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Assessing Sulphur Nutrition to Enhance the Yield and Quality of Small Onion (*Allium cepa var. aggregatum*) Grown in Sulphur Deficient Soil

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A field experiment was conducted to assess the impact of sulphur fertilisation on the yield and quality of small onion (CO (On) 5) grown in S deficient black soil (Vertic Ustropept) which was sandy loam in texture with available S content of 7 mg kg^{-1}. Ammonium sulphate and Single super phosphate were the two sources of sulphur applied along with recommended doses of N, P and K at the levels of 0, 20 and 40 kg S ha^{-1} with and without VAM. The bulb yield increased significantly with the application of ammonium sulphate with recommended dose of fertilizers at the higher level of 40 kg S ha^{-1} (6.5 t ha^{-1}) which was 31.07% higher over the control (4.48 t ha^{-1}). However, application of VAM with ammonium sulphate and RDF at higher levels was also statistically on par with the same combination without VAM. The highest sulphur content (0.754%) and sulphur uptake in bulbs (19.83 kg ha^{-1}) were higher with application of ammonium sulphate @ 40 kg S ha^{-1} + RDF. The quality parameters of small onion like ascorbic acid and pyruvic acid were also higher with the application of ammonium sulphate and recommended dose of fertilizers at 40 kg S ha^{-1}.

Introduction

Onion (*Allium cepa L.*) "Queen of kitchen" is one of the most important commercial crop not only in India but also in the world. Onion is a sulphur loving plant and the requirement is high for its proper growth and yield. Sulphur is recognised as an important nutrient for higher yield and better quality of onion bulbs (Tripathy *et al.*, 2013). No sulphur application in sulphur deficient soils has often resulted in low yield of onion. Keeping in view the significance of sulphur in the production of onion crop, the present investigation on onion was undertaken.

Materials and Methods

A field experiment was conducted in Putthur village of Narasipuram block, Coimbatore

district, where soil was found to be deficient in available sulphur with the value of 7.00 mg kg^{-1}. The soil was sandy loam in texture, black coloured with neutral pH (7.15) and non-saline (0.19 dS m^{-1}). The soil texture was analysed by following the international pipette method (Piper, 1966), pH by potentiometry (Jackson, 1973) and EC by conductometry (Jackson, 1973). The treatments of this study (T_1 to T_{10}) include absolute control, Recommended doses of fertilizers (NPK 60:60:30 kg ha^{-1}) alone, Ammonium sulphate @ 20 kg S ha^{-1} + RDF, Ammonium sulphate @ 20 kg S ha^{-1} + RDF + 200.0 g VAM, Ammonium sulphate @ 40 kg S ha^{-1} + RDF, Ammonium sulphate @ 40 kg S ha^{-1} + RDF+ 200.0 g VAM, Single super phosphate @ 20 kg S ha^{-1}+ RDF, Single super phosphate @ 20 kg S ha^{-1}+ RDF + 200.0 g VAM, Single super phosphate @ 40 kg S ha^{-1}+ RDF and Single super phosphate @ 40 kg S ha^{-1}+ RDF + 200.0 g VAM. These ten treatments were laid out in RBD with 3 replications. The matured bulbs were harvested at 100 DAT, shade dried, weighed and then expressed as yield in kg ha^{-1}. The harvested bulbs were then again oven dried at 70°C to a constant weight and their dry weights were recorded. These oven dried bulbs were then ground finely and sulphur content analysis was carried out by turbidimetry method (Chesnin and Yien, 1951) and sulphur uptake was computed by multiplying the contents with dry weights. The harvested bulbs were also analysed for quality parameters like pyruvic acid (Randle and Bussard, 1993) and ascorbic acid (A.O.A.C, 1975) contents. The results were statistically analysed using Aggress software at 5% level of significance.

Results and Discussion

S content and uptake in bulb

The sulphur content (0.754%) and uptake (19.83 kg ha^{-1}) in bulbs were found to be superior with the application of AS @ 40 kg S ha-1 + RDF (Fig.1) which was a 58.22% and 79.82% increase over the control, respectively. The sulphur content and sulphur uptake in bulbs of control plots registered the least values of 0.315% and 4.00 kg ha^{-1}, respectively. Also, it was observed that there was an increase in S uptake with increase in S levels from 20 to 40 kg S ha-1 which might be due to the highest sulphur content in bulbs at this level of 40kg S ha-1. Nasreen and Imamul Huq in 2005, also reported that an increase in S levels from 0 to 45 kg S ha^{-1} increased the S content in bulbs which was 142-165% higher over the control. These might be due to higher availability of applied sulphur and its more absorption and translocation to bulbs and also dilution effect.

Bulb Yield

The highest bulb yield of 6.5 t ha-1 was noted with the application of AS @ 40 kg S ha-1 + RDF, which was on par with the application of AS @ 40 kg S ha-1 + RDF + 200.0 g VAM (6.27 t ha^{-1}) (Table.1). Jana and Kabir (1990) also reported that application of 40 kg S/ha resulted in higher bulb yield of onion. Khalid *et al.,* (2009) also noticed that the yield of rapeseed were increased in the order of AS>SSP>Gypsum, though non-significant and discussed that crops respond to sulphur application and the magnitude of response depends on the extent of soil S deficiency (< 10 mg kg^{-1}).

Pyruvic acid and ascorbic acid

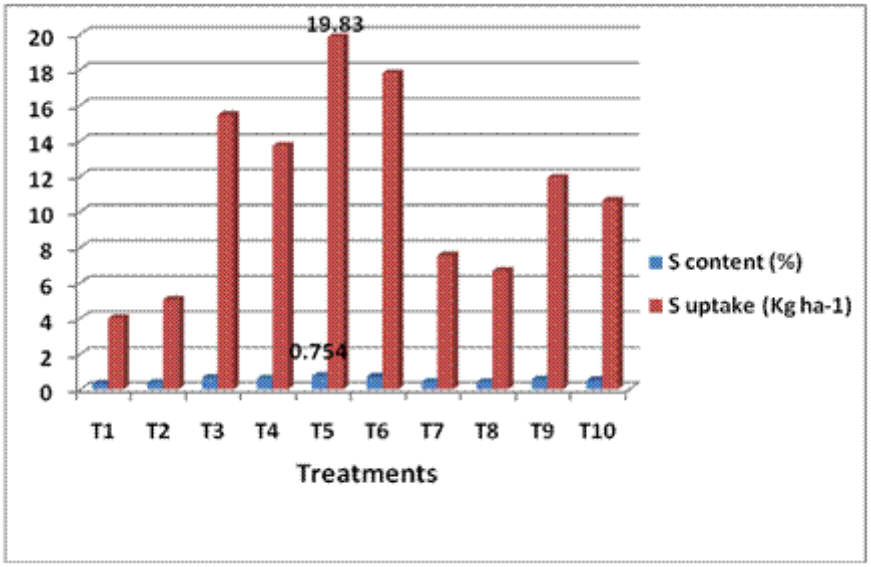
Though, the highest amount of pyruvic acid (2.51µmol g^{-1}) and ascorbic acid contents (9.38 mg100g^{-1}) in bulb were higher with AS @ 40 kg S ha^{-1} + RDF it was also on par with, AS @ 40 kg S ha^{-1} + RDF + 200.0 g VAM (2.46 µmol g^{-1}) in case of pyruvic acid and was on par with AS @ 40 kg S ha^{-1} + RDF + 200.0 g VAM (9.21 mg100g^{-1}) and AS @ 20 kg S ha^{-1} + RDF (9.16 mg100g^{-1}) in case of

ascorbic acid (Table.1). This indicated that the application of sulphur to S deficient soils in the form of ammonium sulphate enhances the quality of onion bulbs due to the highest amount of available sulphur content present in it.

Table.1 Effect of sources and levels of sulphur on Bulb Yield (t ha^{-1}), ascorbic acid (mg 100 g of $bulb^{-1}$) and pyruvic acid (µmol g^{-1} of bulb) contents in bulbs

Treatments	Bulb Yield (t ha^{-1})	Ascorbic acid (mg 100 g of $bulb^{-1}$)	Pyruvic acid (µmol g^{-1} of bulb)
T1	4.48	7.11	1.05
T2	4.92	7.51	1.12
T3	6.13	9.16	2.32
T4	6.04	8.87	2.15
T5	6.50	9.38	2.51
T6	6.27	9.21	2.46
T7	5.13	8.11	1.63
T8	5.00	7.84	1.42
T9	5.88	8.75	2.08
T10	5.71	8.63	1.95
Mean	**5.60**	**8.46**	**1.87**
SEd	**0.13**	**0.20**	**0.04**
CD (0.05)	**0.28**	**0.42**	**0.09**

Fig.1 Effect of sources and levels of sulphur on S content (%) and S uptake (Kg ha^{-1}) in bulbs



Higher S release in AS treated plots might be due to relatively higher solubility of AS as compared to SSP (Scherer, 2001). Pungency intensity is controlled by genetic and

environmental factors, especially soil S content, temperature, and water availability (McCallum *et al.,* 2001).

In conclusion, the results from the present field investigation infer that the application of Ammonium Sulphate @ 40 kg S ha^{-1} + RDF can be recommended as the suitable and best sulphur source and dosage for enhancing the onion yield and quality through sulphur nutrition.

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