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Effect of irrigation and sulphur on growth and productivity of summe sesame (*Sesamum indicum* L.)

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Abstract: A field experiment was conducted during the summer season of 1997 and 1999 to study the effect of irrigation and sulphur on growth and productivity of summer sesame and change in available S in soil. The experiment was carried out with four levels of irrigation *viz.* one irrigation at flowering, two irrigations at flowering and branching, three irrigations at flowering, branching and capsule development and four irrigations at 4-6 leaf stage, branching, flowering and capsule development stages and four levels of sulphur *i.e.* 0, 15, 30 and 45 kg/ha in a split plot design and replicated thrice. Summer sesame applied with four irrigations produced significantly higher growth *viz.* plant height, drymatter production, LAI and CGR than other levels of irrigation. Seed and stick yields and harvest index were observed maximum at four levels of irrigation. Four irrigations produced 14.51, 32.43 and 63.14% higher seed yield over three, two and one irrigations respectively. 45 kg S ha^{-1} recorded maximum growth attributes and were observed minimum with 0 level of sulphur. The highest seed and stick yield were obtained from the crop receiving 45 kg S ha^{-1} though the effect was on par with that of 30 kg S ha^{-1}. The highest available sulphur was recorded under one irrigation in 0-30 cm. soil depth but it was the highest in 30-60 cm soil depth with four irrigations. The lowest and highest available S content were found under 0 level and 45 kg S ha^{-1} respectively.

Key words : Irrigation, Sulphur, Growth attributes, Yields, HI, Available soil S, Sesame.

Introduction

Sesame (*Sesamum indicum*) is an important oilseed crop of West Bengal next to rapeseed mustard. In Indo-Gangetic alluvium this crop is being cultivated extensively during summer season in rice-potato based cropping system with a little assurance of irrigation water under residual soil fertility condition. In general this crop is irrigated up to a certain growth periods depending on the availability of limited water source without considering the critical growth stages of the crop. Since, water is a valuable input, levels of irrigation should be confined within the critical growth stages for improving the productivity of the crop. Similarly, maximum emphasis has already been given on N, P and K fertilization of the crop. But sulphur nutrition plays an important role in improving the growth and productivity of the oil seeds. Little information based on irrigation and sulphur fertilization to sesame is observed in this lateritic belt of West Bengal. Keeping in view the above fact a study was undertaken to find out the effec of sulphur on growth and yield of sesam under different levels of irrigation.

Materials and Methods

The field experiment was conducted durin the summer season of 1997 and 1999 on sand loam soils (56.4% sand, 24.8% silt and 18.89 clay) of Agriculture Farm, Institute of Agriculture Visva-Bharati, Sriniketan, West Bengal. The Farn soil was acidic in reaction (pH 5.4) havin 0.31% organic carbon, 0.036%, total N 157.: kg ha^{-1} available N, 38.2 kg ha^{-1} availabl P, 137.6 kg ha^{-1} available K and 26.61 k ha^{-1} available S and the farm was located a about 23°39' N and 87°42' E longitude wit an average altitude of 58.9 m above the mea sea level under sub-humid and semi-arid tropic The treatments consisted of four levels of irrigation *i.e.* I_1 (irrigation at flowering stage), I_2 (irrigatior able 1. Effect of irrigation and sulphur on height and dry matter accumulation of summer season at different growth stages (Mean data of two years)

	Plant height (cm)			Dry matter accumulation (g m^2)$^{-1}$		
reatments	30 DAS	50 DAS	70 DAS	30 DAS	50 DAS	70 DAS
evels of irrigation						
:	29.55	57.39	65.44	35.35	209.46	310.08
i+F	29.67	59.48	68.22	35.03	224.89	327.17
l+F+Cd	29.79	61.36	69.28	37.10	231.93	336.76
:+B+F+Cd	29.88	61.53	72.10	38.37	236.54	348.00
.Em(±)	0.38	0.71	0.53	0.46	1.46	2.32
:D (0.05)	NS	2.44	1.82	1.58	5.04	8.02
evels of sulphur (kg ha^{-1})						
	29.36	59.49	67.75	36.32	223.01	325.81
i	29.73	59.56	68.40	36.02	224.95	328.02
)	29.86	59.91	68.95	36.87	226.85	331.98
i	29.94	60.30	69.95	36.56	228.01	335.32
Em (+)	0.63	0.63	0.61	0.49	2.11	2.28
D (0.05)	NS	NS	1.77	NS	NS	6.71

= 4-6 Leaf stage, B = Branching stage, F = Flowering stage, Cd = Capsule development stage

able 2. Effect of irrigation and sulphur on leaf area index (LAI), crop growth rate (CGR) and yield (kg ha^{-1}) of summer sesame (Mean data of two years)

	Leaf area index (LAI)			Crop growth rate CGR in g m$^{2-1}$ day^{-1}		Yield (kg ha^{-1})	
reatments	30 DAS	50 DAS	70 DAS	30-50 DAS	50-70 DAS	Seed yield	Stick yield
evels of irrigation							
:	0.822	1.004	0.957	7.797	4.448	593.44	1553.32
3+F	0.827	1.214	1.054	8.488	4.506	731.05	1747.70
3+F+Cd	0.836	1.278	1.088	8.708	4.605	845.47	1864.04
.+B+F+Cd	0.851	1.281	1.147	8.881	4.908	968.12	1935.67
;.Em(±)	0.005	0.027	0.042	0.080	0.130	16.81	27.60
:D (0.05)	NS	0.093	0.148	0.275	0.449	58.16	95.50
evels of sulphur (kg ha^{-1})							
)	0.835	1.166	1.027	8.368	4.487	749.32	1672.64
.5	0.829	1.186	1.057	8.457	4.562	775.21	1759.26
i0	0.836	1.212	1.074	8.497	4.648	798.27	1809.37
l5	0.834	1.217	1.088	8.552	4.765	815.27	1859.44
;.Em (+)	0.011	0.021	0.573	0.120	0.160	12.05	36.41
:D (0.05)	NS	NS	NS	NS	NS	35.16	106.27

= 4-6 Leaf stage, B = Branching stage, F = Flowering stage, Cd = Capsule development stage

t branching and flowering), I_3 (irrigation at ranching, flowering and capsule development) nd I_4 (irrigation at 4-6 leaf stage, branching, lowering and capsule development) and four doses of sulphur (0, 15, 30 and 45kg S ha^{-1}). The experiment was carried out in split-plot design (irrigation levels were in main plots and sulphur levels were in sub-plots) with three replications. Sesame variety 'Rama' was sown on 12[th] March in 1997 and 8[th] March in 1999 at a spacing of 30 cm x 10 cm with seed rate of 4 kg ha^{-1}. A basal dose of 80 kg N, 40 kg P and 40 kg K ha^{-1} were applied in the form of urea, DAP and muriate of potash. Sulphur was also applied as basal dose in the form of elemental sulphur. The data on growth attributes and yields were recorded at different growth stages and at maturity after harvesting and threshing the crop respectively. The crop was harvested on June 8 and June 5 in the first and second year respectively. Available S of the soil was determined from the samples collected in the soil layers of 0-30 and 30-60cm before starting the experiment and just after harvesting crop using the method described by Williams and Steinburgs (1959). The crop received the rainfall of 223.8 and 204.2 mm during the cropping season in 1997 and 1999 respectively.

Results and Discussion

Growth attributes

Growth attributes *viz.* plant height, drymatter accumulation, leaf area index (LAI) and crop growth rate (CGR) of sesame were influenced greatly by levels of irrigation (Table 1 and 2). All the growth parameters were increased steadily with the increase in irrigation levels. The crop receiving highest number of irrigation recorded maximum plant height and drymatter accumulation at all the growth stages. Four irrigations maintained optimum soil moisture throughout the crop growth caused maximum plant height and drymatte accumulation. The leaf area index increase steadily till flowering state (50 DAS) of thi crop and then declined due to leaf sequence The maximum LAI and CGR were observe with the application of four irrigations an one irrigation applied at flowering stage produce minimum LAI and CGR. The result highlighte that four levels of irrigation helped prope crop growth and leaf expansion of the cro and it was significantly superior to other leve of irrigation. Ayyaswamy and Kulandaivelu (199 found that plant growth was improved by mor frequent irrigation.

Sulphur level influenced the growt attributes markedly though the effect was nc significant throughout the growth period excep plant height and drymatter accumulation at 7 DAS. Sulphur level of 45 kg ha^{-1} produce maximum plant height and drymatter accumulatio but the effect was on par with that of 3 kg S ha^{-1}. Rahul and Paliwal (1987) and Ghos *et al.* (1997) reported the similar result. Applicatio of different doses of sulphur slightly influence the leaf area index and crop growth rate bu

Table 3. Effect of irrigation and sulphur on available sulphur (kg/ha) in soil layers (Mean data c two years)

Soil depth	0-30 cm					30-60 cm				
Initial	26.61					29.03				
After harvest	Levels of sulphur (kg ha^{-1})					Levels of sulphur (kg ha^{-1})				
	0	15	30	45	Mean	0	15	30	45	Mean
Levels of irrigation										
F	24.19	29.03	29.03	31.44	28.42	24.19	26.61	26.61	29.03	26.61
B+F	19.35	24.19	29.03	31.44	26.00	21.77	24.19	29.03	31.44	26.61
B+F+Cd	19.35	26.61	29.03	29.03	26.01	24.19	26.61	29.03	31.44	27.82
L+B+F+Cd	24.19	26.61	26.61	31.44	27.21	24.19	31.44	31.44	33.86	30.23
Mean	21.77	26.61	28.43	30.84		23.59	27.21	29.03	31.44	

L = 4-6 Leaf stage, B = Branching stage, F = Flowering stage, Cd = Capsule development stage e effect was not significant throughout the owing period (Table 2). However, 45 kg ha^{-1} recorded the highest LAI and CGR and was lowest with no sulphur application.

ed yield, stick yield and harvest index

Seed yield and stick yields significantly luenced by irrigation level (Table 2). Addition every unit of irrigation resulted significant crease in seed yield, stick yield and harvest dex. The highest seed and stick yields were corded with the application of highest level irrigation (4-irrigations) and this was significantly perior to the lower levels of irrigation except ck yield. The effect of four irrigations on ck yield was on par with that of three irrigations. ed yield increased by 14.51, 32.43 and 63.14% ereas 3.81, 10.76 and 24.62% increased in ck yield were recorded with four irrigations er three, two and one irrigations respectively. e irrigation applied at flowering stage was t sufficient for optimum summer sesame oduction and crop might have suffered water ess during other critical growth stages. Four igations at all the critical growth stages improved the growth attributes of sesame which contributed significantly greater seed and stick- yield sesame. The result showed the need for e application for four irrigations for obtaining gher yield of summer sesame under this casionally drought prone lateritic belt of West engal. The results are corroborated with the ndings of Ayyaswamy and Kulandaivelu (1992).

Seed and stick yield increased due to creasing the levels of sulphur (Table 2). Sulphur rtilization improved most of the growth attributes d hence seed and stick yield of this crop creased significantly by sulphur application. he highest seed and stick yield were obtained om the crop receiving 45 kg S ha^{-1} though e effect was on par with that of 30 kg ha^{-1}. This indicated that sulphur is another sential nutrient for obtaining higher growth d yield of sesame. These findings are in reement with the findings reported by Nageshwar *al.* (1995).

Available Sulphur in Soil

The initial status of available sulphur was found slightly higher than its critical level (25 kg ha^{-1} available S) in both the soil layers. This might be due to judicious application of organic matter and sulphur containing single super phosphate in high yielding crop varieties in the intensive cropping programme of this farm.

Irrigation water influenced available sulphur in soil markedly. Lower level of irrigation accumulated more sulphur in surface 0-30 cm soil depth whereas increased irrigation levels showed higher sulphur content beyond 30 cm of soil layer. The result indicated that repeated application of irrigation water leached down the available sulphur to the deeper soil layer (30-60 cm) along with water. The highest available sulphur was recorded under one irrigation in 0-30 cm. soil depth but it was the highest in 30 - 60 cm soil depth with four irrigations. Irrigation water accelerated the mobilization of sulphur to the deeper soil region. Increase in movement of available nitrogen to the deeper soil layer by applying higher quantity of irrigation water was also reported by Reddy and Dakshina-murti (1976).

Available sulphur in soil was greatly influenced by sulphur application (Table 3). Treatment with no sulphur recorded the lowest available sulphur and it was the highest with 45 kg S ha^{-1}. This is mainly due to crop uptake of sulphur which depleted the available sulphur that resulted lower sulphur content with no sulphur than that of present in initial soil. Increased sulphur doses helped uniform distribution of available sulphur within the soil rhizosphere. Four levels of irrigation with 45 kg S ha^{-1} recorded the maximum available sulphur in both the soil depths. Available S status of the soil was improved due to application of higher doses of elemental S during both years of experimentation.

From the present study, it may be concluded that sesame crop grown during the summer season in this sub-humid lateritic belt of West Bengal, four irrigations and application of 30 kg S ha^{-1} are conducive for obtaining optimum yield of the crop. The crop is to be irrigated to the physiological growth stages giving the first priority at the flowering stage followed by branching, capsule development stage and lastly by the 4-6 leaf stage.

References

Ayyaswamy, M. and Kulandaivelu, R. (1992). Effect of methods and intervals of irrigation on seed yield and its attributes in Co 1 Sesame. *Madras Agric. J.* **80**: 343-345.

Ghosh, P., Jana, P. K. and Sounda, G. (1997). Effect of sulphur and irrigation on growth, yield and oil content and nutrient uptake by irrigated summer sesame. *Environment and Ecology*. **15**: 83-89.

Nageshwar, Lal, Sarawgi, S. K., Tripathi, R. & and Bhambri, M. C. (1995). Effect of nitroge potassium and sulphur on seed yield, nutrie uptake, quality and economics of summ sesame. *Indian J. Agron.* **40**: 333-335.

Rahul, D.S. and Paliwal, K.V. (1987). Sulphur requir ment of maize and sesame in nutrient solt tion. *Indian J. Plant Physiol.* **30**: 71-7

Reddy, D.S. and Dakshinamurti, C. (1976). Effe of applying different quantities of irrigatio water on.the movement of available nitrog in a sandy-loam soil of Delhi. *J. Indi Soc. Soil Sci.* **24**: 163-167.

Williams C.H. and Steinburgs, A. (1959). Sc sulphur fractions as chemical indices available sulphur in some Australlian soi *Aust. J. Agric. Res.* **10**: 340-352.

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