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Effect of Plant Spacing and Manganese on Yield, Economics and Quality of Sesame (*Sesamum indicum* L.)

Tappeta Sangeetha [a*++], Rajesh Singh [a#] and Thakur Indu [a†]

[a] *Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences (SHUATS), Prayagraj- 211007, Uttar Pradesh, India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during *Zaid* season (2022) at Crop ResearchFarm, Department of Agronomy, SHUATS, Prayagraj (U.P.),India, to study the influence of spacing and manganese on yield and economics and quality of sesame. The treatments consisted of 3 levels of spacing (30×10cm, 40× 10cm, 50× 10 cm) and 3 levels of manganese (1.5,3.0 and 4.5 kg/ha). The experiment was laid out in Randomized Block Design with 10 treatments and replicated thrice. The results recorded significantly higher in yield and yield attributes viz. number of capsules/plant (52.47), number of seeds per capsules (74.50), test weight (3.37 g), seed yield (1.19 t/ha), stover yield (2.67 t/ha) and oil content (48.10%).Maximum Gross returns (113050.00 (Indian Rupee) INR/ha), Net returns (76944.15(Indian Rupee) INR/ha) and Benefit cost ratio (2.13) was found in treatment (T9)with the application of 50×10cm + manganese sulfate (MnSO4) 4.5 Kg/ha.

[++] *M.Sc. Scholar;*
[#] *Associate professor;*
[†] *Ph. D Scholar;*
**Corresponding author: E-mail: sangeethasrinu56@gmail.com;*

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1. INTRODUCTION

Sesame *(Sesamum indicum* L.*)*is important oil seed crop which plays crucial role in Indian agricultural economy both in area as well as production. It is a drought resistant crop and it can be easily survive or grown under rain-fed conditions. Sesame mostly grown in summer season and also in Kharif season.Sesame is the oldest known oil seed crop and it is popular worldwide. It is commonly known as Till, Gingelly, Simsim. Sesame have the highest protein contents and oil content. (Raja *et al.* 2007). Oil content of sesame is varies from 46-52%. Sesame seeds are rich in protein, energy, dietary fiber, carbohydrate and also contains riboflavin, thiamine [1,2]. Proper spacing supply sufficient light, efficient, absorption of nutrients and water from soil and at optimum spacing avoids intra space competition [3-5]. Spacing have effect on yield attributes viz., number of capsules/ plant, number of seeds/ capsules [6] Optimum plant spacing starts the sesame plant to grow properly both its aerial and underground parts through utilizing radiant energy more to encourage crop production [7] spacing will bring a positive effect on yield. It is most important component in farming system in intensive method.Micro nutrients bring positive effect on yield parameters [8,9]. Manganese in plants is a constituent and activator of enzymes involved in protein synthesis, lipid metabolism and photosynthesis. Manganese deficiency mostly leads to NO_3 - N in plant tissues. The signs of manganese deficiency in plants include decrease in number of lower per plant, infertility of pollen [10-12]. Keeping these points in view an experiment was conducted to achieve yield with profitable investment by treatment combinations of different spacing and also manganese levels.

2. MATERIALS AND METHODS

A field experiment was carried out during *Zaid* season of 2022. The experiment was conducted in Randomized Block Design and it consists of ten treatment combinations with three replications and was laid out variously with different treatments assigned randomly in each replication. The soil in experimental field was sandy loam texture, having alkaline reaction (pH 7.1) with very low organic carbon (0.28%), available higher n (225 Kg/ha), p (19.50 kg/ha) and higher level of potassium (92.00 kg/ha). Treatment combinations were T_1 - 30×10 cm + Manganese sulfate ($MnSO_4$)1.5 kg/ha, T_2 - 40×10cm + $MnSO_4$ 1.5 kg/ha, T_3 - 50×10cm + $MnSO_4$ 1.5 kg/ha, T_4 - 30×10cm + $MnSO_4$ 3.0 kg/ha, T_5 - 40×10 cm+ $MnSO_4$ 3.0kg/ha, T_6 - 50×10 cm+ $MnSO_4$ 3.0kg /ha, T_7 - 30×10 cm +$MnSO_4$ 4.5 kg/ha, T_8 - 40×10cm+ $MnSO_4$ 4.5 kg/ha, T_9 - 50× 10cm + $MnSO_4$ 4.5 Kg/ha, T_{10}-Control (RDF) . The observations were recorded on yield and yield parameters i.e. Number of capsules/plant, number of seeds/ capsule, test weight, grain yield and stover yield, oil content, gross returns, net returns, Benefit-Cost Ratio (BCR).

3. RESULTS AND DISCUSSION

3.1 Yield

Treatment with the spacing of 50×10cm + (Manganese sulfate) $MnSO_4$4.5kg/ha was reported maximum number of capsules/ plant (52.47) which was significantly superior over all from other and treatment with spacing of 50×10cm +$MnSO_4$ 3.0 Kg/ha (50.53) which was statistically at par with the treatment with the application of 50×10cm+ $MnSO_4$ 4.5 Kg/ha.Treatment with spacing of 50×10cm+ $MnSO_4$ 4.5 Kg/ha was recorded maximum number of seeds per capsules (74.50) which was significantly superior over all other and treatment with spacing of 30×10 cm + $MnSO_4$ 4.5 Kg/ha (73.07) and 50×10cm + $MnSO_4$ 1.5 Kg/ha (72.67) which was statistically at par to the treatment with spacing of 50×10cm + $MnSO_4$ 4.5 Kg/ha.Treatment with spacing of 50×10cm+ $MnSO_4$ 4.5 Kg/ha was recorded maximum test weight (3.37g) which was significantly superior over all other and treatment with spacing of 50×10cm + $MnSO_4$ 3.0 Kg/ha (3.20) which was statistically at par to the treatment with spacing of 50×10cm + $MnSO_4$ 4.5 Kg/ha. Treatment with spacing of 50×10cm + $MnSO_4$ 4.5 Kg/ha was recorded maximum seed yield (1.19 t/ha) which was significantly high over all other and treatment with spacing of 40×10cm +$MnSO_4$ 4.5 Kg/ha (1.16) which was statistically at par with the treatment with spacing of 50×10 cm + $MnSO_4$ 4.5 Kg/ha. Treatment with spacing of 50×10cm +$MnSO_4$ 4.5 Kg/ha was recorded maximum stover yield (2.67t/ha) which was

significantly more from all other and treatment with application of 50×10cm + $MnSO_4$ 3.0 Kg/ha (2.66 t/ha) which was statistically at par to treatment application of 50×10cm +$MnSO_4$ 4.5 Kg/ha. Treatment with application of 50×10 cm + $MnSO_4$ 4.5 Kg/ha was observed maximum harvest index (30.82 %) and minimum with application of 40×10 cm + $MnSO_4$ 4.5 kg/ha (30.36%) [13].

3.2 Oil Content

With treatment application of 50×10cm + $MnSO_4$ 4.5kg/ha found more oil content (48.10%) and higher compared to all other treatments. With treatment of50×10cm+$MnSo_4$3.0kg/ha observed (47.54%) and it was statistically at par with 50 ×10cm + $MnSO_4$ 4.5kg/ha.

3.3 Economics

Economic viability and efficiency of crop cultivation are mostly outcome of crop production with less production cost. Higher cost of cultivation (36,105.85) was observed in (T9) 50×10cm+$MnSO_4$ 4.5kg/ha. Maximum Gross returns(113050.00≠/ha),netreturns(76944.15≠/h), Benefit -cost ratio (BCR) (2.13) was reported in (T9) 50× 10 cm + $MnSO_4$ 4.5kg/ha.

Table 1. Effect of plant spacing and manganese on yield and yield attributes of sesame

S.no	Treatments	No. of capsules perplant	No. of seeds per capsules	Test weight (g)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
1.	30×10 cm + $MnSO_4$ 1.5 kg/ha	47.03	68.87	2.10	1.00	2.54	29.37
2.	40 ×10cm+ $MnSO_4$ 1.5 kg/ha	45.17	69.10	2.63	1.04	2.57	28.80
3.	50×10cm+ $MnSO_4$ 1.5 kg/ha	46.77	72.67	3.07	1.07	2.59	29.23
4.	30×10cm + $MnSO_4$ 3.0 kg/ha	46.47	68.17	2.40	1.10	2.60	29.72
5.	40 ×10cm + $MnSO_4$ 3.0 kg/ha	45.27	72.60	2.77	1.11	2.62	29.75
6.	50×10 cm + $MnSO_4$ 3.0 kg /ha	50.53	74.43	3.20	1.17	2.64	30.70
7.	30×10 cm + $MnSO_4$ 4. 5 kg/ha	47.60	73.07	2.43	1.13	2.61	30.21
8.	40 ×10cm + $MnSO_4$ 4.5 kg/ha	48.40	72.07	2.90	1.16	2.66	30.36
9.	50×10 cm + $MnSO_4$ 4.5 Kg/ha	52.47	74.50	3.37	1.19	2.67	30.82
10.	Control (RDF)	46.97	65.03	2.07	0.90	2.50	26.47
	SEm (±)	1.02	1.75	0.09	0.04	0.01	0.02
	CD (5%)	3.05	5.22	0.28	0.14	0.03	0.06

Table 2. Effect of plant spacing and manganese on economic indicators

S. No	Treatments	Total cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C ratio
1.	30×10 cm + $MnSO_4$ 1.5 kg/ha	35,930.55	94683.33	58752.78	1.64
2.	40 ×10cm+ $MnSO_4$ 1.5 kg/ha	35,830.55	98800.00	62969.45	1.76
3.	50×10cm+ $MnSO_4$ 1.5 kg/ha	35,630.55	101650.00	66019.45	1.85
4.	30×10cm + $MnSO_4$ 3.0 kg/ha	36,116.85	104183.33	68066.48	1.88
5.	40 ×10cm + $MnSO_4$ 3.0 kg/ha	36,016.85	105766.67	69749.82	1.94
6.	50×10 cm + $MnSO_4$ 3.0 kg /ha	35,916.85	111150.00	75233.15	2.09
7.	30×10 cm + $MnSO_4$4. 5 kg/ha	36,305.85	107666.67	71360.82	1.97
8.	40 ×10cm + $MnSO_4$ 4.5 kg/ha	36,205.85	110200.00	73994.15	2.04
9.	50×10 cm + $MnSO_4$ 4.5 Kg/ha	36,105.85	113050.00	76944.15	2.13
10.	Control (RDF)	35,743.35	85183.33	49439.98	1.38

Table 3. Effect of plant spacing and manganese on oil content of sesame

S.no	Treatments	Oil content (%)
1.	30×10 cm + $MnSO_4$ 1.5 kg/ha	45.48
2.	40 ×10cm+ $MnSO_4$ 1.5 kg/ha	46.02
3.	50×10cm+ $MnSO_4$ 1.5 kg/ha	46.14
4.	30×10cm + $MnSO_4$ 3.0 kg/ha	46.10
5.	40 ×10cm + $MnSO_4$ 3.0 kg/ha	45.70
6.	50×10 cm + $MnSO_4$ 3.0 kg /ha	47.54
7.	30×10 cm + $MnSO_4$ 4. 5 kg/ha	46.45
8.	40 ×10cm + $MnSO_4$ 4.5 kg/ha	47.15
9.	50 ×10cm + $MnSO_4$ 4.5kg/ha	48.10
10.	Control (RDF)	45.20
	SEm (±)	S
	CD (5%)	0.98

4. CONCLUSION

Based on conclusions of one season experimentation it can be concluded that spacing of 50×10cm+$MnSO_4$ 4.5 kg/ha was found more productive (1.19 t/ha) and it can be recommended to farmers after further trails.

FUTURE SCOPE

As there was less research happened in this field, further research should be done to obtain better results and help farmers obtaining better yield. Since findings are based on one season further trails are needed to confirm the results of this experiment.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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