EFFECT OF DIFFERENT RATE OF SULPHUR SOURCES ON GROWTH, YIELD AND QUALITY OF SESAME (*SESAMUM INDICUM* L.) GROWN IN THE ALLEY SPACE OF GUAVA (*PSIDIUM GUAJAVA* L.)

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Abstract: A field experiment was conducted in a sandy loam soil during *kharif* season, 2012-2013 at Rajiv Gandhi South Campus, Barkachha, BHU, Mirzapur, Uttar Pradesh, India to find out the effect of different rate of sulphur sources on growth, yield and quality of sesame (*Sesamum indicum* L.) grown in the alley space of guava (*Psidium guajava* L.). The experiment was laid out in a randomized block design with 3 replications and three sources of sulphur *viz.* single super phosphate, gypsum and elemental sulphur and three levels of sulphur *viz* 15, 30 and 45 kg ha^{-1} with control. The total treatment combination for all the levels were ten (T_1-Control, T_2-15 kg Sulphur ha^{-1} through SSP, T_3-15 kg Sulphur ha^{-1} through ES, T_4-15 kg Sulphur ha^{-1} through gypsum, T_5-30 kg Sulphur ha^{-1} through SSP, T_6-30 kg Sulphur ha^{-1} through ES, T_7-30 kg Sulphur ha-1 through gypsum, T_8-45 kg Sulphur ha-1 through SSP, T_9-45 kg Sulphur ha-1 through ES, T_{10}-45 kg Sulphur ha-1 through gypsum). The crop was fertilized with recommended dose of NPK of 60:30:30 kg ha^{-1}. Results revealed that application of 45 kg S ha^{-1} through elemental sulphur recorded the highest plant height, number of branch $plant^{-1}$, dry matter accumulation, capsules $plant^{-1}$, seeds $capsule^{-1}$, seed weight $plant^{-1}$ and test weight, seed yield, stover yield, biological yield, harvest index, protein content per cent, oil content per cent, carbohydrate per cent, total nutrient uptake and available nutrient in soil. It was significantly superior over 45 kg S ha^{-1} through gypsum over rest of the treatment. The highest net monetary return (Rs. 24921.27 ha^{-1}) and Benefit: Cost (B: C) ratio (1.52) was obtained when 45 kg sulphur was applied through elemental sulphur this was also found to be best treatment for sesame.

Keywords: Sesame, Agroforestry, Sulphur, Alley space, Oil content, Benefit

INTRODUCTION

Sesame (Sesamum indicum L.) is one of the important oilseed crops. It is one of the crop under cultivation from ancient times (Joshi, 1961; Weiss, 1983; Bist et al., 1998). It is used for its seed which contains about 50% oil and 25% protein. For human nutrition, a balanced diet should consist of carbohydrate, protein, fats, minerals and vitamins in adequate amount and in suitable proportion. The bulk of this fat is supplied in the form of digestible vegetable oil and comes through oilseed crops. In India, sesame occupies third position in area and production, being preceded by groundnut and rapeseed sesame. Extension of acreage being ruled out and new cropping patterns emerging to cater to increase should be brought about in productivity. It is well-known that satisfactory yield of crops can only be obtained under adequate nutrient combinations. There has been a consciousness among the farmers on fertilizer use N, P and K fertilizers are extensively used to meet the nutrient rsequirement of the sesame crop. Even with the application of recommended doses of NPK fertilizers, the high potential of yield could not be achieved with presently available high yielding varieties due to the inadequacy of the micronutrients. Among secondary nutrients sulphur (S) is vital for protein synthesis in oil seeds. Jones et al., 1970 reported that when sulphur in the soil was below critical limits both plant growth and quality was adversely affected. Several other workers have documented that oil seeds respond remarkably to sulphur depending on the soil type. Besides, sulphur influences the uptake of major and micro nutrients to a large extent, which results in quantitative changes in seed yield and oil percent (Wasmatkar et al., 2002). Since there is a lack of information on the needs of micronutrient for efficient use of crop nutrition, the present study was undertaken.

MATERIAL AND METHOD

A field experiment was conducted at the Rajiv Gandhi South Campus, Barkachha, BHU, Mirzapur which is situated in *Vindhyan* region of district Mirzapur (25º 10' latitude, 82º 37' longitude and altitude of 427 metres above mean sea level during *kharif* season, 2012 on sandy loam soil containing 0.58 % organic carbon, available nitrogen (177.2 kg ha^{-1}), low in available phosphorus (10 kg ha^{-1}) and potassium (115.7 kg ha^{-1}) having slightly acidic soil pH (5.84). The treatments consisted of 3 sources of sulphur viz. single super phosphate, gypsum and elemental sulphur and 3 levels of sulphur *viz* 15, 30 and 45 kg ha^{-1} and one control. These fertilizers are applied in the field one month before the date of sowing. The nitrogen was supplied through Di-Ammonium phosphate (@ 60 kg N ha^{-1}) in three splits half at basal and remaining half in two split at vegetative stage and at flower initiation stage; phosphorous (@ 30 kg P_2O_5 ha^{-1}) was supplied through Di-Ammonium phosphate as based;

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potassium (@ 30 kg K_2O ha^{-1}) through murate of potash as based.The experiment was laid out in R.B.D with three replicates with a gross plot size 4.95 x 4 m and net plot size 4 x 3 m with spacing of 45 x 15 cm by using sesame variety Gujarat Til-2. Thinning was done twice at 15 and 30 days after sowing. The plant height, number of branch plant^{-1}, dry matter accumulation , capsules plant^{-1}, seeds capsule^{-1}, seed weight plant^{-1} and test weight, seed yield, stover yield, biological yield, harvest index, protein content per cent, oil content per cent, carbohydrate per cent , total nutrient uptake and available nutrients in soil was recorded at harvest stage of crop. The nitrogen content of seed was estimated by kjeldahl's method and protein content of seed was derived by multiplying there seed nitrogen content with the factor 6.25(Humphries,1956) .The oil content was estimated by Soxhelet apparatus method following the procedure of Singh *et al*., 1960 .

RESULT AND DISCUSSION

The data presented in Table-1 shows that effect of different rate of sulphur sources had significant influence on plant height, dry matter accumulation, capsule plant^{-1}, seeds capsule^{-1} , seed weight plant^{-}1, test weight, seed yield kg ha^{-1}, stover yield kg ha^{-1}, harvest index per cent, protein content per cent, oil content per cent and carbohydrate per cent of the sesame.

Among the sulphur levels, application of 45 kg S ha-1through elemental sulphur recorded the highest plant height, dry matter accumulation, capsule plant^{-1}, seeds capsule^{-1} , seed weight plant^{-1}, test weight, seed yield kg ha^{-1}, stover yield kg ha^{-1}, harvest index per cent, protein content per cent, oil content per cent and carbohydrate per cent . It was significantly superior over 45 kg S ha^{-1} through gypsum over all the treatment. The crop receiving 45 kg S ha^{-1} through elemental sulphur might have been helped in terms of vigorous root growth, formation of chlorophyll, , play a vital role in the formation of amino acids. It had favourable effect on dry matter and yield components due to proper partitioning of photosynthates from source to sink. The results of investigation are in consonance with the findings of Raja *et al*. (2007) and Hussain *et al*. (2011) Uptake of nitrogen, phosphorus and potassium by seed and Stover showed a significant variation with the application of different level of sulphur (Table-2). The highest nitrogen, phosphorus and potassium uptake and available nutrient in soil found when sulphur was applied @45 kg S ha^{-1}through elemental sulphur (T_9) and superior over 45 kg S ha^{-1} through gypsum (T_{10}) over rest of the treatment. These results are in conformity with the findings of Lal *et al*. (1995) and Prajapat *et al*. (2012)

Economics

Data presented in Table-2 shows that effect of different rate of sulphur sources caused the maximum net return (Rs .24921.27 ha^{-1}) by 45 kg S ha^{-1} through elemental sulphur (T_9) and it was significantly superior over rest of the treatments. The treatment 45 kg S ha^{-1} through gypsum is at par with 45 kg S ha^{-1} through elemental sulphur (T_9). The minimum net return (Rs. 14721.44 ha^{-1}) was recorded in control (T_1). These results are in conformity with the findings of Deshmukh *et al*. (2010)

Data presented in Table-2 shows that effect of different rate of sulphur sources caused the maximum B: C ratio (1.52) by 45 kg S ha^{-1} through elemental sulphur and it was significantly superior over rest of the treatments. The treatment 45 kg S ha^{-1} through gypsum (T_{10}) is at par with 45 kg S ha^{-1} through elemental sulphur. The minimum B:C ratio (1.10) was recorded in control (T_1). These results are in conformity with the findings of Deshmukh *et al*. (2010).

CONCLUSION

Results revealed that application of 45 kg S ha^{-1} through elemental sulphur recorded the highest plant height, number of branch plant^{-1}, dry matter accumulation, capsules plant^{-1}, seeds capsule^{-1}, seed weight plant^{-1} and test weight, seed yield, stover yield, biological yield, harvest index, protein content per cent, oil content per cent, carbohydrate per cent, total nutrient uptake and available nutrient in soil. It was significantly superior over 45 kg S ha^{-1} through gypsum over rest of the treatment. The highest net monetary return (Rs. 24921.27 ha^{-1}) and Benefit: Cost (B: C) ratio (1.52) was obtained when 45 kg sulphur was applied through elemental sulphur this was also found to be best treatment for sesame.

Table 1. Effect of different rate of sulphur sources on growth, yield and quality of sesame grown in the alley space of guava.

Treatment	plant height (cm)	dry matter (g plant^{-1})	Capsules plant^{-1} (No.)	Seeds capsule^{-1} (No.)	Seed weight plant^{-1} (g)	Test weight (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Protein content (%) in seed	Oil content (%)	Carbo-hydrate (%)
T_1	106.27	39.0	18.83	55.67	3.31	3.16	397.0	2278.00	22.63	36.5	11.20
T_2	106.57	39.2	20.67	56.47	3.75	3.22	402.6	2304.00	22.75	36.7	11.50
T_3	107.60	41.3	22.17	58.57	4.36	3.36	456.0	2400.67	23.10	37.2	12.30

T_4	107.27	40.3	21.19	57.33	4.04	3.33	427.0	2338.33	23.02	36.5	11.70
T_5	108.40	40.8	22.50	59.07	4.50	3.38	467.6	2418.33	23.50	38.4	12.27
T_6	109.70	42.5	24.00	59.83	4.88	3.40	523.0	2506.12	23.90	41.4	12.37
T_7	109.60	42.3	23.50	59.25	4.72	3.39	507.6	2458.90	23.69	40.2	12.30
T_8	110.17	43.5	27.00	60.50	5.60	3.43	530.3	2581.62	24.15	42.3	12.43
T_9	110.83	44.5	32.33	62.27	7.47	3.53	574.6	3433.33	25.54	46.2	13.47
T_{10}	110.53	43.8	31.33	61.96	7.14	3.45	564.6	3360.00	25.38	45.5	13.37
SEm±	0.21	0.62	0.58	0.51	0.12	0.08	6.25	76.40	0.15	0.25	0.33
C.D(P=0.05)	0.61	1.84	1.73	1.50	0.36	0.24	18.56	226.99	0.46	0.74	0.99

T_1-Control, **T_2**-15 kg Sulphur ha^{-1} through SSP, **T_3**-15 kg Sulphur ha^{-1} through ES, **T_4**-15 kg Sulphur ha^{-1} through gypsum, **T_5**-30 kg Sulphur ha^{-1} through SSP, **T_6**-30 kg Sulphur ha^{-1} through ES, **T_7**-30 kg Sulphur ha^{-1} through gypsum, **T_8**-45 kg Sulphur ha^{-1} through SSP, **T_9**-45 kg Sulphur ha^{-1} through ES, **T_{10}**-45 kg Sulphur ha^{-1} through gypsum

Table 2. Effect of different rate of sulphur sources on total nutrient uptake in seed, stover and available nutrient in soil and economics

Treatment	Total nutrient uptake in (seed + stover) in kg ha^{-1}			Available nutrient in soil			Cost of cultivation (Rs.ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs. ha^{-1})	B:C ratio
	N	N	P	K	P	K				
T_1	56.21	168.95	15.37	190.43	5.29	20.02	13342.56	28064	14721.44	1.10
T_2	58.82	169.25	15.53	191.20	5.68	20.70	14107.56	28432	14324.44	1.02
T_3	66.71	171.14	17.33	194.33	6.52	25.57	14448.84	31155.33	16706.49	1.16
T_4	61.79	171.73	16.27	193.40	6.02	24.63	14364.86	29625.67	15260.81	1.06
T_5	68.85	177.62	17.77	195.50	7.11	26.73	14732.56	31733.67	17001.11	1.15
T_6	76.03	182.74	18.67	196.67	7.96	28.67	15415.7	34496.6	19080.9	1.24
T_7	72.69	179.55	18.20	196.23	7.58	27.56	15247.16	33616.48	18369.32	1.20
T_8	82.45	181.14	19.40	197.27	8.59	29.67	15357.56	35182.12	19824.56	1.29
T_9	113.84	185.03	21.64	199.77	14.22	42.25	16381.4	41302.67	24921.27	1.52
T_{10}	108.06	183.98	20.83	199.20	12.78	41.21	16129.46	40516	24386.54	1.51
SEm±	2.45	20.69	0.33	0.23	0.68	0.71				
C.D (P=0.05)	7.29	61.47	0.97	0.69	2.01	2.11				

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