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RESEARCH ARTICLE

Response of Sesamum Varieties to Graded Levels of Sulphur on Seed Yield and Oil Content in Soils of Different Sulphur Status

Venkatakrishnan, L1*, M.R.Backiyavathy2, S. Meena2, T. Kalaiselvi3 and D. Amirtham4 1*Research Scholar, Department of Soil Science & Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore-3 2Professor, Department of Soil Science & Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore-3 3 Professor, Department of Agricultural Microbiology, Tamil Nadu Agricultural University, Coimbatore-3 4 Assistant Professor, Department of Food Processing and Post-Harvest Technology, Tamil Nadu Agricultural University, Coimbatore-3 Corresponding author: krishnann93@gmail.com

ABSTRACT

Field experiments were conducted in Coimbatore District with discrete soil sulphur status *i.e.,* soils with sufficient and deficient levels of sulphur, to know the relative response of graded levels varied doses of sulphur on two different sesamum varieties. The experiments were laid out in a split-plot design with two factors *viz.,*twosesamum varieties (TMV 7 - Black var. and SVPR 1 - White var.) and six sulphur levels (0, 20, 30, 40, 50, and 60 kg S ha^{-1}). The results revealed that application of 30 and 50 kg S ha^{-1} at sulphur sufficient and sulphur deficient soils, respectively, has increased the yield parameters such as test weight, seed weight per plant, seed yield, stalk yield, oil yield, and biological yield.Between the two varieties, TMV 7 has performed better when compared with SVPR 1.Under both the soil sulphur status, further increase in the level of sulphur recorded a non-significant increase in the yield attributes.

Keywords:Sulphur levels; Sulphur status; Growth; Yield attributes

INTRODUCTION

Sesame is commonly known as “Till.” Its botanical name is *Sesamumindicum L.* It is one of the earliest domesticated plants. Due to the presence of a potent antioxidant, sesame seeds are known as “the seed of immortality”. Two distinct types of seed are recognized, the white and the black. There are also intermediate colored varieties varying from red to rose or from brown or grey.

India is the foremost producer of oilseed crops in terms of area (26 million ha) and production (30 million tonnes), in which 72% of the area is under rainfed condition. As per 4th Advance Estimates Oilseeds Production in the country during 2017-18,the production was estimated as 31.31 million tonnes which is marginally higher than the production of 31.28 million tonnes during 2016-17. However, the production of oilseeds during 2017-18 was higher by 1.76 million tonnes than the average of 2012-13 to 2016-17. The per capita consumption was 15.80 kg per person per annum during 2012-13 and has increased to 19.30 kg per person in 2017-18. In addition, demand for edible oils in both quantity and quality is growing due to population growth, which was 1.21 billion in 2011 (Luna, 2011) and now reached above 1.25 billion (Gupta, 2014). Considering the growing domestic demand for edible oils, it has now been planned to achieve a production of 45.64 million tonnes from nine annual oilseed crops by 2022-2023, expecting an additional production of about 15.58 million tonnes over and above the 30.06 million tonnes production during quinquennium ending2016-17. Thus, the availability of total vegetable oil from domestic production would be about 13.69 million tonnes by 2022 (at 30 per cent recovery) as against the current annual output of about 7.0 million tonnes(NFSM, 2017).

Among the oilseed, sesamum is one of the most important oil seed crops belonging to the Pedaliaceae family and extensively grown in different parts of the world and it ranks fourth among oil seed crops of the world in terms of area of production. It is a versatile crop with a diversified use of high-quality edible oils that contains vitamins, amino acids and polyunsaturated fatty acids. In sesamum seeds, linoleic and oleic acids are the prime factors, which are responsible for oil consistency (Uzun*et al*., 2008).

Generally, the sulphur (S) requirement by crops is equal to that of phosphorus, which plays a vital role in plant metabolism. It is indispensable for the synthesis of essential oils (Singh *et al*., 2000), a constituent of several organic compounds (Shamina and Imamul, 2013), oil storage organs, particularly oil glands i.e., glyoxysomes (Jaggi*et al*., 2000) and vitamin B_1 (Thirumalaisamy*et al*., 2001). It also serves as a component of plant amino acids, proteins, vitamins, and enzyme structures. It has been observed that increasing sulphur application increases oil content and oil yield, protein, and glucosinolates of canola seeds (Haneklaus*et al*., 1999). Sulphuralso influences the productivity of oil seed and total oil content (Egesel*et al*., 2009). In addition, the continuous application of NPK fertilizers contributes to a sulfur deficiency along with a great deal of organic matter deficiency, making the situation worse for oilseed crops. In view of this background, the present study was taken up to trace the optimum level of sulfur recommendation for yield maximization and quality improvement in sesamum.

MATERIAL AND METHODS

Two field experiments were conducted at two different locations of Coimbatore district in soils having two sulphurstatus*i.e.,* a soil with sufficient level and soil with deficient level of sulphur in order to study the response of two sesamum varieties to graded doses of sulphur with respect to seed yield and quality. The field experiments were conducted at farmers' holdings in Selambanur (Latitude: 10.995069 and Longitude: 76.788893) and Puthur (Latitude: 10.979436 and Longitude: 76.836387) villages of Thondamuthur block at Coimbatore district from February 2019 to July2019 and March2019 to August 2019, respectively. The selected experimental field soils were neutral in pH 7.5 & 7.2 and has an electrical conductivity of 0.19 & 0.15 dSm^{-1}, available N of 361 & 349 kg ha^{-1}; available P of 19 & 21 kg ha^{-1}; available K of 295 & 288 kg ha^{-1}; available S of 43.23 & 7.3 $mgkg^{-1}$ respectively in soils of high and low sulphur status field. The treatments comprised six levels of sulphur supplied using gypsum as the source (0, 20, 30, 40, 50 and 60 kg S ha^{-1}) along with soil test based application ofmajor nutrients fertilizer doses, which were replicated three times in a split-plot design (Main plot – sesamum varieties, Sub plot- S levels). The data on yield parameters, seed yield and oil content were analyzed statistically using the AgRes statistical software (Pascal Intel Software Solutions). Wherever the treatment differences were found significant, critical differences (CD) were worked out at 5% level of significance with mean separation by least significant difference and denoted by the symbol (* for 5% and ** for 1%). A simple correlation was worked out between different parameters to know the relationship that exists among them (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Test weight: Statistically significant variations were recorded for sulphur application with respect to the test weight of sesame seeds. The test weight of sesamum varieties with 30 kg S ha^{-1} was significantly higher in the case of sulphur sufficient soil. Inthe case of sulphur deficient soil, the highest test weight of 3.51 g (TMV 7) and 3.45 g (SVPR 1) were recorded by applying 50 kg S ha^{-1} which was significantly higher than all the other treatments. Among the varieties, TMV 7 has recorded the highest test weight and proved to be the best responding variety than SVPR 1 (Table 1). The increase in test weight might be due to the role of sulphur in activating the growth and yield components (Tahir*et al.,* 2014;Ojoni*et al.,* 2018).

Seed yield: The effect due to varieties, sulphur levels and their interactions were prominent in case of seed yield (Table 2). In sulphur sufficient soil, the seed yield of varieties were significantly higher by applying 30 kg S ha^{-1} which was *on par* with 40, and 50 kg S ha^{-1}, however application of 60 kg S ha^{-1} showed decrease in seed yield. Whereas in case of sulphur deficient soil, the highest seed yield was recorded with the application of 50 kg S ha^{-1} irrespective of the varieties. Considering the varietal effects, TMV 7 has proven to be the best responding variety than SVPR 1. The increase in seed yield could be attributed to the promotion of photosynthesis, net assimilation rate and crop growth rate due to the S application, which resulted in higher seed yield (Tahir*et al.,* 2014; Suchhanda*et al.*, 2016).

Stoveryield: The stalk yield of sesamum was significantly influenced by graded levels of sulphur application (Table 3). In sulphur sufficient soil, the stalk yield has shown a significant increase withsulphurapplication at the rate of 30 kg S ha^{-1}. Further increase of sulphur application did notincreasethe yield significantly. However, in sulphur deficient soil, a significant increase in stalk yield was recorded up to 50 kg S ha^{-1} with a yield of 3175and 3154 kg ha^{-1}. Among the varieties, TMV 7 has recorded the highest stalk yield than that of SVPR 1. Suchhanda*et al.* (2016) and Ojoni*et al. (*2018) have reported a similarincrease in stalk yield.

Oil content: The graded levels of sulphur application (Fig. 1) significantly influenced the oil content of different varieties. The oil content has shown a significant increase by applying sulphur up to 30 kg S ha$^{1;}$ the increase in oil content was not significant with a further increase of sulphur applicationin sulphur sufficient soil. However, in the case of sulphur deficient soil, a significant increase in oil content was recorded up to 50 kg S ha^{-1} with a yield of 49.90 per cent and 52.30 per cent, respectively, for TMV 7 and SVPR 1. Among the varieties, SVPR 1 has shown increased oil content. This might be due to the vital role of sulphurin the synthesis of S-containing amino acidsand vitamins like biotin, thiamine, vitamin B_1 as well as the formation of ferredoxin, an iron-containing plant proteinthat is required for the production oil. Bosale*et al.* (2011) and Dharati*et al*. (2017) also obtained similar results.

Biological yield: Data presented in Fig. 2 showed that application of sulphur to sesamum had significantly enhanced the biological yield at different soil sulphur status. In the case of sulphur sufficient soil, the yield response was significantly increased up to 30 kg S ha^{-1} and on further increase in sulphurlevel through gypsum has resulted in a non-significant trend. In accordance to the sulphur application, in sulphur deficient soil, the response of yield was extended up to 50 kg S ha^{-1} with a yield of 4021 and 3908 kg ha^{-1} respectively for two varieties, among which TMV 7 had produced a higher biological yield than SVPR 1.

Table 1. Effect of graded levels of sulphur on test weight of sesamum varieties

Test weight (g)						
	Sulphur sufficient soil			Sulphur deficient soil		
Treatments	TMV 7	SVPR 1	Mean	TMV 7	SVPR 1	Mean
Absolute Control	2.41	2.29	**2.35**	2.10	2.00	**2.05**
RDF alone	2.62	2.51	**2.57**	2.31	2.21	**2.26**
RDF+ S_{20} kg ha^{-1}	2.84	2.72	**2.78**	2.53	2.45	**2.49**
RDF+ S_{30} kg ha^{-1}	3.11	3.02	**3.07**	2.75	2.67	**2.71**
RDF+ S_{40} kg ha^{-1}	3.14	3.05	**3.10**	2.97	2.89	**2.93**
RDF+ S_{50} kg ha^{-1}	3.17	3.10	**3.14**	3.51	3.45	**3.48**
RDF+ S_{60} kg ha^{-1}	3.15	3.11	**3.13**	3.28	3.25	**3.27**
Mean	**2.92**	**2.83**		**2.78**	**2.70**	
	SEd	**CD**		**SEd**	**CD**	
V	0.006	0.02**		0.01	0.05*	
T	0.035	0.07**		0.05	0.10**	
V at T	0.047	NS		0.06	NS	
T at V	0.050	NS		0.07	NS	

*RDF –Recommended dose of NPK fertilizers

Table 2. Effect of graded levels of sulphur on seed yield of sesamum varieties

Seed yield (kgha^{-1})						
	Sulphur sufficient soil			Sulphur deficient soil		
Treatments	TMV 7	SVPR 1	Mean	TMV 7	SVPR 1	Mean
Absolute Control	652	573	**613**	619	519	**569**
RDF alone	725	633	**679**	643	542	**593**
RDF+ S_{20} kgha^{-1}	801	696	**749**	672	574	**623**
RDF+ S_{30} kgha^{-1}	870	760	**815**	733	638	**686**
RDF+ S_{40} kgha^{-1}	876	766	**821**	794	692	**743**
RDF+ S_{50} kgha^{-1}	880	770	**825**	846	754	**800**
RDF+ S_{60} kgha^{-1}	860	765	**813**	836	736	**786**
Mean	**809**	**709**		**735**	**636**	
	SEd	**CD**		**SEd**	**CD**	

V	7.71	33.20**	5.50	23.94**
T	13.13	27.1**	12.1	25.04**
V at T	18.84	NS	16.8	NS
T at V	18.57	NS	17.1	NS

Table 3. Effect of graded levels of sulphur on stover yield of sesamum varieties

Stover yield (kgha^{-1})						
	Sulphur sufficientsoil			Sulphur deficient soil		
Treatments	TMV 7	SVPR 1	Mean	TMV 7	SVPR 1	Mean
Absolute Control	3034	2975	**3005**	2960	2951	**2956**
RDF alone	3067	3025	**3046**	2994	2983	**2989**
RDF+ S_{20} kgha^{-1}	3110	3086	**3098**	3024	3013	**3019**
RDF+ S_{30} kgha^{-1}	3195	3175	**3185**	3065	3052	**3059**
RDF+ S_{40} kgha^{-1}	3205	3184	**3194**	3085	3061	**3073**
RDF+ S_{50} kgha^{-1}	3211	3193	**3202**	3175	3154	**3165**
RDF+ S_{60} kgha^{-1}	3204	3184	**3194**	3165	3163	**3164**
Mean	**3146**	**3117**		**3067**	**3054**	
	SEd	**CD**		**SEd**	**CD**	
V	12.75	NS		8.07	NS	
T	38.98	80.45**		38.4	79.2**	
V at T	52.61	NS		50.9	NS	
T at V	55.13	NS		54.3	NS	

Fig. 1: Effect of graded levels of sulphur application on oil content

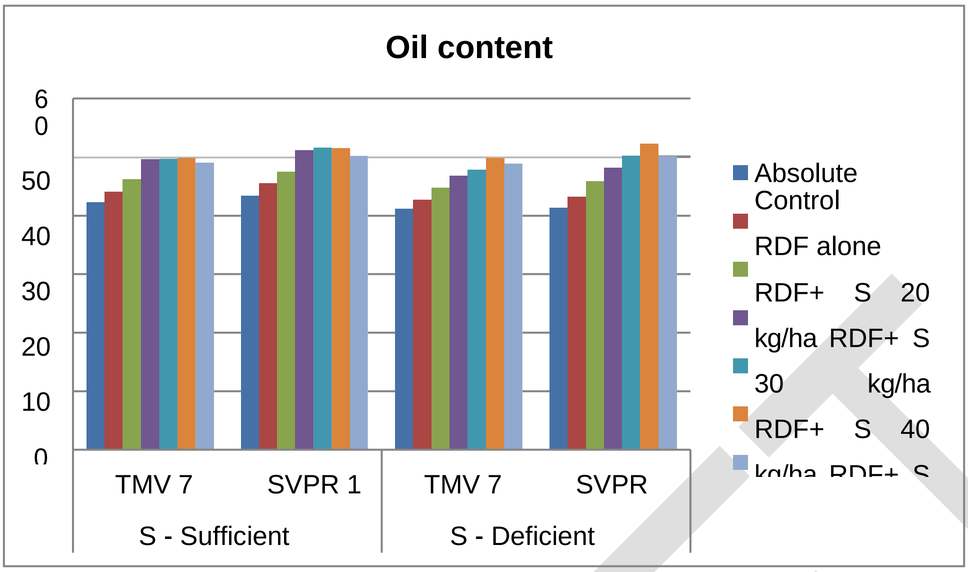
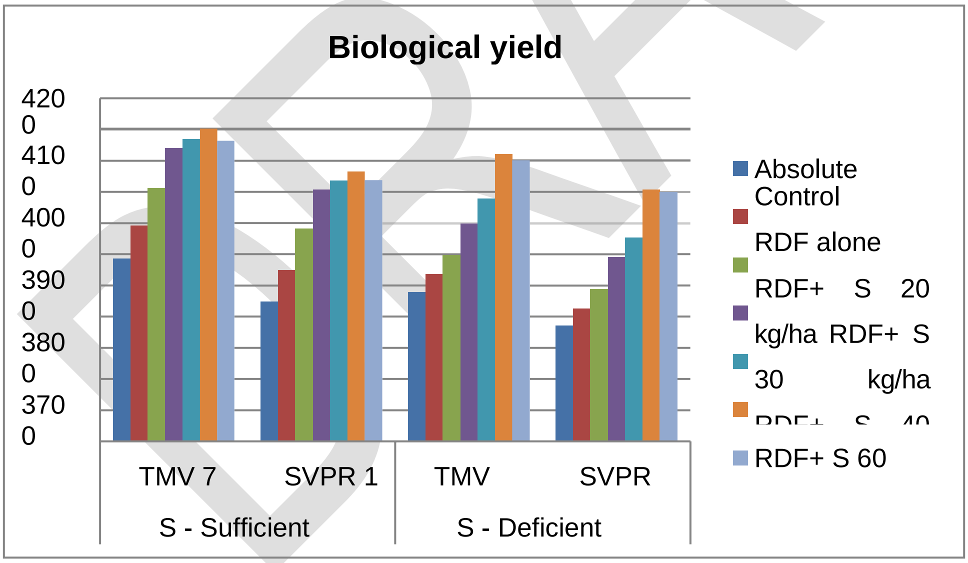


Fig. 2: Effect of graded levels of sulphur application on biological yield



CONCLUSION

Based on the experiment conducted in soils of two different sulphur statuses with two different sesamum varieties, it is concluded that TMV 7 proves to be a better responding variety than that of SVPR 1 by applying sulphur @ 30 and 50 kg ha^{-1}insulphur sufficient and deficient soils. The results indicated that supplementation of sulphur nutrition to sesamumin sulphur deficient soil isa boon for the increased growth and yield ofsesamum crop.

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