

# Effects of Elemental Sulphur and Organic Manure on Sulphur, Zinc, and Total Chlorophyll Contents of Tomato in a Calcareous Sandy Loam Soil

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## INTRODUCTION

High pH and the presence of CaCO<sub>3</sub> usually result in reduced micronutrient availabilities in the soil. Elemental S is biologically oxidized to H<sub>2</sub>SO<sub>4</sub> under aerobic conditions. The oxidation of S to H<sub>2</sub>SO<sub>4</sub> is particularly beneficial in alkaline soils to reduce pH, supply SO<sub>4</sub> to plants, make P and micronutrients more available, and reclaim soils (Burns 1967). However, the response to S amendment is unpredictable (Lindemann et al. 1991). Although micronutrient availabilities can improve with S applications in calcareous soils, the response often depends on the amount of CaCO<sub>3</sub> present (buffering capacity). No improvement was observed in soils in New Mexico (Lindemann et al. 1991). In these soils, S was not completely oxidized, and the produced H<sub>2</sub>SO<sub>4</sub> was quickly neutralized by CaCO<sub>3</sub>.

Biomass, organic amendments and soil organic C content have been related to S oxidation rates (Wainwright et al. 1986, Janzen and Bettany 1987, Lawrence and Germida 1988), suggesting that an increase in heterotrophic S-oxidizer numbers after the addition of an organic substrate enhances S oxidation. The addition of S to organic matter stimulates S oxidation in calcareous soil (Cifuentes and Lindemann 1993).

In this study, our objectives were to determine the influence of elemental S and farmyard manure on S, Zn and total chlorophyll contents of tomato (*Lycopersicum esculentum*) grown in a calcareous sandy loam soil.

## METHODS

A pot experiment with a calcareous sandy loam soil was conducted. Selected soil chemical and physical properties are given in Table 1. Elemental S and farmyard manure were mixed with the soil at six concentrations (0, 50, 100, 150, 200, 400 mg kg<sup>-1</sup>) and two rates (0, 3 tones da<sup>-1</sup>), respectively, in a completely randomized design factorial with 4 replicates. Soil samples were taken at 2 different periods to examine the change of pH and EC after the experimental set up. Tomato seedlings were planted three weeks after the application. Plants were harvested eight weeks later to determine S, Zn, and total chlorophyll contents, and dry matter yield (g pot<sup>-1</sup>).

## RESULTS AND DISCUSSION

Effects of different S levels with and without farmyard manure on soil pH and Zn concentration of tomato plants are given in Table 2. Sulphur and farmyard manure applications reduced soil pH while it increased soil EC. These effects were particularly determined in the 1<sup>st</sup> soil sampling period (3 weeks after mixing soils) and at the highest S level. The applications did not significantly affect the dry matter yield of tomatoes. Sulphur and total chlorophyll contents increased and Zn content decreased with S applications. Farmyard manure applications reduced Zn and total chlorophyll contents, but did not affect the S content of the plant.

**Table 1. Physical and chemical properties of soil used.**

Parameter	Soil
Sand (%)	63.52
Clay (%)	18.48
Silt (%)	18
Texture	Sandy loam
pH	7.80
CaCO <sub>3</sub> (%)	18.92
EC (dS m <sup>-1</sup> )	2.07
Organic matter (%)	2.27
Total N (%)	0.049
Extractable-SO <sub>4</sub> (mg/kg)	2.40
DTPA-extractable Zn (mg kg <sup>-1</sup> )	3.02

**Table 2. Effects of different sulphur (S) levels with and without farmyard manure (FYM) on soil pH and Zn concentration of tomato plant.**

Applied S mg kg <sup>-1</sup>	1 <sup>st</sup> soil sampling			2 <sup>nd</sup> soil sampling			Zn concentration of tomatoes mg kg <sup>-1</sup>		
	pH			pH					
	0 FYM* <sub>0</sub>	3 FYM* <sub>1</sub>	Means	0 FYM* <sub>0</sub>	3 FYM* <sub>1</sub>	Means	0 FYM* <sub>0</sub>	3 FYM* <sub>1</sub>	Means
S <sub>0</sub> (0)	8.03	7.85a, <b>B</b>	7.94	7.92a, <b>A</b>	7.93a, <b>A</b>	7.93	65.65	48.15	59.60a
S <sub>1</sub> (50)	a <sup>1</sup> , <b>A</b> <sup>2</sup>	7.81b, <b>A</b>	7.82	7.80bc, <b>B</b>	7.91a, <b>A</b>	7.86	44.55	41.55	43.05bc
S <sub>2</sub> (100)	7.83 b, <b>A</b>	7.76cd, <b>A</b>	7.76	7.83b, <b>B</b>	7.91a, <b>A</b>	7.87	47.20	41.10	44.15bc
S <sub>3</sub> (150)	7.76 c, <b>A</b>	7.77c, <b>A</b>	7.77	7.83b, <b>A</b>	7.84b, <b>A</b>	7.84	41.75	37.55	39.65c
S <sub>4</sub> (200)	7.77 c, <b>A</b>	7.73d, <b>B</b>	7.76	7.82b, <b>A</b>	7.82b, <b>A</b>	7.82	54.45	42.85	48.65ab
S <sub>5</sub> (400)	7.78 c, <b>A</b>	7.66e, <b>A</b>	7.66	7.77c, <b>B</b>	7.81b, <b>A</b>	7.79	64.40	42.35	53.38a
Means	7.65 d, <b>A</b>	7.76		7.83	7.87		53.00 <b>A</b>	42.26 <b>B</b>	

\*FYM was applied in tonnes da<sup>-1</sup>.

<sup>1</sup> Means in the same column followed by the same letter are not significantly different at 5 % probability level by LSD test.

<sup>2</sup>Means in the same row followed by the capital and bold same letter are not significantly different at 5 % probability level by LSD test.

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