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# Influence of different levels of sulphur on growth and yield of onion under eastern dry zone of Karnataka

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**Abstract:** Field experiment was conducted to study the effect of different levels of sulphur on growth and yield of onion. The treatment $T_4$-Recommended dose of fertilizer (RDF) + 45 kg S $ha^{-1}$ was recorded maximum plant height at 30 days after planting (DAT) (16.79 cm), 60 DAT (19.65 cm) and 90 DAT (24.68 cm), maximum number of leaves per plant at 30 DAT (7.63), 60 DAT (9.75) and 90 DAT (9.83), collar thickness (1.53 cm), neck thickness (0.78 cm), polar diameter of bulb (5.83 cm), equatorial diameter of bulb (5.78 cm), number of rings per bulb (7.75), average bulb dry weight (12.35 g $bulb^{-1}$), bulb yield per plot (27.48 kg $plot^{-1}$), total bulb yield (45.79 t $ha^{-1}$) and marketable bulb yield (44.09 t $ha^{-1}$) which was followed by treatment T5- RDF + 30 kg S $ha^{-1}$ and T5-RDF + 60 kg S $ha^{-1}$. Therefore, among the different levels of sulphur treatment, application of 45 kg of S $ha^{-1}$ along with recommended dose of fertilizer is recommended to increase growth and yield of onion.

**Key words:** Growth, Sulphur fertilizer, Yield, Onion

## Introduction

Onion (*Allium cepa* L.) belongs to the family Alliaceae and has chromosome number 2n=2x=16 is one of the important commercial vegetable cum spice crops of India and widely cultivated throughout the world. Onion is a versatile vegetable crop owing to its utility. India is the second largest producer of onion in the world, productivity wise is much lower (16.41 t/ha) and top ranking countries mostly grow long day onions which enjoy congenial climate and as a result the bulking of onion is very high. In India, onion grows in an area of 7.56 lakh hectares with total production of 121.67 lakh tons (Anon., 2013). Maharashtra, Karnataka, Gujrat, Bihar, Madhya Pardesh, Rajasthan, Andhra Pradesh and Tamil Nadu are the main onion growing states. The productivity and quality of crop can be enhanced by proper nutrient management. Among the secondary nutrients, sulphur plays a vital role in plant growth and improves the yield of important vegetable crops. Sulphur requirement of crops is almost similar to that of phosphorus (Channagoudar and Janawade, 2006). Sulphur is a constituent of secondary compounds *viz.,* alline, cycloalline and thio propanol which not only influence the taste, pungency and medicinal properties of onion besides inducing resistance against pests and diseases. In this view the experiment was conducted to study the influence of different levels of sulphur on growth and yield of onion.

## Materials and Methods

A field experiment was carry out in sandy loam soil at Collage of Horticulture, University of Horticultural Sciences campus, Bangalore during *kharif* 2013-14. Seven levels of sulphur fertilizer 0, 15, 30, 45, 60, 75 and 90 kg S $ha^{-1}$, were used as treatment variable. The trail comprised seven treatments: $T_1$ - Recommended dose of fertilizer 125:75:125 kg NPK $ha^{-1}$(RDF) (control), $T_2$ – RDF + 15 kg S $ha^{-1}$, $T_3$ – RDF + 30 kg S $ha^{-1}$, $T_4$ – RDF + 45 kg S $ha^{-1}$, $T_5$ – RDF + 60 kg S $ha^{-1}$, $T_6$ – RDF + 75 kg S $ha^{-1}$ and $T_7$ – RDF + 90 kg S $ha^{-1}$. The experiment was laid out in randomize complete block design (RCBD) with four replications. The unit plot size 3 × 2 m. fertilizers at the rate of 125 kg N from Urea, 75 kg $P_2O_5$ from triple super phosphate (TSP) and 125 kg $K_2O$ from muriate of potash (MOP) were used as a blanket dose. Sulphur fertilizer was used in the form of gypsum (calcium sulphate) as per treatments. Besides, farm yard manure (FYM) was applied at the rate of 25 t $ha^{-1}$. Full dose of TSP, MSP, Gypsum, FYM and 50% of Urea were applied at final land preparation (Anon., 2012). Healthy and disease free 40 days old seedlings of onion (cv. Arka Kalyan) were transplanted during the third week of August at a spacing of 15 × 10 cm. the remaining 50% of urea was applied 30 days after transplanting (DAT) followed by irrigation. The plots were irrigated 4-5 days interval as flood irrigation depending on climatic condition.

The crop was harvested on first week of January 2014 when the plant attained to maturity and showing drying up of most of the leaves and bending over. Harvesting was done with help of a Guddali, care was taken to avoid any kind of bulb injury during lifting. The observations were recorded on plant height at 30, 60 and 90 days after transplanting (DAT), number of leaves at 30, 60 and 90 DAT, collar thickness (cm), neck thickness (cm), polar diameter of bulb (cm), equatorial diameter of bulb (cm), number of

rings per bulb, average plant height (cm), average bulb dry weight (g), bulb yield per plot (kg), total bulb yield (t $ha^{-1}$) and marketable bulb yield (t $ha^{-1}$) and analyzed through MS STAT program. The DMRT test was used for mean separations of the studied parameters.

## Results and Discussion

The data pertaining to plant height as influenced due to different levels of sulphur showed a significant variation at 30, 60 and 90 days after transplanting during *kharif* (Table-1). Plant height gradually increased with increasing in levels of sulphur up to 45 kg S $ha^{-1}$ beyond which it decreased. The tallest plant (16.79, 19.65 and 24.68 cm) was recorded in $T_4$ – RDF (125:75:25 kg NPK $ha^{-1}$) + 45 kg S $ha^{-1}$, which was statically on par with $T_3$ - RDF +30 kg S $ha^{-1}$ (16.10, 18.73 and 23.58). The shortest plants (14.17, 16.78, 20.03 cm) were found in $T_1$ - RDF (control). Increased plant height with different levels of sulphur was also reported by Channagoudra (2004) and Jaggi (2005b). The treatment $T_4$ – RDF + 45 kg S $ha^{-1}$ was recorded significantly maximum number of leaves per plant at 30, 60 and 90 days after transplanting (7.63, 9.75 and 9.83) respectively, which was on par with $T_3$ – RDF + 30 kg S $ha^{-1}$ *i e.* 7.25, 9.38 and 9.80 during 30, 60 and 90 DAT respectively and the lowest number of leaves were recorded in $T_1$ – RDF (control) *i e*. 5.5, 7.75 and 8.30 during 30, 0 and 90 DAT respectively (Table-1).

With respect to collar thickness and neck thickness at harvest differed significantly as influenced due to the different levels of sulphur. The treatment $T_4$ – RDF + 45 kg S $ha^{-1}$ recorded maximum bulb collar thickness (1.53 cm) and neck thickness (0.78 cm) which was followed by $T_3$ – RDF + 30 kg S $ha^{-1}$ (1.46 & 0.73 cm) and $T_5$ – RDF + 60 kg S $ha^{-1}$ (1.38 & 0.68 cm) and the least was recorded in $T_1$ - RDF (control) (1.15 & 0.50 cm) for collar thickness and neck thickness respectively (Table-1). Polar diameter of bulb and equatorial diameter of bulb produced differed significantly due to different levels of sulphur. The highest polar diameter of bulb (5.83 cm) and equatorial diameter of bulb (5.78 cm) recorded in $T_4$ - RDF + 45 kg S $ha^{-1}$, which was on par with $T_3$ - RDF + 30 kg S $ha^{-1}$ (5.70 & 5.55 cm), $T_5$ - RDF + 60 kg S $ha^{-1}$ (5.6 & 5.4 cm) and $T_6$ - RDF + 75 kg S $ha^{-1}$ (5.55 & 5.2 cm), whereas least was recorded in $T_1$ - RDF (control) (5.03 & 4.5 cm) for polar diameter and equatorial diameter of bulb respectively (Table-2). Significant differences were observed for number of rings per bulb among the different levels of sulphur evaluated. Among the different levels of sulphur the maximum number of rings per bulb was recorded in case of $T_4$ – RDF + 45 kg S $ha^{-1}$ (7.75) which was on par with $T_3$ – RDF + 30 kg S $ha^{-1}$ (7.40) and $T_5$ – RDF + 60 kg S $ha^{-1}$ (7.28), followed by $T_6$ – RDF + 75 kg S $ha^{-1}$ (6.93), while $T_1$ – RDF (control) recorded the minimum number of rings per bulb (5.55) (Table-2).

The data pertaining on bulb weight produced as influenced by different levels of sulphur differed significantly during *kharif*. The $T_4$ - RDF + 45 kg S $ha^{-1}$ recorded the maximum average bulb weight (79.00 g) which was on par with $T_3$ - RDF + 30 kg S $ha^{-1}$ (77.25 g) and $T_5$ - RDF + 60 kg S $ha^{-1}$ (74.00 g), followed by $T_6$ - 75 kg S $ha^{-1}$ (72.50 g), while $T_1$ - RDF (control) registered the minimum bulb weight (63.75 g) (Table-3). Application of sulphur at the rate of 45 kg S $ha^{-1}$ along with RDF recorded maximum bulb dry weight (12.35 g $bulb^{-1}$) and bulb yield per plot (27.48 kg), which was on par with $T_3$ – RDF + 30 kg S $ha^{-1}$ (11.98 g $bulb^{-1}$ and 27.03 kg $plot^{-1}$) followed by $T_5$ – RDF + 60 kg S $ha^{-1}$ (11.30 g $bulb^{-1}$ & 26.63 kg $plot^{-1}$) and the minimum was recorded in $T_1$ – RDF (control) (8.22 g $bulb^{-1}$ and 20.35 kg $plot^{-1}$) for bulb dry weight and bulb yield per plot respectively (Table-3). There was a significant difference among the different levels of sulphur treatment with respect to total bulb yield per hectare and marketable bulb yield per hectare. The maximum total yield and marketable yield per hectare was recorded in $T_4$ – RDF + 45 kg S $ha^{-1}$ (45.79 t $ha^{-1}$ & 44.09 t $ha^{-1}$), which was on par with $T_3$ - RDF + 30 kg S $ha^{-1}$ (45.04 t $ha^{-1}$ & 43.05 t $ha^{-1}$) followed by $T_5$ - RDF + 60 kg S $ha^{-1}$ (44.38 t $ha^{-1}$ & 42.16 t $ha^{-1}$), whereas minimum was recorded in $T_1$ – RDF (control) (33.92 t $ha^{-1}$ & 31.02 t $ha^{-1}$) for maximum total yield and marketable yield per hectare respectively (Table-3).

Increased number of leaves, collar thickness and neck thickness may be due to the application of sulphur helps in the availability of other nutrients resulting in better growth and increased uptake of all the nutrients at higher levels of sulphur. Similar results have also been reported by Dabhi *et al*. (2004), Jaggi (2005b) and Nasreen *et al*. (2007). The increase in yield was mainly because of a positive association between yield and yield attributing characters like bulb polar diameter, bulb equatorial diameter, number of rings per bulb and bulb weight differed significantly. Previous studies also reported significant variation with respect to bulb polar

**Table-1:** Effect of different levels of sulphur on plant height (cm), number of leaves per plant at different stages of crop growth, collar thickness at harvest and neck thickness after curing under flood irrigation

| Treatments | Plant height (cm) | | | Number of leaves | | | Collar | Neck |
|---|---|---|---|---|---|---|---|---|
| | 30 DAT | 60 DAT | 90 DAT | 30 DAT | 60 DAT | 90 DAT | thickness (cm) | thickness (cm) |
| $T_1$ – RDF (control) | 14.17 | 16.78 | 20.03 | 5.50 | 7.75 | 8.38 | 1.15 | 0.50 |
| $T_2$ – RDF +15 kg S $ha^{-1}$ | 15.20 | 17.78 | 22.63 | 6.15 | 8.38 | 8.75 | 1.35 | 0.65 |
| $T_3$ – RDF + 30 kg S $ha^{-1}$ | 16.10 | 18.73 | 23.58 | 7.25 | 9.38 | 9.50 | 1.46 | 0.73 |
| $T_4$ – RDF + 45 kg S $ha^{-1}$ | 16.97 | 19.65 | 24.68 | 7.63 | 9.75 | 9.83 | 1.53 | 0.78 |
| $T_5$ – RDF + 60 kg S $ha^{-1}$ | 16.08 | 18.40 | 23.13 | 7.18 | 9.17 | 9.40 | 1.38 | 0.68 |
| $T_6$ – RDF + 75 kg S $ha^{-1}$ | 15.55 | 18.25 | 22.25 | 6.90 | 9.13 | 9.38 | 1.33 | 0.66 |
| $T_7$ – RDF + 90 kg S $ha^{-1}$ | 14.95 | 17.63 | 22.18 | 6.88 | 8.75 | 9.07 | 1.25 | 0.60 |
| S Em± | 0.519 | 0.523 | 0.720 | 0.242 | 0.369 | 0.289 | 0.073 | 0.040 |
| CD at 5% | 1.541 | 1.554 | 2.139 | 0.725 | 1.096 | 0.860 | 0.217 | 0.118 |
| CV (%) | 6.66 | 5.75 | 6.36 | 7.20 | 8.29 | 6.30 | 10.82 | 12.14 |

DAT: Days After Transplanting, RDF: Recommended Dosage of Fertilizer

**Table-2:** Effect of different levels of sulphur on polar diameter of bulb, equatorial diameter of bulb and number of rings per bulb of onion at harvest under flood irrigation

| Treatments | Polar diameter of bulb (cm) | Equatorial diameter of bulb (cm) | No. of rings /bulb |
|---|---|---|---|
| $T_1$ – RDF (control) | 5.03 | 4.53 | 5.55 |
| $T_2$ – RDF +15 kg S $ha^{-1}$ | 5.25 | 5.15 | 6.13 |
| $T_3$ – RDF + 30 kg S $ha^{-1}$ | 5.70 | 5.55 | 7.40 |
| $T_4$ – RDF + 45 kg S $ha^{-1}$ | 5.83 | 5.78 | 7.75 |
| $T_5$ – RDF + 60 kg S $ha^{-1}$ | 5.60 | 5.40 | 7.28 |
| $T_6$ – RDF + 75 kg S $ha^{-1}$ | 5.55 | 5.20 | 6.93 |
| $T_7$ – RDF + 90 kg S $ha^{-1}$ | 5.10 | 5.08 | 6.63 |
| S Em± | 0.188 | 0.212 | 0.219 |
| CD at 5% | 0.559 | 0.630 | 0.650 |
| CV (%) | 6.92 | 8.10 | 6.43 |

RDF: Recommended Dosage of Fertilizer

diameter, bulb equatorial diameter, number of rings per bulb and bulb weight due to the application of different levels of sulphur. Nandi *et al*., 2002; Hariyappa, 2003; Dabhi *et al*., 2004; Nasreen *et al*., 2005; Jaggi, 2005b; Channagoudar and Janawade, 2006; Nasreen *et al*., 2007; Sing, 2008; Farooqui *et al.,* 2009 and Mishu *et al*., 2013 are reported similar trends.

The highest yield of bulbs could be due to different levels of sulphur which can be attributed to maximum plant height and number of leaves which are important component of growth which resulted in accumulation of maximum photosynthesis in the bulb and also better percentage plant establishment which is directly proportional to number of bulbs produced. Apart from these, it may be related to increased uptake of N, P, K and S by the crop to maximum bulb polar diameter, bulb equatorial diameter, number of rings per bulb and bulb weight which are major yielding contributing components. Similar results were also reported in onion crop by Nasreen *et al*., 2003; Sankaran *et al*., 2005; Mishu *et al*., 2013 and Jaggi, 2005 who also recorded a significantly higher bulb yield of onion due to application of sulphur.

**Table-3:** Effect of different levels of sulphur on yield and yield attributes of onion under flood irrigation

| Treatments | Av. bulb wt. (g) | Av. bulb dry wt. (g) | Bulb yield (Kg $plot^{-1}$) | Total bulb yield (t $ha^{-1}$) | Marketable bulb yield (t $ha^{-1}$) |
|---|---|---|---|---|---|
| $T_1$ – RDF (control) | 63.75 | 8.22 | 20.35 | 33.92 | 31.02 |
| $T_2$ – RDF +15 kg S $ha^{-1}$ | 67.00 | 9.35 | 23.70 | 39.50 | 37.21 |
| $T_3$ – RDF + 30 kg S $ha^{-1}$ | 77.25 | 11.98 | 27.03 | 45.04 | 43.05 |
| $T_4$ – RDF + 45 kg S $ha^{-1}$ | 79.00 | 12.35 | 27.48 | 45.79 | 44.09 |
| $T_5$ – RDF + 60 kg S $ha^{-1}$ | 74.00 | 11.30 | 26.63 | 44.38 | 42.16 |
| $T_6$ – RDF + 75 kg S $ha^{-1}$ | 72.50 | 11.02 | 26.28 | 43.79 | 41.11 |
| $T_7$ – RDF + 90 kg S $ha^{-1}$ | 70.25 | 10.39 | 24.38 | 40.63 | 38.77 |
| S Em± | 2.644 | 0.421 | 0.800 | 1.333 | 1.447 |
| CD at 5% | 7.856 | 1.252 | 2.376 | 3.959 | 4.300 |
| CV (%) | 7.35 | 7.91 | 6.37 | 6.37 | 7.30 |

RDF: Recommended Dosage of Fertilizer

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