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Impact of residual sulphur on mulberry (*Morus alba* L.) nutrition and soil reaction

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The principal contributors for sulphur deficiency in soil are continuous use of high analysis sulphur-free fertilizers, enhanced exhaustion of sulphur from soil by high-yielding mulberry varieties, increased cropping intensity and wide-spread lack of organic matter in tropical soil under mulberry farming (Bose and Kar, 2007; Kar *et al*., 2008). Recently, Bose *et al.* (2010a) has reported the direct effect of fertilizer sulphur on growth, yield and nutrient uptake of mulberry on a sulphur-deficient sandy clay loam soil under irrigated condition. The increasing surface activity of the adsorbed sulphate ion with an increase in its activity in the soil solution (Dolui *et al*., 1993) and preponderance of carbon-bonded sulphur in soil (Bhogal *et al*., 1996) indicates formation of its stable as well as reserve pool under sulphur fertilization. This exerts special significance of sulphur fertilizer in terms of its carry-over effect. Higher soil efficiency factor of sulphur over its fertilizer efficiency factor (Bose *et al*., 2010b) further substantiates the earlier postulation. Therefore, an investigation was undertaken to study the residual effect of sulphur on the performance of mulberry in terms of productivity as well as sulphur uptake and also on soil reaction as well as availability of sulphur in soil.

The field experiment was conducted at Central Sericultural Research and Training Institute, Berhampore, West Bengal during 2009-10 to 2010-11 on a sandy clay loam soil under irrigated condition. It was previously treated with varying levels of sulphur and uniform levels of nitrogen, phosphorus, potassium and FYM for three years (2006-07 to 2009-10) as per the recommended doses of mulberry for irrigated condition. The experiment under Gangetic alluvial soil comprised four levels of sulphur (0, 20, 30 and 40 kg ha^{-1} $year^{-1}$ in five equal split doses corresponding to five crops) through two sources, namely elemental sulphur (ES) and ammonium sulphate (AS). All the treatments including control received recommended doses of N, P_2O_5 and K_2O @ 336, 180 and 112 kg ha^{-1} $year^{-1}$, respectively and were applied in five equal split doses along with 20 mt FYM ha^{-1} $year^{-1}$ applied in single dose.

The experiment was laid out in a randomized block design with three replications for mulberry (*Morus alba* L.) variety S-1635 planted at 60 cm x 60 cm spacing. The treatments were applied in the preceding mulberry crops for three years along with other inputs as mentioned. Mulberry crops of the succeeding year received only other inputs at the same doses but no sulphur treatment to find out the residual effect of the respective treatment.

Mulberry leaf and shoot yields were recorded for five crops of the succeeding year, pooled and presented on annual basis. For computation of sulphur uptake, leaf and shoot samples were digested in di-acid mixture (HNO_3 : $HClO_4$ :: 4 : 1) and sulphur content of the digested material was analyzed by turbidimetric method. Soil samples, drawn from each plot after completion of the crop schedule in the succeeding year, were extracted with 0.15% $CaCl_2$ and available sulphur in the clear extract was estimated by the method as described by Chesnin and Yien (1951).

Mulberry productivity

The residual effect of different levels and sources of sulphur on mulberry productivity is presented in table- 1. Only the highest level of sulphur (40 kg ha^{-1} $year^{-1}$) in both the forms registered significant residual effect on leaf yield. The residual responses were 3.32 and 3.10 mt ha^{-1} annually for AS and ES, respectively. Barring 20 kg S ha^{-1} $year^{-1}$ as ES, all the levels of sulphur in both the forms exhibited significant residual effect on shoot yield furnishing a range of 2.03 to 4.17 t ha^{-1} residual responses annually. Similar reports are available on the residual effect of sulphur application on the productivity of mulberry, sugarcane, groundnut, green gram and wheat (Bokhtiar *et al*., 2008; Sinha and Sakal, 1993; Banik and Sengupta, 2012; Giri *et al*., 2011; Bose *et al*., 2011). However, in both the cases of mulberry productivity, sulphur applied @ 40 kg ha^{-1} $year^{-1}$ as AS was highlighted.

Table 1: Residual effect of fertilizer sulphur on mulberry productivity

Sulphur (kg ha^{-1} $year^{-1}$)	Leaf yield (mt ha^{-1} $year^{-1}$)	Shoot yield (mt ha^{-1} $year^{-1}$)
0	32.12	21.71
20 (ES)	31.79	22.97
30 (ES)	33.50	24.92
40 (ES)	35.22	23.74
20 (AS)	34.23	24.16
30 (AS)	34.38	24.86
40 (AS)	35.44	25.88
LSD (0.05)	**2.35**	**1.99**

Sulphur uptake

The residual effect of levels and sources of fertilizer sulphur on sulphur uptake by mulberry as presented in table-2 varied differently in terms of leaf and shoot. For sulphur uptake by leaf, ES only @ 40 kg ha^{-1} $year^{-1}$ and AS @ 30 as well as 40 kg ha^{-1} $year^{-1}$ both imparted significant residual response.

But, all the levels of sulphur in both the forms registered significant residual effect in terms of sulphur uptake by shoot. Interaction of residual available sulphur in soil with applied organic manure (FYM) might be the plausible

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reason for such augmentation of sulphur uptake by mulberry (Sinha and Sakal, 1993). However, difference in solubility between the two sources in solution phase of soil is supposed to affect the recovery of sulphur by mulberry (Bose *et al*., 2010a).

Table 2: Residual effect of fertilizer sulphur on sulphur uptake by mulberry

Sulphur (kg ha^{-1} year^{-1})	S uptake by leaf (kg ha^{-1} year^{-1})	S uptake by shoot (kg ha^{-1} year^{-1})
0	7.82	2.18
20 (ES)	8.04	2.64
30 (ES)	8.61	3.27
40 (ES)	9.72	3.37
20 (AS)	8.14	2.84
30 (AS)	9.02	3.27
40 (AS)	9.61	3.43
LSD (0.05)	**1.08**	**0.29**

Soil study

Data on available sulphur and pH in post harvest soil samples collected after pruning of the last crop under residual study during 2010-11 are presented in table- 3. The results showed that the residual value of available sulphur in soil was found to be significant at all levels of sulphur both as ES and AS ranging from 4.81 to 8.44 kg ha^{-1}. But, it is interesting to note that the treatments were not varying significantly among themselves in terms of the same. Enhanced mobilization of residual sulphur from soil to mulberry at higher doses of application might be the reason for such finding (Table 2).

Table 3: Residual effect of fertilizer sulphur on pH and available sulphur content of soil

Sulphur (kg ha^{-1} year^{-1})	Soil pH	Available sulphur (kg ha^{-1})
0	8.05	13.96
20 (ES)	7.80	18.77
30 (ES)	7.73	20.85
40 (ES)	7.61	20.44
20 (AS)	7.84	19.92
30 (AS)	7.65	21.88
40 (AS)	7.54	22.40
LSD (0.05)	**0.27**	**3.70**

It also indicates that the mulberry crops under the experimentation were not supplied with sulphur in wide-excess of its requirement even at its higher level of application. On the other hand, soil pH was found to decrease with increasing levels of sulphur from 8.05 at control to 7.54 at 40 kg S ha^{-1} year^{-1} applied as AS. But, drop in soil pH due to residual effect of sulphur was insignificant at lowest dose (20 kg S ha^{-1} year^{-1}) whereas the higher levels were significantly effective. Such drop in soil pH may be explained in terms of alteration of charge characteristics of soil colloids due to surface activity of the sulphate ion (Dolui *et al*., 1993) adsorbed on the basal plane surface of the clay minerals to satisfy the unbalanced charges within octahedral layer of the clay lattice (Grim, 1968).

It may, therefore, be inferred that use of sulphur even one year after its application can maintain the higher level of available sulphur in soil in comparison to control and the same is capable of exerting significant impact on mulberry productivity through enhanced sulphur nutrition in mulberry.

REFERENCES

Banik, N. C. and Sengupta, K. 2012. Effect of sulphur on growth and yield of green gram [*Vigna radiata* (L.) Wilczek]. *J. Crop and Weed*, **8**:109-10.

Bhogal, N. S., Choudhary, K. C. and Sakal, R. 1996. Distribution of different forms of sulphur in Calciorthents of North Bihar. *J. Indian Soc. Soil Sci*., **44**: 65-69.

Bokhtiar, S. M., Paul, G. C., Alam, K. M. 2008. Effects of organic and inorganic fertilizer on growth, yield and juice quality and residual effects on ratoon crops of sugarcane. *J. Pl. Nutr*., **31**: 1832-43.

Bose, P. C. and Kar, R. 2007. Triple role of sulphur in mulberry garden. *Indian Silk*, **46**: 10-12.

Bose, P. C., Kar, R. and Bajpai, A. K. 2010a. Effect of levels and sources of sulphur on growth, yield, nutrient uptake of mulberry (*Morus alba* L.) and its economics. *Sericologia,* **50**: 509-18.

Bose, P. C., Kar, R. and Bajpai, A. K. 2010b. Soil test based sulphur fertilization for targeted yields of mulberry. *J. Crop Weed*, **6**: 22-24.

Bose, P. C., Kar, R. and Majumdar, S. K. 2011. Effect of sulphur on yield, nutrient concentration and sulphur use efficiency of mulberry. *J. Crop and Weed*, **7**:127-29.

Chesnin, L. and Yien, C. H. 1951. Turbidimetric determination of available sulphur. *Soil Sci. Soc. Am. Proc.*, **15**: 149-51.

Dolui, A. K., Karmakar, A. and Nayek, A. K. 1993. Effect of sulphate ion on charge characteristics of soils. *J. Indian Soc. Soil Sci*., **41**: 227-32.

Giri, U., Kundu, P., Chakraborty, A. and Bandopadhyay, P. 2011. Effect of sulphur and different irrigation regimes on groundnut. *J. Crop and Weed*, **7**: 80-83.

Grim, R. E. 1968. *Clay Mineralogy*. McGraw-Hill, New York, pp. 228.

Kar, R., Bose, P. C., Majumder, S. K. and Dutta, R. N. 2008. Physical characterization of mulberry (*Morus sp*.) growing soils in four states of Eastern India in relation to their organic carbon and available nutrient contents. *Indian J. Seric.*, **47**: 126-29.

Sinha, R. B. and Sakal, R. 1993. Effect of pyrite and organic manures on sulphur nutrition of crops-II. Residual effect on groundnut and wheat. *J. Indian Soc. Soil Sci*., **41**: 316-20.