Indian J. Agron. 38 (3) : 410–413 (September 1993)

Effect of levels and modes of sulphur application on biochemical changes in mustard (*Brassica juncea*) leaves

V. D. KHANPARA[1], B. L. PORWAL[2] AND J. C. PATEL[3]

Rajasthan College of Agriculture, Rajasthan Agriculture University, Udaipur 313 001

Received: February 1992

ABSTRACT

An experiment was conducted during 1987–88 and 1988–89 to study effect of levels and modes of sulphur application on biochemical changes in leaves of mustard [*Brassica juncea* (L.) Czernj. & Cosson]. Chlorophyll content (*a*, *b* and total) and peroxidase activity in fresh leaf at 50% flowering increased significantly, but leaf-sap pH decreased significantly due to S application. Total chlorophyll content and peroxidase activity increased significantly up to 150 kg S/ha in pooled results. Pooled data of 2 years indicated that modes of S application did not show significant effect on chlorophyll (*a*, *b* and total), peroxidase activity and pH of leaf sap.

Sulphur is now recognized as the fourth major nutrients. Of late, it has received increasing attention. Global reports of sulphur deficiency and consequent crop responses are quite ostensible (Singh and Singh, 1984). Very little information is available about the effect of sulphur on biochemical changes in mustard [*Brassica juncea* (L.) Czernj. & Cosson] leaf at 50% flowering, particularly in Udaipur region. Therefore, the present investigation was carried out to find out the effect of levels and modes of S application on biochemical changes in mustard leaf.

MATERIALS AND METHODS

The experiment comprising 36 treatment combinations was laid out in split-plot design with 4 replications. The treatments consisted of 4 levels of nitrogen (0, 20, 40 and 60 kg/ha) in main plots, whereas the combinations of 4 levels of sulphur (50, 100, 150 and 200 kg/ha) and 2 modes of S application (application of full dose of S through elemental S 21 days before sowing; application of 50 kg S/ha through gypsum + remaining dose through elemental S at sowing) along with an absolute control (no S) were relegated to subplot treatments. Fresh-leaf samples from bottom-to-top of plants were collected form selected treatments (from 9 subplot treatments, in which N was not applied) on the day of analysis at 50% flowering of crop. These samples were analysed for chlorophyll content (Arnon, 1949), peroxidase activity (Shannon *et al.*, 1971) and leaf-sap pH. The data were statistically analysed using randomized plot design (randomized block design was is used because all the treatments

Present address: [1]Department of Agronomy, Gujarat Agricultural University, Junagadh 362 001; [2]KVK, RAU, Sirohi 307 501; [3]N.M. College of Agriculture, GAU, Navasari 396 450

Table 1. Effect of levels and modes of sulphur application on chlorophyll content in mustard leaf at 50% flowering (mg/g fresh-leaf weight)

Treatment	Chorophyll 'a'			Chlorophyll 'b'			Total chlorophyll		
	1987–88	1988–89	Mean	1987–88	1988–89	Mean	1987–88	1988–89	Mean
Control vs sulphur (S)									
Control	0.765	0.685	0.725	0.506	0.416	0.461	1.271	1.101	1.186
S	0.883	0.822	0.853	0.605	0.528	0.567	1.488	1.351	1.420
'F' test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
S (kg/ha)									
50	0.794	0.743	0.769	0.557	0.423	0.490	1.351	1.166	1.259
100	0.867	0.806	0.837	0.596	0.526	0.561	1.462	1.332	1.397
150	0.926	0.867	0.897	0.625	0.554	0.590	1.551	1.421	1.486
200	0.944	0.873	0.909	0.644	0.611	0.628	1.588	1.484	1.536
CD (P = 0.05)	0.046	0.034	0.040	0.029	0.032	0.031	0.065	0.046	0.055
Mode of S application									
Elemental S alone 21 DBS	0.894	0.830	0.862	0.611	0.543	0.577	1.505	1.373	1.439
Gypsum + elemental S at sowing	0.872	0.815	0.844	0.599	0.514	0.577	1.471	1.329	1.400
CD (P = 0.05)	NS	NS	NS	NS	0.023	NS	NS	0.032	NS

NS, Not significant; Sig, Significant; DBS, days before sowing

were tested with equal weightage). The soil was clay loam having moderately alkaline reaction. The soil was medium in available nitrogen (274.40 and 282.24 kg/ha) and available S (17.00 and 18.00 ppm), whereas it was high in available phosphorus (67.30 and 65.65 kg/ha) and available potash (365.00 and 405.00 kg/ha). Mustard variety 'Kranti' was sown maintaining 30 cm inter-row spacing with a uniform seed rate of 5 kg/ha.

RESULTS AND DISCUSSION

Application of S significantly increased chlorophyll *a, b* and the total in fresh leaf compared with the control during both the years as well as in pooled result (Table 1). Pooled data indicate that chlorophyll *a, b* and the chlorophyll total were significantly increased up to 50, 100 and 150 kg S/ha respectively. This increase seems to be due to increased supply of S, which apparently increases the availability of iron by creating favourable cellular environment. Adequate availability of Feat the sites of prophyrin biosynthesis may result in greater synthesis of cholrophyll. Singh and Singh (1983) and Rathore and Manohar (1989) reported similar findings.

Peroxidase activity in leaf at 50% flowering was significantly increased with up to 150, 100 and 150 kg S/ha during 1987–88, 1988–89 and in pooled result respectively. Increased activity of peroxidase with S fertilization appears to be due ot higher content of S in leaf at this stage, which might have made more Fe physiologically active for the synthesis of

Table 2. Effect of levels and modes of sulphur application on peroxidase activity and leaf-sap pH in fresh leaf at 50% flowering of mustard

Treatment	Peroxidase activity*			Leaf-sap pH		
	1987–88	1988–89	Mean	1987–88	1988–89	Mean
Control vs sulphur (S)						
Control	0.179	0.165	0.172	6.40	6.21	6.31
S	0.199	0.189	0.194	6.42	6.01	6.22
'F' test	Sig	Sig	Sig	Sig	Sig	Sig
S (kg/ha)						
50	0.183	0.174	0.179	6.33	6.11	6.22
100	0.197	0.187	0.192	6.25	6.03	6.14
150	0.207	0.196	0.202	6.17	5.98	6.07
200	0.210	0.199	0.205	6.15	5.94	6.04
CD (P = 0.05)	0.010	0.010	0.010	0.12	NS	0.15
Modes of S application						
Elemental S alone 21 DBS	0.203	0.192	0.198	6.20	5.99	6.10
Gypsum + elemental S at sowing	0.196	0.186	0.191	6.24	6.03	6.14
CD (P = 0.05)	NS	NS	NS	NS	NS	NS

*Δ OD 460/min/mg fresh weight; DBS, days before sowing

chlorophyll, as peroxidase is a haematin enzyme.

Sulphur significantly reduced leaf-sap pH compared with the control (Table 2). However, levels of S significantly influenced leaf-sap pH during 1987–88 and in pooled results. This may be due to high S content of leaf. This significant inverse relationship indicates that apart from making up the nutritional deficiency of the element, S arrests the development of high leaf-sap pH and thereby enables the plant to grow and yield better on alkaline soil of Udaipur. Thus, the results showed that in addition to its nutritional role, S also plays the role of metabolic regulants in plants.

Effect of mode of sulphur application

Pooled analysis of the results (Tables 1, 2) indicated that modes of S application failed to attain the level of significance in respect of chlorophyll (*a*, *b* and total), peroxidase activity and leaf-sap pH.

REFERENCES

Arnon, D. I. 1949. Copper enzyme in isolated chloroplast. *Plant Physiology* **24** (1) : 15.

Rathore, P. S. and Manohar, S. S. 1989. Response of mustard to nitrogen and sulphur. I. Effect of nitrogen and sulphur on growth and chlorophyll content of mustard. *Indian Journal of Agronomy* **34** (3) : 328–332.

Shannon, L. M., Uritani, I. and Imaseki, H. 1971. Denovo synthesis of peroxide isoenzymes in sweet potato slices. *Plant Physiology* **47** : 493–498.

Singh, B. P. and Singh, H. G. 1983. Effect of sulphur on oil production, amino acids and thioglucosides contents of seed and oil of mustard grown in vertisol. *Crop Physiology* **1** : 77–86.

Singh, T. P. and Singh, H. P. 1984. Response of Indian rape to planting density, nitrogen and sulphur. *Indian Journal of Agronomy* **29** (4) : 539–542.