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Effect of irrigation, vermicompost and sulphur on oil content and S content and uptake of summer *sesamum* (*Sesamum indicum* L.) under loamy sand

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Abstract
A field experiment was conducted during summer season of 2016 at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat) with four irrigation schedules (IW:CPE ratios 0.4, 0.6 and 0.8 and irrigation at critical growth stages flowering, branching, capsule formation and seed filling stages), two vermicompost levels (0 and 2 t ha^{-1}) and two sulphur levels (0 and 20 kg ha^{-1}). The result revealed that the different irrigation and vermicompost levels failed to exert any significant influence on oil content and S content in seed and straw. Oil content in sesamum seed and S content in seed and straw was highest under application of 20 kg sulphur ha^{-1}. Higher value of oil yield and sulphur uptake in seed and straw was recorded under treatment I_3 (0.8 IW:CPE ratio). Application of 2 t vermicompost ha^{-1} and 20 kg sulphur ha^{-1} significantly increase oil yield and sulphur uptake in seed and straw.

Keywords: Sesamum, irrigation, vermicompost and sulphur

Introduction
Sesamum (*Sesamum indicum* L.), which is known variously as *sesame, til, gingelly, simsin, gergelin* and *tillie ect.* It is annual or perennial herbs with edible seeds which belongs to the family *Pedaliaceae*. Sesamum seed provides excellent food, nutrition, health care, edible oil and biomedicine. It ranks first for the highest oil content *i.e.* 50 per cent as well as seeds are rich source of protein *i.e.* 20.28 per cent, sugar 14-16 percent and minerals 5-7 percent. Sesamum seeds are digestive, rejuvenative, anti-aging and rich source of quality oil for which it is known as "Queen of oilseed crops". In India, it occupies an area of about 17.47 lakh hectares with production of 8.27 lakh tones having the productivity of 474 kg ha^{-1} (Anon., 2015) [1]. Irrigation to this crop is mostly based on physiological growth stages and the latest approach of scheduling irrigation through irrigation water depth: cumulative pan evaporation (IW: CPE) ratio has not yet been amply tried in almost states of India. Therefore, it is important to compare the previous methods with the latest approach of scheduling irrigation to identify the most suitable frequency, time and depth of irrigation for higher yield of sesamum. Vermicompost application has been known to improve physical, chemical and biological properties of soil. Sulphur as a plant nutrient can play a key role in augmenting the production and productivity of oilseeds in the country as it has a significant influence on quality and development of oilseeds. (Tandon, 1991) [10]. Since research work on these aspects of this crop is very meagre, the present experiment was planned and conducted.

Materials and Methods
A field experiment was conducted at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, (Gujarat) during the summer season of the year 2016. The soil of experimental field was loamy sand in texture having good drainage, low in organic carbon content (45%), low in available nitrogen (219.52 kg ha^{-1}), low in available phosphorus (25.53 kg ha^{-1}), medium in available potassium (218.28 kg ha^{-1}) and low in available sulphur (10.34 kg ha^{-1}) with 8.4 soil pH. The soil had 82.05% sand, 11.73% silt and 5.04% clay with 14.57% F.C. and 4.52% PWP. The treatment comprising four levels of irrigation (I_1 0.4 : IW: CPE ratio, I_2 : 0.6 IW: CPE ratio, I_3 : 0.8 IW: CPE ratio and I_4 : irrigation at B+F+C+S), two levels of vermicompost *viz.* (V_0 : 0 t vermicompost ha^{-1} and V_1 : 2 t vermicompost ha^{-1}) and two levels of sulphur *viz.*, (S_0 : 0 kg S ha^{-1} and S_1 : 20 kg S ha^{-1}) laid out in a split plot design

with four replications. Combination of irrigation and vermicompost were assigned to main plots and levels of sulphur were assigned to the sub plots.

Irrigation water of 50 mm (measured with the help of Parshall flume) was allowed to run in each plot at each irrigation. The irrigation treatment was given on the base of fraction of pan evaporation. Daily pan evaporation was measured with the help of USDA Class-A pan evaporimeter installed at the meteriological observatory. Nitrogen (25 kg ha^{-1}) and phosphorus (25 kg ha^{-1}) were applied as basal through urea and DAP respectively. Entire quantity of vermicompost and S through gypsum applied at time of sowing. Crop was harvested in fourth week of May. Sesamum was sown on 24 February with seed rate 2.5 kg ha^{-1}.

Oil content in the seed for each treatment was estimated by Nuclear Magnetic Resonance (NMR) analysis as described by Tiwari *et al*. (1974). Sulphur uptake was calculated by multiplying the sulphur content with respective seed and straw yield and express as kg ha^{-1}.

Resutls and Discussion

Effect of irrigation

Data presented in Table 1 indicated that application of irrigation at 0.8 IW: CPE ratio recorded significantly higher oil yield (381 kg ha^{-1}) being at par with treatment I_2 (0.6 IW: CPE ratio, 357 kg ha^{-1}). The higher oil yield obtained under more number of irrigation might be due to higher availability of moisture in the root zone, which enhanced absorption of nutrients and favourable effect of on seed yield which ultimately resulted in higher oil yield. The results are in agreement with Damdar *et al.* (2015) [3].

Significantly the highest sulphur uptake by seed (4.0 kg ha^{-1}) and stalk (11.54 kg ha^{-1}) was recorded with irrigation scheduling I_3 (0.8 IW: CPE ratio) whereas, significantly the lowest sulphur uptake (2.89 kg ha^{-1}) by seed and stalk was registered with irrigation level I_1 (0.4 IW: CPE ratio). These might be due to more number of irrigation attributed to higher availability of moisture in the root zone, which enhanced absorption of nutrients. Thus, nutrients which are moving along with the stream of moisture which is termed as mass flow transport of nutrient increases when conductivity of the soil is high. Therefore, it is obvious that when moisture content is more, the rate at which nutrients reach to root surface is high which in turn contributes to high sulphur uptake. The higher uptake of sulphur also might be due to higher production of seed yield under this level of irrigation. These results are in line with those reported by Dutta *et al.* (2000) [4] and Kundu and Singh (2006) [7].

Table 1: Effect of irrigation, vermicompost and sulphur on oil content and S content and uptake of sesamum

Treatment	Oil content (%)	Oil yield (kg ha^{-1})	Sulphur content in seed (%)	Sulphur content in stalk (%)	Sulphur uptake by seed (kg ha^{-1})	Sulphur uptake by stalk (kg ha^{-1})
(A)Main plot treatment (i) Irrigation scheduling (I)						
I_1:0.4 IW:CPE	47.53	281	0.48	0.51	2.89	8.00
I_2:0.6 IW:CPE	47.74	357	0.50	0.52	3.73	10.15
I_3:0.8 IW:CPE	47.86	381	0.51	0.55	4.00	11.54
I_4: B+F+C+S	47.76	297	0.49	0.50	3.00	8.24
S.Em.±	0.14	9	0.012	0.015	0.12	0.33
C.D. at 5%	NS	27	NS	NS	0.35	0.97
V_0: 0 t vermicompost ha^{-1}	47.66	269	0.49	0.51	2.76	9.14
V_1: 2 t vermicompost ha^{-1}	47.78	389	0.50	0.52	4.05	9.81
S.Em.±	0.10	06	0.01	0.01	0.09	0.23
C.D. at 5%	NS	19	NS	NS	0.25	NS
C.V. %	1.19	11.34	9.40	11.22	14.14	13.85
S_0: 0 kg S ha^{-1}	47.49	317	0.37	0.43	2.45	7.65
S_1: 20 kg S ha^{-1}	47.96	341	0.62	0.61	4.37	11.31
S.Em. ±	0.09	05	0.008	0.008	0.08	0.20
C.D. at 5%	0.26	14	0.23	0.23	0.24	0.58
C.V. %	1.05	8.25	8.87	8.47	13.38	11.95
I × V	NS	Sig	NS	NS	Sig.	NS
I × S	NS	NS	NS	NS	NS	NS
V × S	NS	NS	NS	NS	Sig.	NS
I × V × S	NS	NS	NS	NS	NS	NS

B = Branching, F = Flowering, C = Capsule formation and S = Seed filling stages

NS = Not significant Sig. = Significant

Effect of vermicompost

A perusal of data presented in Table 1 indicated that oil yield of sesame was significantly affected due to vermicompost levels. Significantly the highest oil yield (389 kg ha^{-1}) was observed with the vermicompost level V_1 (2 t vermicompost ha^{-1}). The lower oil yield (269 kg ha^{-1}) was noticed with vermicompost level V_0 (0 t vermicompost ha^{-1}). It might be due to better availability of desired and required nutrients in the crop root zone resulting from its solubilization caused by the organic acid produce from the decaying organic matter and also increased their uptake by sesame roots due to its association with micro-organisms, ultimately reflected into higher oil content. The result is in close agreement with observations of Kansotia *et al*. (2015) [7] in mustard crop.

Perusal of data (Table 1) showed that vermicompost levels had significant effect on sulphur uptake by seed. Significantly the highest sulphur uptake (4.05 kg ha^{-1}) by seed was noted with vermicompost level V_1 (2 t vermicompost ha^{-1}). The lowest sulphur uptake (2.76 kg ha^{-1}) was found with vermicompost level V_0 (0 t vermicompost ha^{-1}). Application of vermicompost increased seed yield because of nutrient removal is directly related with the yield of the crop and nutrient content hence, the significant response was noticed at 2t vermicompost ha^{-1}. The result is in conformity with the work of Kademani *et al.* (2003) [5] in sunflower.

Effect of sulphur

Data presented in Table 1 showed that application of sulphur to sesamum enhanced the oil content and oil yield. Significantly higher oil content (47.96%) and oil yield (341 kg ha^{-1}) was recorded under the sulphur level S_1 (20 kg S ha^{-1}). This might be due to sulphur play an important role in synthesis of essential amino acids like Cysteine, Cystine, Methionine and certain vitamins like Biotin, Thiamine, Vitamin B_1 as well as formation of ferodoxin an iron-containing plant protein that acts as an electron carrier in the photosynthetic process and chlorophyll which required for the production of oil. Similar results were also obtained by Yadav *et al.* (1996) [13], Patel *et al.* (2009) [9] and Bhosale *et al.* (2011) [2].

Significant variation in sulphur content and uptake in seed and stalk of sesame was observed due to different levels of sulphur (Table 1). Crop fertilized with 20 kg S ha^{-1} appreciably increased S content in seed (0.62%) and stalk (0.61%) and also uptake in seed (4.37 kg ha^{-1}) and stalk (11.31 kg ha^{-1}). The probable reason for higher S content and uptake in seed and stalk under higher application of sulphur might have increased their concentration in soil solution, which increased the availability and uptake by plant and improved nutritional environment both in the rhizosphere and in the plant system. Moreover increasing trend of seed and stalk yield as well as sulphur content in seed and stalk were noticed with sulphur application. The results are in conformity with the work of Lal *et al.* (1995) [8] and Yadav *et al.* (1996) [13].

Interaction effect

Interaction effect of irrigation scheduling and vermicompost levels on oil yield

The interaction effect between irrigation scheduling and vermicompost levels with respect to oil yield was found significant. The significantly higher oil yield (464 kg ha^{-1}) was recorded under treatment combination I_3V_1 (0.8 IW: CPE ratio and 2 t vermicompost ha^{-1}), however this treatment combination was remained at par with the treatment combinations I_2V_1 (0.6 IW: CPE ratio and 2 t vermicompost ha^{-1}, 435 kg ha^{-1}). Lower oil yield (248 kg ha^{-1}) was observed under the treatment combination I_1V_0 (0.4 IW: CPE ratio and 0 t vermicompost ha^{-1}). Higher oil yield recorded under treatment combination I_3V_1 (464 kg ha^{-1}) might be due to more vigourous crop growth and higher order of yield attributes under frequent irrigation with adequate supply of vermicompost which ultimately resulted in higher oil yield. The result is in agreement with Tripathy and Bastia (2012) [12].

Table 2: Interaction effect of irrigation scheduling and vermicompost levels on oil yield (kg ha^{-1}) of sesamum

Irrigation (I)	Vermicompost levels (V)	
	V_0 :0 t ha^{-1}	**V_1 :2 t ha^{-1}**
I_1: 0.4 IW:CPE	248	314
I_2: 0.6 IW:CPE	279	435
I_3: 0.8 IW:CPE	297	464
I_4: At branching, flowering, capsule formation and seed filling stages	250	343
S.Em.±	13	
C.D. at 5 %	38	
C.V. (%)	11.34	

Interaction effect irrigation scheduling and vermicompost levels on sulphur uptake (kg ha^{-1}) in sesamum seed

Data show (Table 3 and 4) that interaction effect was found significant between irrigation and vermicompost as well as vermicompost and sulphur levels with respect to sulphur uptake by seed recorded after harvest.

The significantly higher sulphur uptake by seed (4.89 kg ha^{-1}) was recorded under treatment combination I_3V_1 (0.8 IW: CPE ratio and 2 t vermicompost ha^{-1}), however, this treatment combination was remained at par with the treatment combinations I_2V_1 (0.6 IW: CPE ratio and 2 t vermicompost ha^{-1}, 4.64 kg ha^{-1}). Lower sulphur uptake (2.52 kg ha^{-1}) in sesamum seed was observed under the treatment combination I_1V_0 (0.4 IW: CPE ratio and 0 t vermicompost ha^{-1}).

Table 3: Interaction effect of irrigation scheduling and vermicompost levels on sulphur uptake (kg ha^{-1}) in sesamum seed

Irrigation (I)	Vermicompost levels (V)	
	V_0 :0 t ha^{-1}	**V_1 :2 t ha^{-1}**
I_1: 0.4 IW:CPE	2.52	3.25
I_2: 0.6 IW:CPE	2.80	4.64
I_3: 0.8 IW:CPE	3.11	4.89
I_4: At branching, flowering, capsule formation and seed filling stages	2.59	3.41
S. Em.±	0.17	
C.D. at 5 %	0.50	
C.V. (%)	14.14	

The data presented in Table 3 indicated that the effect of irrigation scheduling and vermicompost on sulphur uptake in seed was found significant. These might be due to more number of irrigation attributed to higher availability of moisture in the root zone, which enhanced absorption of nutrients. The higher uptake of sulphur also might be due to higher production of seed yield under this level of irrigation and vermicompost. The present finding is close agreement with those of Tripathy and Bastia (2012) [12].

Table 4: Interaction effect of vermicompost and sulphur levels on sulphur uptake (kg ha^{-1}) of sesamum seeds

Vermicompost levels (V)	Sulphur levels (S)	
	S_0 : 0 kg ha^{-1}	**S_1 : 20 kg ha^{-1}**
V_0 : 0 t ha^{-1}	1.00	2.44
V_1 : 2 t ha^{-1}	2.04	2.60
S.Em.±	0.11	
C.D. at 5 %	0.33	
C.V. (%)	13.38	

The significantly higher sulphur uptake by seed (2.60 kg ha^{-1}) was recorded under treatment combination V_1S_1 (2 t vermicompost ha^{-1} and 20 kg S ha^{-1}), however this treatment combination was remained at par with the treatment combinations V_0S_1 (0 t vermicompost ha^{-1} and 20 kg S ha^{-1}, 2.44 kg ha^{-1}). Lower sulphur uptake (1.00 kg ha^{-1}) was observed under the treatment combination V_0S_0 (0 t vermicompost ha^{-1} and 0 kg S ha^{-1}).

Conclusion

From the foregoing study, it is concluded that for securing higher oil content, oil yield and sulphur content and uptake of sesamum, crop should be irrigated with two common irrigations for crop establishment and remaining at 0.8 IW: CPE ratio in conjunction with 2 t vermicompost and 20 kg S per hectare as a basal application.

References

1. Anonymous. Ministry of Agriculture & Farmers Welfare, Govt. of India: http:// www.Indiastate.com, 2015.

2. Bhosale ND, Dabhi BM, Gaikwad VP, Chavan AB. Growth, yield and quality parameters of sesamum (*Sesamum indicum* L) as influenced by different levels of potash and sulphur. Inter. J. Forestry & Crop Improv. 2011; 2(2):121-123.
3. Damdar RR, Bhale VM, Deshmukh KM. Yield, growth and quality of summer sesame (*Sesamum indicum* L.) as influenced by irrigation and nitrogen levels. International Journal of Agricultural Sciences. 2015; 11(2):301-306.
4. Dutta D, Jana PK, Bandyopadhyay P, Maity D. Response of summer sesame (*Sesamum indicum* L.) to irrigation! Indian J. Agron. 2000; 45(3):613-616.
5. Kademani MB, Radder BM, Hebsur NS. Effect of organic and inorganic fertilizers on availability and uptake of nutrients by sunflower in vertisol! Karnataka J. Agril. Sci. 2003; 16(1):48-53.
6. Kansotia BC, Sharma Yogesh, Meena RS. Effect of vermicompost and inorganic fertilizers on soil properties and yield of Indian mustard (*Brassica juncea* L.)! Journal of Oilseed Brassica. 2015; 6(1):198-201.
7. Kundu DK, Singh R. Effect of irrigation on yield and nutrient uptake of summer sesame (*Sesamum indicum* L.) in coastal Orissa! Indian J. Agric. Sci. 2006; 76(9):531-534.
8. Lal N, Sawargi SK, Tripati RS, Bhambari MC. Effect of nitrogen, potassium and sulphur on seed yield, nutrient uptake, quality and economics of sesame (*Sesamum indicum* L.)! Indian J. Agron. 1995; 40(1):333-335.
9. Patel PN, Patel PG, Patel BT. Response of sesamum (*Sesamum indicum* L.) varieties to different levels of nitrogen and sulphur in loamy sand soils of north Gujarat! GAU Res. J. 2009; 34(2):150-151.
10. Tandon HLS. Fertilizer management in Dryland Agriculture FDCO, New Delhi, 1991.
11. Tiwari RK, Namdeo KN, Jha G. Effect of nitrogen and sulphur on growth, yield and quality of sesame (*Sesamum indicum* L.). varieties, Res. on Crops. 2001; 1(2):163-167.
12. Tripathy S, Bastia DK. Irrigation and nutrient management for yield augmentation of summer sesame (*Sesamum indicum* L.). Journal of Crop and weed. 2012; 8(2):53-57.
13. Yadav NPS, Mehta VS, Singh V. Effect of different levels and sources of sulphur on yield, quality and uptake of sulphur by sesame! J. of Oilseeds Res. 1996; 13(1):22-25.