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Studies on effect of manganese nutrition on quality parameters of sesame (*Sesamum indicum* L.)

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Abstract
A field study entitled "Studies on effect of manganese nutrition on quality parameters of sesame." was carried out during late *Rabi*, 2021 at Narkhoda Research Farm, ICAR-IIOR. The soil was sandy loam in texture, slightly alkaline in reaction, low in available manganese. The experiment was carried out in two Factor randomised block design with 4 treatments and 3 replications. The treatments were viz., Control (Recommended dose of NPK) (T_1), Manganese@ 2.5 kg/ha + Recommended dose of NPK (T_2), Manganese @3.5 kg/ha + Recommended dose of NPK (T_3), Manganese@ 5.0 kg/ha + Recommended dose of NPK (T_4). This experiment was conducted in Mn deficient soil. Soil application of manganese in the form of $MnSO_4$ was done at the time sowing. Soil application of manganese had significantly influenced the quality parameters of sesame. Oil content varied among different genotypes in different treatments. Maximum oil content (48.5) percentage was recorded in the genotype swetha at a level of application of Mn @ 3.5kg ha^{-1}. Fatty acid content (Palmitic acid, Stearic acid and Oleic acid) values differed among the sesame varieties with different manganese treatments. The results revealed that maximum values for fatty acid contents were recorded in JCS-2454 at a level of application of Mn @ 3.5kg ha^{-1}.

Keywords: *Sesamum indicum* L., randomised block

1. Introduction

Sesame (*Sesamum indicum*) is a flowering plant popularly known as Queen of oil seeds' due to its stabilized keeping quality contributed by high degree of resistance to oxidation and rancidity. It is the third major oilseed crop after Groundnut and Mustard. India ranks first in area and production of sesame in the world and it is cultivated in an area of 1.71 million hectares (ha) with average production and productivity of 0.8 million tonnes and 405 kg/ha respectively in the year 2019-20.

The oil seed crops require fairly good amount of N, P, K, S and small amount of micronutrients. (Ahmadi and Javidfar, 1998) [1].

Manganese is one of the main micronutrients, which has an important role in plant as a component of enzymes involved in photosynthesis and other processes. Manganese in plants is a constituent and activator of enzymes involved in protein synthesis, lipid metabolism and photosynthesis. It is also important in N metabolism and in CO2 assimilation and regulates the activity of nitrate reductase (Tisdale *et al*., 1990) [11]. Manganese is essential for splitting the water molecule during photosynthesis and its deficiency leads to accumulation of NO -N in plant tissue (Foy *et al*., 1988) [3].

Manganese deficiency causes yield decline to the tune of 30 % in oil seed production. The major symptom of deficiency is a reduction in the efficiency of photosynthesis leading to a general decline in dry matter productivity and yield.

Manganese fertilizer increases the crop yield and quality, due to improved plant nutrition and increasing photosynthesis in plants, so crop yield and quality increases by increasing photosynthetic efficiency (Mousavi *et al*., 2007; Crosier *et al*., 2004; Kelling and Speth, 2001; Hiller, 1995) [9, 2, 7, 5].

The production of oilseeds in India including sesame is not enough to meet the domestic demand of the large population. Low production of sesame is attributed to the fact that the crop is usually grown during rainy season on marginal and less fertile soils. Further lack of proper nutrient management is one of the major causes for low yields.

Adequate and balanced fertilizer is essential for obtaining better yield. Generally farmers do not apply micronutrients to sesame crop hence the quality production is low. As manganese deficiency causes reduction in oil quality of sesame, therefore for wide spread adoption and exploitation of high yield potential of the crop "Effect of manganese nutrition on Quality parameters of sesame" was planned to investigate the performance of sesame cultivars and the role of manganese on influencing the oil content and fatty acid profile of sesame.

Materials and Methods

The experiment was conducted at ICAR-IIOR Research Farm at Narkhoda, Hyderabad, located at an altitude of 542 m above mean sea level with a geographical bearing of 17015'16" N latitude and 78018'30" E longitude. The experiment was carried out in randomized block design in four treatments i.e., T1-Control (NPK), T2-NPK+MnSO4@ 2.5Kg/ha; T3-NPK+MnSO4@ 3.5Kg/ha; T4- MnSO4@ 5Kg/ha with three replications during the late Rabi season of the year 2021. The mean maximum and minimum temperature ranged from 27.5oC to 37.1oC and 15oC to 23.2oC respectively and the total precipitation during the crop growth was 2.34 mm. A set of three sesame genotypes that includes Swetha, JCS-2454 and JCS-1020 were used. The seeds were sown in a plot of 4×3 sq. m size by dibbling and replicated thrice. The crop was raised as per prescribed POP i.e., recommended dose of fertilizers were applied (40 kg N+ 20 kg P_2O_5+ 20 kg K_2O /ha) in two split doses. Soil application of manganese was done at the time sowing. Prophylactic measures were taken against the pests and diseases. Crop was irrigated on need basis.

Results and Discussion

Oil content

The values for oil content (%) of different sesame varieties are shown in the table indicated significant differences at treatments and genotypic levels, whereas their interaction was not significant. Among different dosages of Mn, T3 (Mn @ 3.5kg/ha) recorded highest oil content percentage in all the three genotypes i.e., Swetha (48.5%) followed by JCS- 1020(47.87%)and JCS-2454(46.49%), which was on par with T2 (Mn @ 2.5kg/ha). Treatment T1(control) recorded least oil content percentage, from genotypes Swetha (42.75%) followed by JCS-1020 (44.1%) and JCS-2454 (44.2%). Manganese is cation activator of Acetyl-CoA carboxylase, an enzyme involved in the first committed step in fatty acid synthesis. The level of Mn in plant tissues may therefore affect oil and protein proportions in seed. Lääniste *et al*. (2004) [8] carried out field trials, to investigate the effect of microfertilisers on the seed oil content of rape cultivar 'Mascot' and revealed that different microelements influenced the oil content of rape seeds. Foliar application of manganese and molybdenum increased the oil content in the seeds more than one percent. Similar results were observed by Salwa *et al*. (2010) [10] and Habimana *et al*. (2016) [4] in sesame.

Fatty acid profile

Fatty acid content (Palmitic acid, stearic and oleic acids) values of different sesame varieties were presented in the table.The values of palmitic acid ranged from 10.06 to 11.9%, stearic acid :5.4 to 6.47% and oleic acid : 39.32 to 46.63 %.

The data on palmitic acid indicated significant differences among the treatments. There was no significant differences among the genotypes and interaction levels. Among the different treatments, T3 (Mn @ 3.5kg/ha) gave significantly highest value for palmitic acid in all the three genotypes *viz*., JCS-2454(11.9%) followed by Swetha (10.76%) and JCS- 1020(10.63%). Lowest palmitic acid content recorded in control in all the three genotypes.

The values for stearic acid content (%) of different sesame genotypes indicated significant difference at treatment, genotypic levels and their interaction effect was also significant. Higher stearic acid content was observed in case of JCS-2454 (6.47%) with in the T3 (Mn @ 3.5kg/ha) treatment, however T2(Mn @ 2.5kg/ha) and T3(Mn@ 3.5kg/ha) were found to be on par with each other. Lowest Stearic acid content was recorded in the genotype Swetha (5.4%) with in the T1 (control) treatment.

Table 1: Effect of manganese on quality parameters of sesame genotypes under different Mn treatments

Treatment	Genotype	Oil content (%)		Palmitic acid (%)		Stearic acid (%)		Oleic acid (%)	
T1	Swetha	42.75		10.42		5.40		41.80	
	JCS2454	44.20		10.27		6.00		42.36	
	JCS1020	44.10		10.06		6.02		39.32	
T2	Swetha	46.41		10.59		5.71		44.85	
	JCS2454	46.56		10.55		6.31		44.66	
	JCS1020	44.31		10.56		6.13		45.42	
T3	Swetha	48.50		10.76		6.17		45.52	
	JCS2454	46.49		11.90		6.47		46.63	
	JCS1020	47.87		10.63		6.17		45.85	
T4	Swetha	45.91		10.51		5.66		43.93	
	JCS2454	44.44		10.39		6.15		43.32	
	JCS1020	44.15		10.32		6.56		43.86	
		S. Em±	CD(P=0.O5)	S. Em±	CD(P=0.O5)	S. Em±	CD(P=0.O5)	S. Em±	CD(P=0.O5)
Treatments		0.827	2.606	0.118	0.370	0.056	0.175	0.522	1.645
Genotypes		0.717	0.892	0.102	N/S	0.048	0.151	0.452	N/S
Interaction		1.433	N/S	0.204	N/S	0.096	0.303	0.904	N/S

The values for oleic acid content (%) of different sesame genotypes indicated significant differences among the treatments. However interaction effect was non-significant. Highest oleic acid content was recorded in the T3 (Mn @ 3.5kg/ha) treatment in all the three genotypes JCS-2454(46.63%) followed by JCS-1020 (45.85%) and Swetha

(45.52%). Lowest oleic acid content was recorded in the genotype JCS-1020 (39.32%) with in the T1 (control) treatment.

Conclusion

In the present investigation, it was apparent that manganese application improved quality parameters like oil content and fatty acid content. In general application of Mn @ 3.5kg/ha along with recommended dose of NPK was found to be beneficial in Mn deficient soil to get improved seed quality in sesame.

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