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SULPHUR CONCENTRATION AND ITS UPTAKE BY CROPS AS AFFECTED BY INTENSIVE CROPPING AND CROP ROTATIONS IN CALCAREOUS SOILS OF BIHAR

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ABSTRACT

The present investigation was undertaken with 37th to 39th crop under long-term experiment started during Kharif, 1985 under Micronutrient scheme at R.A.U. Research farm, Pusa to assess the effect of intensive cropping with four fertility levels and two crop rotations; rice-wheat-sorghum and rice-mustard-moong, on sulphur concentration and its uptake by crops. Initial soil of the experimental plot have pH 8.75, E.C 0.20 Ds/m, organic carbon 0.66 %, available N, P_2O_5 and K_2O; 205, 10.3 and 215.0 Kg/ha, respectively. Four fertility levels consisting of control, low fertility (50% of the recommended NPK), medium fertility (100% of the recommended NPK), high fertility (150% of the recommended NPK) were replicated six times in a Randomized Block design for rice cv. Rajshree-wheat cv. HP 1102-sorghum cv. Local, along with one dummy replication. The sources of NPK were urea, SSP and murate of potash, respectively. The recommended N: P_2O_5: K_2O for rice / wheat and sorghum were 100: 50: 50 and 60: 50: 30, respectively. After 10 complete cycles of rotations i.e. 30th crop, all treatments under different replications were superimposed with sub treatments like R1 (10 Kg Zn/ha), R2 (10 Kg Zn + 2 Kg B + 40 Kg S/ha), R3 (100 q FYM/ha), R4 (100 q FYM + 10 Kg Zn + 2 Kg B + 40 Kg S/ha) and R5 and R6 were kept as such. Increasing fertility levels decreased the sulphur concentration in straw of rice-wheat-sorghum rotation. The S content of grain was increased in case of rice, decreased in case of wheat and had showed irregular trend in case of sorghum with increasing fertility levels. However, sulphur concentration of grain and straw increased for all the crops with increasing fertility levels under rice- mustard-moong rotation. The effect of superimposition of treatments was found to be most effective on sulphur concentration in Zn + organic matter sub-treatment for all crops under both rotations. Increasing fertility levels significantly increased total S uptake in one complete cycle from 5.8 to l7.9 kg/ha under rice-wheat-sorghum rotation and 3.5 to 30.0 kg ha-1 under rice-mustard-moong rotation. The data on S-uptake also showed that application of 50 kg $ZnSO_4.7H_2O$ along with l0 t FYM/ha is highly essential over the recommended dose of N, P and K to check the declining trend of' yield overtime and maintained the yield at higher level. This might be due to buildup of available S from l3.60 to 21.54 mg/kg under rice-wheat-sorghum and from l1.25 to 15.41 mg/kg under rice-mustard-moong rotation.

Key words : Intensive cropping, fertility levels, superimposition, long- term experiment.

Sulphur treated as fourth major nutrient is required by crops in amount very much similar to phosphorus. The incidence of S-deficiency in our soils is growing day by day because of intensive cropping, use of S-free fertilizers and inclusion of high S requiring crops like oil seeds and pulses in crop rotation. The Sulphur deficiency in soils of Bihar was first reported by Ahmad and Jha (1969). Intensively cultivated soils at various fertility levels in the long runs may alter the extent of Sulphur status in variable quantity resulting in imbalance in Sulphur nutrition of crops (Paliwal and Dixit, 1989).According to an estimate, the sulphur removal by crops annually by Indian soils is around one million tonne and replenishment through fertilizer is about 0.34 million tonne (Tondon, 1988). This wide gap has resulted in emergence of sulphur deficiency which is expected to intensify in the years to come.The result of long term experiment carried out by AICRP on micro and secondary nutrients and pollutant element in soils and plant, R.A.U., Pusa Centre on calcareous soil of north Bihar suggested that increasing fertility levels increased the Sulphur nutrition and uptake by crops. Management practices (crop rotation) also affected these parameters. Sulphur is being added regularly, but in variable quantities, which might have affected the sulphur nutrition of crops, under two rotations. Keeping in view the above consideration the present investigation was carried out with the objective to see

long-term effect of intensive cropping and crop rotation on Sulphur concentration and its uptake by crops.

MATERIALS AND METHODS

A long-term experiment was laid out in Kharif, 1985 at R.A.U. Research Farm, Pusa by AICRP on micro and secondary nutrients and pollutant elements in soils and plants. At the start of the experiment, the initial soil was having pH 8.75, EC 0.20 dSm^{-1}, organic carbon 6.6 g kg^{-1}, avail. N 205 kg ha^{-1}, avail. P_2O_5 10.3 kg ha^{-1}, avail. K_2O 215 kg ha^{-1},avail S (0.15% $CaCl_2$ extractable) 8.72 mg kg^{-1}.Four fertility levels consisting of control, low fertility (50% of recommended NPK), medium fertility (100% of recommended NPK) and high fertility (150% of recommended NPK) were replicated six times in randomized block design for two cropping sequences (rice cv. Rajshree-wheat cv. HP1102-sorghum fodder cv. Local and rice cv. Saket-4- mustard cv. Varuna-Moong cv. Sona) along with one replication as dummy in between two rotations. The sources of NPK were urea, SSP, and murate of potash, respectively. The recommended N: P_2O_5: K_2O for rice/wheat, mustard, moong and sorghum were 100:50:50, 60:40:30, 20:50:30 and 60:50:30 kg ha^{-1}, respectively. The total amount of Sulphur added through SSP up to 39^{th} crop under different fertility levels in both rotations was calculated (Table-1). After 10 complete cycles of rotations i.e. 30^{th} crop, all treatments under different replications were superimposed with the sub treatments like R_1 (10 Kg Zn ha^{-1}), R_2 (10 Kg Zn+2 Kg B+40 Kg S ha^{-1}), R_3 (100 q FYM ha^{-1}), R_4 (100 q FYM + 10 Kg Zn+ 2 Kg B+40 Kg S ha^{-1}) and R_5 and R_6 were kept as such. The crop of 13^{th} cycle of rotation in sequence was undertaken for the present investigation. Plant samples (grain and straw) of all the crops under both rotations were analyzed for total sulphur content in binary acid digest using turbidimetric method (Chesnin and Yien, 1951).

RESULTS AND DISCUSSION

Sulphur concentration in crops

Rice-wheat-sorghum rotation : Total S content in rice grain and straw ranged between 0.030 to 0.069 and 0.039 to 0.103 per cent, respectively. In case of wheat grain and straw it ranges between 0.049 to 0.094 and 0.148 to 0.187 per cent, respectively whereas total sulphur content in sorghum straw varied from 0.021 to 0.040 per cent (Table-2). Increasing fertility level increased the S content of rice grain from 0.040 to 0.053 percent which might be due to application of S through SSP applied as a source of phosphate, while S content of wheat grain decreased from 0.070 to 0.063percent with increasing fertility level. Increasing fertility level decreased the S concentration in rice and wheat straw from 0.076 to 0.052 and 0.178 to 0.157 percent, respectively. Decrease in sulphur concentration might be due to dilution effect dominant over fertility effect. Total S content in sorghum straw had showed irregular trend with increasing fertility levels which first decreased up to medium fertility level and then increased at high fertility level under rice-wheat-sorghum rotation. The increase in S content at high fertility might be due to the fact that sorghum is sensitive to Shence application of S either through SSP or through $ZnSO_4$ alone or along with organic matter and gypsum at all fertility levels was able to reduce the dilution effect and hence increased the S content in straw. The superimposition of treatments over and above fertility levels was effective in increasing S status of rice grain and straw.In case of wheat also, superimposition of treatments have increased the S content in grain and straw over untreated crop at all fertility levels. Among the sub treatments, the effect of OM + Zn was more effective. This suggested the solubilization of native as well as applied S by the organic matter. Wheat grain and straw contained much higher total S than rice grain and straw. A much higher S content in Wheat grain has been reported by Aggrawal and Nayyar (1998).

Rice-mustard-moong rotation

Total S content in rice grain and straw ranged between 0.021 to 0.073 and 0.036 to 0.125 per cent, respectively (Table-3). In case of mustard seed and straw total S content was much higher than that in other crops in both rotations where it ranges between 0.228 to 0.544 and 0.093 to 0.223 per cent, respectively. Increasing fertility level regularly and significantly increased the S content in both grain and straw of rice, mustard and moong under this rotation. However, the rate of increase was low at lower fertility level in case of mustard and at higher fertility level in case of moong grain.Increase in case of rice might be due to varietal difference and narrow grain to straw ratio besideapplication of S through SSP applied as a source of phosphate. The superimposition of various treatments was effective in increasing S status of grain and straw of rice,mustard as well as moong crop. Effect of organic manure along with $ZnSO_4$ was more pronounced in increasing sulphur content and confirming the findings of Sinha and Sakal (1993a) and Rakesh (1999).

Table-1 : Sulphur added through SSP (Kg/ha) up to 39th crop.

Treatments	Rice-wheat-sorghum rotation			
	Rice	Wheat	Sorghum	Total
Control	-	-	-	-
Low Fertility	254.59	254.59	257.40	766.58
Medium Fertility	509.18	509.18	514.80	1533.16
High Fertility	763.78	763.78	772.20	2299.76
Rice-mustard-moong rotation				
Control	-	-	-	-
Low Fertility	254.59	187.20	257.40	699.19
Medium Fertility	509.18	374.40	514.80	1398.38
High Fertility	763.78	561.60	772.20	2097.58

Table-2 : Long term effect intensive cropping and fertility levels on S concentration of crops under Rice-wheat-sorghum rotation.

Treatments	Sulphur concentration in grain (%)						Sulphur concentration in Straw (%)					
	Zn	Zn+B+S	OM	OM+Zn	Control	Mean	Zn	Zn+B+S	OM	OM+Zn	Control	Mean
A. Rice as 37th crop												
Control	0.049	0.042	0.033	0.057	0.030	0.040	0.071	0.077	0.084	0.103	0.059	0.076
Low Fertility	0.059	0.048	0.040	0.060	0.036	0.046	0.062	0.071	0.071	0.086	0.058	0.068
Medium Fertility	0.059	0.054	0.045	0.062	0.043	0.051	0.048	0.069	0.058	0.065	0.047	0.056
High Fertility	0.060	0.056	0.061	0.069	0.036	0.053	0.051	0.062	0.054	0.064	0.039	0.052
Mean	0.057	0.050	0.045	0.062	0.036	-	0.058	0.070	0.067	0.080	0.051	-
C.D.at 5%						0.006						0.006
B. Wheat as 38th crop												
Control	0.076	0.079	0.060	0.086	0.058	0.070	0.168	0.168	0.177	0.182	0.187	0.178
Low Fertility	0.065	0.065	0.057	0.082	0.055	0.063	0.164	0.157	0.164	0.178	0.180	0.171
Medium Fertility	0.062	0.062	0.054	0.080	0.051	0.060	0.158	0.153	0.158	0.169	0.176	0.165
High Fertility	0.066	0.062	0.061	0.094	0.049	0.063	0.150	0.148	0.152	0.155	0.170	0.157
Mean	0.067	0.067	0.058	0.086	0.053	-	0.160	0.157	0.163	0.177	0.178	-
C.D.at 5%						0.006						0.003
C. Sorghum as 39th crop												
Control	-	-	-	-	-	-	0.030	0.033	0.039	0.042	0.021	0.033
Low Fertility	-	-	-	-	-	-	0.029	0.032	0.036	0.039	0.027	0.033
Medium Fertility	-	-	-	-	-	-	0.027	0.035	0.025	0.039	0.028	0.031
High Fertility	-	-	-	-	-	-	0.033	0.039	0.029	0.040	0.036	0.035
Mean	-	-	-	-	-	-	0.030	0.035	0.032	0.040	0.026	-
C.D.at 5%	-	-	-	-	-	-						0.009

Sulphur uptake by crops

Rice-wheat-sorghum rotation : The sulphur uptake by grain, straw and total sulphur uptake by rice varied from 0.19 to 3.45, 0.90 to 4.48 and 1.07 to 7.93 Kg ha^{-1}, respectively (Table 4). Increasing fertility level significantly enhanced the S uptake by rice. Although, the sulphur- concentration in rice grain and straw was not regular or even there was decrease in S-content with increase in fertility. This increase in S uptake might be due to tremendous increase in crop yield and secondly, the S was applied through SSP in graded level. Since all the superimposed treatments contained S, their application have increased the S-uptake by both rice grain and straw. The maximum increase in S-uptake was recorded in treatment where $ZnSO_4$ was applied along with organic manure suggesting that organic manure has increased the utilization of S along with increasing efficiency of applied and native S. Increase in S-uptake with addition of S-fertilizers have

Table-3 : Long term effect intensive cropping and fertility levels on S concentration of crops under Rice-mustard-moong rotation.

Treatments	Sulphur concentration in grain (%)						Sulphur concentration in Straw (%)					
	Zn	Zn+B+S	OM	OM+Zn	Control	Mean	Zn	Zn+B+S	OM	OM+Zn	Control	Mean
A. Rice as 37th crop												
Control	0.043	0.043	0.036	0.047	0.021	0.040	0.043	0.045	0.041	0.056	0.036	0.044
Low Fertility	0.049	0.045	0.043	0.054	0.026	0.040	0.048	0.056	0.048	0.057	0.041	0.049
Medium Fertility	0.059	0.057	0.055	0.065	0.036	0.051	0.057	0.071	0.068	0.074	0.056	0.064
High Fertility	0.066	0.060	0.060	0.073	0.050	0.061	0.097	0.097	0.077	0.125	0.064	0.087
Mean	0.054	0.051	0.049	0.059	0.033	-	0.061	0.067	0.059	0.078	0.049	-
C.D.at 5%						0.002						0.011
B. Mustard as 38th crop												
Control	0.0443	0.443	0.228	0.493	0.280	0.359	0.140	0.133	0.093	0.148	0.156	0.138
Low Fertility	0.308	0.300	0.325	0.514	0.511	0.345	0.101	0.097	0.114	0.150	0.193	0.141
Medium Fertility	0.388	0.352	0.414	0.521	0.363	0.400	0.151	0.149	0.123	0.207	0.220	0.178
High Fertility	0.445	0.418	0.430	0.544	0.417	0.445	0.197	0.181	0.166	0.223	0.205	0.196
Mean	0.396	0.376	0.349	0.518	0.393	-	0.147	0.140	0.124	0.182	0.194	-
C.D.at 5%						0.061						0.024
C. Moong as 39th crop												
Control	0.145	0.216	0.123	0.164	0.116	0.147	0.116	0.125	0.137	0.141	0.101	0.120
Low Fertility	0.211	0.223	0.197	0.222	0.151	0.194	0.140	0.179	0.206	0.206	0.112	0.159
Medium Fertility	0.159	0.255	0.202	0.236	0.160	0.192	0.142	0.163	0.179	0.181	0.128	0.154
High Fertility	0.123	0.285	0.232	0.263	0.171	0.208	0.148	0.145	0.151	0.152	0.135	0.144
Mean	0.160	0.247	0.189	0.221	0.150	-	0.137	0.153	0.168	0.170	0.119	-
C.D.at 5%						-0.030						0.020

also been reported by Sinha and Sakal (1993b) and Rakesh (1999). Sulphur uptake by rice in present investigation was found to be quite low as compared to that reported by other workers like Sharma (1991) and Rakesh (1999) which might be due to imbalanced and continuous use of nutrients that might have created imbalance fertility status of soil as evidenced by poor yield in present investigation. Presence of other nutrients in imbalance proportion might have interfered with utilization of applied S as evidenced by increase in S-uptake due to organic matter application. The sulphur uptake by wheat grain, straw and total uptake varied from 0.29 to 2.44, 2.52 to 8.38 and 2.82 to 9.73 Kg ha^{-1}, respectively (Table 4). Sulphur removal by wheat grain was less than rice while wheat straw removed more S than rice which might be due to two reasons, firstly due to lower S content in wheat grain and secondly due to higher wheat straw production and S content in wheat straw as compared to rice straw. This also suggested low translocation of S from wheat straw to grain. Similar to rice, in case of wheat also increasing fertility level significantly enhanced the S uptake by wheat grain, straw and total uptake from 0.35 to 1.40, 2.80 to 7.69 and 3.17 to 9.10 Kg ha^{-1}.Superimposition of treatments did not affect S-uptake by wheat straw while S-uptake by wheat grain was found to be highest under subtreatment Zn + organic manure. Increase in S-uptake by wheat due to S-application has also been reported by Sharma (1991).Total S-uptake by dry sorghum forage varied from 0.32 to 2.83Kg ha^{-1} as shown in table -4. The low S-uptake might be due to lower S-content in this crop resulting from imbalanced fertility status of soil created by continuous use of graded levels of NPK fertilizers. Increasing fertility level significantly increased the S uptake by sorghum from 0.65 to 2.34 Kg ha^{-1}. Marked increase in S-uptake was also recorded due to superimposition of treatments containing S even at medium and high fertility levels where 100 and 150 % of NPK fertilizers, respectively are being applied continuously. This suggested that graded levels of NPK fertilizers are insufficient to meet the S-requirement by crops. Here also the effect of organic manure was found superior over other treatments.

Table-4: Long term effect intensive cropping and fertility levels on S uptake by crops under Rice-wheat-sorghum rotation.

Treatments	Sulphur uptake by grain (Kg/ha)						Sulphur uptake by straw (Kg/ha)						Total S uptake (Kg/ha)					
	Zn	Zn+B+S	OM	OM+Zn	Control	Mean	Zn	Zn+B+S	OM	OM+Zn	Control	Mean	Zn	Zn+B+S	OM	OM+Zn	Control	Mean
A. Rice as 37th crop																		
Control	0.59	0.56	0.46	0.68	0.19	0.50	1.42	1.31	1.76	1.85	0.90	1.35	2.01	1.87	2.23	2.54	1.07	1.94
Low Fertility	1.53	1.44	1.00	1.56	1.08	1.28	2.85	2.48	2.48	3.78	2.19	2.66	4.39	3.92	3.48	5.34	3.27	3.95
Medium Fertility	2.54	2.11	2.89	2.67	1.62	2.07	3.22	3.93	3.36	4.03	3.07	3.45	5.75	6.04	5.25	6.70	4.68	5.52
High Fertility	2.40	2.69	2.56	3.45	1.57	2.53	3.88	4.46	3.94	4.48	2.69	3.69	6.28	7.15	6.50	7.93	4.26	6.42
Mean	1.77	1.70	1.48	2.09	1.12	-	2.84	3.05	2.89	3.54	2.21	-	4.61	4.75	4.37	5.63	3.32	-
C.D.at 5%						0.33						0.41						0.65
B. Wheat as 38th crop																		
Control	0.38	0.39	0.30	0.47	0.29	0.35	2.86	2.60	2.83	3.18	2.52	2.80	3.24	3.00	3.13	3.66	2.82	3.17
Low Fertility	0.78	0.72	0.63	1.07	0.65	0.75	5.90	5.97	6.07	6.41	6.09	6.09	6.68	6.68	6.70	7.47	6.73	6.83
Medium Fertility	1.24	0.99	1.03	1.20	0.89	1.04	6.16	6.88	6.64	6.46	6.77	6.66	7.40	7.88	7.66	7.96	7.67	7.70
High Fertility	1.52	1.38	1.16	2.44	0.96	1.40	7.05	7.47	7.60	7.28	8.38	7.69	8.57	8.86	8.76	9.73	9.34	9.10
Mean	0.98	0.87	0.78	1.30	0.70	-	5.49	5.73	5.79	5.83	5.94	-	6.47	6.61	6.56	7.21	6.64	-
C.D.at 5%						0.29						0.62						0.54
C. Sorghum as 39th crop																		
Control							0.55	0.66	0.94	0.76	0.32	0.65						
Low Fertility							1.27	1.41	1.54	1.68	0.58	1.30						
Medium Fertility							1.30	1.75	1.42	1.97	1.50	1.59						
High Fertility							2.14	2.42	1.90	2.83	2.39	2.34						
Mean							1.34	1.56	1.45	1.81	1.20	-						
C.D.at 5%												0.41						

Rice-mustard-moong rotation

The sulphur uptake by grain, straw and total total sulphur uptake by rice varied from 0.35 to 3.29, 0.66 to 7.25 and 1.01 to 10.54 Kg ha^{-1}, respectively (Table 5).It appears that rice crop under this rotation removed a bit higher S as compared to rice under rice-wheat- sorghum rotation which suggested that, beside varietal characters, the nature of other two crops i.e. oilseed and pulse under this rotation might have played important role in Solubilization i.e. Incorporation of oilseed and pulse in crop rotation resulted in better utilization of S by crops. Increasing fertility level significantly enhanced the S uptake by rice grain, straw and total uptake from 0.52 to 254, 0.81 to 5.47 and 1.32 to 8.00 Kg ha^{-1}, respectively.

Superimposition of S through phosphogypsum and/ or $ZnSO_4$ were also able to increase S-uptake by rice over no superimposition suggesting that continuous use of NPK fertilizers might have created S deficiency due to its presence in improper ratio which needs to be supplemented through inorganic S containing fertilizers. Addition of organic manure further enhanced the S-uptake by rice indicating role of organic manure in enhancing efficiency of added and native S. The sulphur uptake by mustard grain, straw and total uptake varied from 0.11 to 7.89, 0.28 to 13.27 and 0.39 to 21.16 Kg ha^{-1}, respectively (Table 5).The data revealed thatsulphur uptake by mustard grain, straw and total uptake were significantly increased from 0.18 to 5.61, 0.35 to 10.59 and 0.54 to 16.09 Kg ha^{-1}, respectively with increasing fertility levels. The superimposition of treatments were found to increase the S-uptake by mustard grain while the same for mustard straw remained unchanged except $ZnSO_4$ + organic manure whose application increased the S-uptake at all fertility levels, and at higher fertility level the rate of increase was more as compared to other treatments. The sulphur uptake by moong grain, straw and total uptake varied

Table-5 : Long term effect intensive cropping and fertility levels on S uptake by crops under Rice-mustard-moong rotation.

Treatments	Sulphur uptake by grain (Kg/ha)						Sulphur uptake by straw (Kg/ha)						Total S uptake (Kg/ha)					
	Zn	Zn+B+S	OM	OM+Zn	Control	Mean	Zn	Zn+B+S	OM	OM+Zn	Control	Mean	Zn	Zn+B+S	OM	OM+Zn	Control	Mean
	A. Rice as 37th crop																	
Control	0.60	0.56	0.54	0.71	0.35	0.52	0.77	0.81	0.82	1.12	0.66	0.81	1.37	1.37	1.36	1.83	1.01	1.32
Low Fertility	1.23	1.26	1.08	1.57	0.77	1.11	1.54	1.62	1.34	1.77	1.44	1.53	2.77	2.88	2.42	3.34	2.21	2.64
Medium Fertility	2.36	2.00	1.82	2.47	1.35	1.89	3.28	3.98	3.54	4.00	3.02	3.47	5.64	5.98	5.36	6.47	4.37	5.37
High Fertility	2.51	2.70	2.52	3.29	2.10	2.54	5.77	6.98	4.47	7.25	4.16	5.47	8.28	9.68	6.99	10.54	6.26	8.00
Mean	1.68	1.63	1.49	2.01	1.14	-	2.84	3.35	2.54	3.54	2.32	-	4.52	4.98	4.03	5.55	3.46	-
C.D.at 5%						0.23						0.77						0.87
	B. Mustard as 38th crop																	
Control	0.22	0.22	0.11	0.25	0.14	0.18	0.28	0.33	0.28	0.52	0.35	0.35	0.50	0.55	0.39	0.77	0.49	0.54
Low Fertility	1.08	0.75	0.81	1.80	0.86	1.03	1.77	1.70	2.00	2.48	3.27	2.42	2.85	2.45	2.81	4.28	4.13	3.44
Medium Fertility	3.10	2.82	3.52	4.69	2.45	3.17	6.34	6.26	4.86	9.11	7.32	6.88	9.44	9.08	8.38	13.80	9.73	10.03
High Fertility	5.34	5.02	6.02	7.89	4.69	5.61	11.54	9.05	8.80	13.27	10.43	10.59	16.88	14.07	14.82	21.16	15.11	16.09
Mean	2.44	2.21	2.62	3.66	2.04	-	4.98	4.34	3.99	6.35	5.34	-	7.42	6.54	6.60	10.00	7.37	-
C.D.at 5%						0.67						1.12						1.60
	C. Moongas 39th crop																	
Control	0.44	0.65	0.49	0.66	0.35	0.49	0.68	0.84	1.27	1.83	0.99	1.10	1.12	1.49	1.76	2.94	1.35	1.59
Low Fertility	1.27	0.93	0.99	1.33	0.76	1.01	2.38	3.31	3.81	4.22	1.96	2.94	3.65	4.24	4.80	5.55	2.71	3.94
Medium Fertility	1.27	1.79	1.62	1.65	1.28	1.48	2.63	3.13	3.97	4.56	2.48	3.21	3.90	4.92	5.59	6.21	3.76	4.69
High Fertility	1.23	3.14	2.78	2.63	1.80	2.23	3.02	3.76	4.20	4.39	3.25	3.64	4.25	6.90	6.98	7.02	5.05	5.87
Mean	1.05	1.63	1.47	1.57	1.05	-	2.18	2.76	3.31	3.75	2.17	-	3.23	4.39	4.78	5.32	3.22	-
C.D.at 5%						0.43						0.45						0.65

from 0.35 to 3.14, 0.68 to 4.39 and 1.12 to 7.02 Kg ha^{-1}, respectively (Table 5). Increasing fertility level significantly enhanced the S uptake by moong grain, straw and total uptake from 0.49 to 2.23, 1.10 to 3.64 and 1.59 to 5.87 Kg ha^{-1}, respectively. All superimposed treatments enhanced S-uptake by moong which was expected at all fertility levels since all sub treatments were the source of S. Among these, addition of organic manure was found to be more effective indicating exploitation of native S and solubilization of applied S by organic manure, although the yield of moong was much less than the cereal crops but the S removal was comparable which might be due to high requirement of S by moong resulting in high S- content in grain and straw of moong. The incorporation of oilseeds and pulses in cropping system might have taken care of balancing the nutrient status of soil after lapses of certain period of time.

Thus it may be concluded from the above study that increasing fertility levels increased sulphur nutrition to crops under intensive cropping. Superimposition of organic manure along with $ZnSO_4$ was more beneficial at higher fertility levels.

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