Annals of Arid Zone 41(2): 191-194, 2002

Short Communication

Response of Wheat to Sulphur Application in Loamy Sand Soil

M.L. Kothari and J.K. Jethra

Department of Soil Science & Agricultural Chemistry, Rajasthan Agricultural University, Agricultural Research Station, Durgapura, Jaipur 302 018, India

Sulphur is now being recognized as the fourth major nutrient after nitrogen, phosphorus and potassium (FAO, 1992) in plant mineral composition and is essential for synthesis of proteins. Increasing cultivation of high yielding crop varieties, use of high analysis S-free fertilizer like urea and DAP, decreased use of organic and crop residues have resulted in widespread S-deficiencies and low crop yield. The light textured soils low in organic matter content are highly prone to S deficiency (Kanwar, 1984). Sulphur deficiency is widespread in Indian soils. In the semi-arid eastern plain of Rajasthan about 22% soil samples are found deficient in available sulphur (Jethra *et al.*, 1989). The present investigation was conducted in the zone to study the response of wheat to sulphur application in the soils deficient in available sulphur.

A field experiment was conducted in rabi season for 3 years (1998-99 to 2000-01) at ARS, Durgapura farm on light textured loamy sand mixed hyper thermic Typic Ustipassment soil. The pH and EC (1:2 soil water suspension) of the soil were 8.10 and 0.15 dS m^{-1}, respectively. Analysis also revealed 158.45 kg ha^{-1} available nitrogen, 25.50 kg ha^{-1} available P_2O_5 and 135.0 kg ha^{-1} available K_2O. Soil was deficient in available S (5.58 mg kg^{-1}), Mn (3.14 mg kg^{-1}) and Cu (0.32 mg kg^{-1}).

The treatments comprised of the following six levels of sulphur application

Table 1. Effect of different levels of sulphur application on test weight, grain and straw yield of wheat (Raj-307) (Pooled data of three years, i.e., Rabi 1998-99 to 2000-2001)

Treatments S kg ha^{-1}	Test weight (g)	Yield (q ha^{-1})	
		Grain	Straw
0.0	33.70	31.56	68.47
12.5	34.25	34.45	68.39
25.0	34.00	35.62	69.30
37.5	34.03	37.39	71.28
50.0	34.54	41.18	73.19
62.5	34.22	38.68	74.72
S.Em±	-	0.898	-
C.D. at 5%	NS	2.547	NS

Table 2. Effect of different levels of sulphur appliction on average nutrient content of wheat (Raj-3077) during rabi 1998-99 to 2000-01

S (kg ha^{-1})	Macronutrients (%)				Micronutrients (mg kg^{-1})			
	N	P	K	S	Zn	Fe	Mn	Cu
0.0	1.58 (0.75)	0.22 (0.26)	0.44 (1.06)	0.17 (0.13)	20.7 (27.0)	222 (69.7)	15.2 (23.5)	35.8 (15.0)
12.5	1.65 (0.78)	0.21 (0.29)	0.46 (1.05)	0.18 (0.11)	20.8 (28.0)	221 (78.6)	15.3 (22.2)	37.2 (15.0)
25.0	1.74 (0.72)	0.20 (0.28)	0.45 (1.20)	0.21 (0.11)	20.8 (26.0)	232 (87.2)	15.4 (23.8)	36.5 (16.2)
37.5	1.78 (0.75)	0.21 (0.26)	0.44 (1.10)	0.21 (0.11)	22.0 (25.0)	229 (78.0)	15.8 (22.8)	38.0 (15.5)
50.0	1.85 (0.78)	0.22 (0.28)	0.44 (1.21)	0.22 (0.13)	22.0 (26.0)	222 (76.3)	15.6 (21.8)	37.0 (15.2)
62.5	1.87 (0.79)	0.23 (0.28)	0.44 (1.08)	0.22 (0.12)	21.3 (25.0)	219 (72.2)	16.3 (23.2)	36.5 (16.2)
CD (P = 0.05)	0.15 (NS)	NS (NS)	NS (NS)	0.03 (NS)	NS (NS)	NS (NS)	NS (NS)	NS (NS)

Concentration in straw in parenthesis.

to soil as gypsum 0, 12.5, 25.0, 37.5, 50.0 and 62.5 kg ha^{-1}. The treatments were replicated four times in a randomized block design. Application of FYM @ 10 t ha^{-1} before sowing and recommended doses of 60 kg nitrogen (as urea), 20 kg P_2O_5 (as DAP) and 30 kg K_2O as murate of potash were applied at the time of sowing. Remaining 60 kg nitrogen ha^{-1} (as urea) was given at the time of first irrigation. The crop was sown in November every year, after presowing irrigation. Six irrigations were given to the crop. All improved agricultural practices were carried out throughout the crop period. The crop was harvested in April and grain and straw yields were recorded. The plant and grain samples of wheat and soil samples were collected for analyzing the nutrient content by standard methods as described by Jackson (1973). Available S was extracted using 0.15% $CaCl_2$ solution (Williams and Steinberg, 1959), and S content in wheat grain and in soil was estimated colorimetrically by turbidity method (Chesnin and Yien, 1951). Soil-available micronutrients were extracted using DTPA (Lindsay and Norvell, 1978) and their quantity was determined on AAS.

The pooled data for three years (Table 1) showed that the grain yield of wheat increased significantly with increasing levels of S application up to 50 kg ha^{-1} over control. Further increase in sulphur levels to 62.5 kg ha^{-1} did not increase the grain yield significantly over 50 kg ha^{-1}. Soil application of sulphur @ 50 kg ha^{-1} as gypsum gave highest grain yield, i.e., 41.18 q ha^{-1} and this treatment was cost-effective. It gave a B:C ratio of 25 as compared to 37.5 kg ha^{-1} application. Straw yield and test weight of wheat grain were not affected by the soil application of sulphur at any level. Tandon (1995) reported that mean yield increases due to

Table 3. Effect of different levels of sulphur appliction on available nutrients of soil after harvest (average of three years; rabi 1998-99 to 2000-2001)

S kg ha^{-1}	Available macronutrients				Micronutrients (mg kg^{-1} soil)			
	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})	S (mg kg^{-1})	Zinc	Iron	Manganese	Copper
0.0	161.38	26.45	136.92	5.51	0.70	3.04	3.18	0.335
12.5	164.28	26.50	139.78	6.51	0.76	3.11	3.11	0.332
25.0	159.28	26.32	140.78	7.00	0.74	3.14	3.33	0.360
37.5	156.93	27.54	139.82	7.23	0.79	3.15	3.13	0.320
50.0	159.64	27.66	140.05	7.72	0.78	3.05	3.44	0.335
62.5	158.34	27.16	140.05	7.84	0.76	3.28	3.42	0.335
CD (P = 0.05)	NS	NS	NS	1.22	NS	NS	NS	NS

S application were 638 to 813 kg ha^{-1} for cereals and average yield percentage response to S for wheat grown in S-deficient soil was 25.3%.

Application of S increased the nitrogen and sulphur content of grain over control (Table 2). Maximum nitrogen content, i.e., 1.87% in grain was observed in the treatment where 62.5 kg S ha^{-1} was applied and were followed by 50 kg S ha^{-1} application. Maximum S content in grain, i.e., 0.22%, was found in the treatment where 50 and 62.5 kg S ha^{-1} were applied, and it was significantly higher as compared to control and 12.5 kg S ha^{-1} application. This shows that in S-deficient soils, application of gypsum would be helpful in boosting the S supply to crops. Application of sulphur did not show any definite trend in phosphorus, potash, zinc, iron, manganese and copper content of the grain and also did not affect significantly the nutrient content of wheat straw (Table 2). Similar results were also reported by Yadav and Desai (1989).

Soil application of sulphur (25 kg ha^{-1} and above) significantly increased the available sulphur content in soil (Table 3) as compared to control and 12.5 kg S ha^{-1} application. Maximum available S content (7.84 mg kg^{-1}) in soil was found in the treatment where 62.5 kg S ha^{-1} was applied, followed by 50 kg S ha^{-1} application. Similar results were also reported by Tripathi and Hazra (2000). Application of sulphur at different levels did not affect the available nutrient contents significantly in the soil, except sulphur after harvest of wheat crop. This study indicated that soil application of sulphur @ 50 kg ha^{-1} through gypsum increased the grain yield, nitrogen, sulphur content of wheat and available sulphur content in soil as compared to no application of sulphur in the semi-arid eastern plain soils deficient in available sulphur.

References

Chesnin, L. and Yien, C.H. 1950. Turbidimetric determination of available sulphates. *Proceedings of Soil Science Society of America* 15: 149-151.

FAO 1992. *The Importance of Sulphur for Crop Production*, FAO-FIAC. Rome. 62 p.

Jackson, M.L. 1973. *Soil Chemical Analysis*. Prentice-Hall of India Limited, New Delhi.

Jethra, J.K., Singh, B. and Kothari, M.L. 1989. Available sulphur status of soils of Jaipur district. *Proceedings of the National Seminar on Sulphur in Agriculture*. Published by USA and FACT, Bangalore, pp. 181-185.

Kanwar, J.S. 1984. Sulphur and food production in tropical countries problems, projection and policy implication. *Journal of Indian Society of Soil Science* 32: 583-591.

Lindsay, W.L. and Norwell, W.A. 1978. Development of DTPA soil test for zinc, iron, manganese and copper. *Soil Science Society of America Journal* 42: 421-428.

Tandon, H.L.S. 1995. *Sulphur in Indian Agriculture* Vol. 19: 3-8.

Tripathi, S.B. and Hazra, C.R. 2000. Sulphur in balanced fertilization in red and black soils of Bundelkhand region of Uttar Pradesh. *Proceedings of the TSI/IFA Workshop on Sulphur in Balanced Fertilization,* February 7-8, 2000. New Delhi, pp. 43-54.

William, C.H. and Steinbergs, A. 1959. Soil sulphur fractions as chemical indices of available sulphur in soil. *Australian Journal of Agricultural Research* 10: 340-352.

Yadav, B.S. and Desai, N.H. 1989. Yield, quality and chemical composition of mustard as influenced by levels and sources of sulphur. *Proceeding of National Seminar on Sulphur,* pp. 124-128. USA & FACT, Bangalore.