the other cultivar. Among the nutrient management practices, poultry manure 100 % provided significantly higher plant height (148.95 cm), dry matter accumulation (11.25 g plant^{-1}), CGR (5.919 g m^{-2} day^{-1}) and leaf area index (4.69) than the control (F_0) treatment. However, the treatment FYM 100% (F_3) was statistically at par with the treatment VC 50% + FYM 50 % (F_5). Treatment VC 50% + PM 50% (F_6) was significantly better than PM 100% (F_4). Significantly lower plant height (cm), dry matter accumulation (g plant^{-1}), CGR (g m^{-2} day^{-1}) and leaf area index were found with the application of the treatment F_0 (control). This is due to the reason that nutrients are essential for better growth and development of the plant. The presence of organic matter has been shown to directly influence the absorption of nutrients by plants, as well as several growth and yield-related metrics. Poultry manure supplies both macro and micro nutrients to plants in an accessible form, ensuring an adequate supply of magnesium for the optimal functioning of chlorophyll in leaves. This, in turn, enhances the process of photosynthesis and improves the source-sink relationship, promoting the proper growth and development of plants. These treatments that received the desired amount of nutrients, exhibited a favorable effect on the sink component that could have resulted in better plant development in terms of plant height, dry matter accumulation and distribution of resources. The results were in the conformity with the findings of Usman *et al.* (2020), who reported that plant height, number of leaves plant^{-1} and number of capsules plant^{-1} were recorded maximum under treatment receiving poultry manure @ 4 t ha^{-1}.

Yield parameters

Table 2 presents the influence of nutrient management practices on various yield attributes of sesame cultivars. The cultivar RT 346 recorded significantly higher number of capsules plant^{-1} (33.30), number of seeds capsule^{-1} (42.80), test weight (2.61 g), seed yield (8.26 q ha^{-1}), straw yield (24.32 q ha^{-1}) and biological yield (32.59 q ha^{-1}) than the other cultivar. In comparison to other nutrient management practices, poultry manure 100 % provided significantly higher number of capsules plant^{-1} (33.33), number of seeds capsule^{-1} (43.58), test weight (2.77 g), seed yield (8.91 q ha^{-1}), straw yield (26.11 q ha^{-1}) and biological yield (35.02 q ha^{-1}) than the control treatment. However, the yield parameters under the treatment FYM 100% (F_3) were statistically at par with the treatment VC 50% + FYM 50 % (F_5). However, treatment VC 50% + PM 50% (F_6) was significantly better than PM 100% (F_4). Significantly lower number of capsules plant^{-1}, number of seeds capsule^{-1}, test weight (g), seed yield (q ha^{-1}), straw yield (q ha^{-1}) and biological yield (q ha^{-1}) were found with the application of the treatment F_0 (control). The increase in the yield attributes under the poultry manure 100 % treatment might be due to the higher number of capsules plant^{-1}, number of seeds capsule^{-1} and test weight of 1000 seeds. Organic manures, such as poultry manure, are well known for improving the physical and biological qualities of soil, including the availability of almost all essential plant nutrients for plant growth and development. Thus, adequate nutrition in a suitable environment may have contributed to the formation of new tissues and shoots, ultimately increasing sesame seed yield. The results are also in agreement with the findings of Haruna and Abimiku (2012), who reported that number of capsule plant^{-1}, capsule weight plant^{-1} and seed yield were recorded significantly higher under treatment receiving poultry manure @ 2.5 t ha^{-1}.

In particular, the humus content organic matter in the soil has a beneficial effect on modifying the soil environment to hold more nutrients, better aeration, and microbial activity, resulting in a favorable environment for increasing nutrient uptake by the plant, as well as a solubility effect on fixed forms of nutrients. Poultry manure application may have reduced soil pH, resulting in the maintenance of balanced nutrition and higher availability of nutritional components from the soil. The results were in conformity with the findings of Kumar *et al.* (2023), who reported that plant height, number of pods plant^{-1}, number of grains pod^{-1}, stover yield and seed yield were recorded maximum under treatment receiving 100 % RDF + PM @ 10 t ha^{-1}. Organic matter content has a direct impact on nutrient intake by plants, resulted in escalating growth and yield parameters. The positive response of the crop to poultry manure as reported in present investigation confirms the previous observations of Singh *et al.* (2016), who reported that plant height, number of pods plant^{-1}, number of grains pod^{-1} were recorded maximum under treatment receiving 50 per cent NPK +FYM @ 5.0 t ha^{-1} + VC @1.5 t ha^{-1} + PM @ 1.5 t ha^{-1}.

Thus, it is inferred from the above study that among the different cultivars of sesame, cv. RT 346 produced significantly higher growth and yield contributing characters resulting in increased seed yield (q ha^{-1}) as compared to cv. Punjab Til No. 2. The increment in seed yield in the cultivar RT 346 (V_2) than Punjab Til No. 2 (V_1) was 4.8 %. The different nutrient management practices showed a significant effect on the growth and yield of sesame. In comparison to (F_0) control, there was 26.2% increase in seed yield with poultry manure 100 % (F_4) treatment.

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