Ffect of Sources and Levels of Sulphur on Growth, Yield and Bulb Quality in Onion (*Allium cepa* L.)

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Abstract

Onion is one of the commercial vegetable crops of India. Sulphur has been recognised as an important nutrient for higher yield and quality of onion bulbs. Keeping this in view, a field experiment was conducted at AINRP on Onion and Garlic, College of Horticulture, OUAT during *rabi*, 2010-11 to study the effect of sources and levels of sulphur on growth, yield and bulb quality in onion. The treatment consists of two sources of sulphur and four levels of sulphur by adopting Factorial RBD with three replications. The results on vegetative growth (plant height, number of leavesplant^{-1} and neck thickness), yield attributing parameters (bulb weight, equatorial and polar diameter), total bulb yield, Physiological Losses of Weight (PLW) and Total Soluble Solid (TSS) revealed significant variations among the levels of sulphur in onion. However, no significant variations were recorded between the sources of sulphur in onion, except bulb weight. Gypsum recorded higher plant height, neck thickness, average bulb weight, polar diameter, total bulb yield and TSS than elemental sulphur. Gypsum as a source of sulphur also reduces the production of doubles and bolter along with better shelf life of onion by reducing PLW, rotting and sprouting. Among the levels of sulphur, irrespective of sources, sulphur @ 30 kg ha^{-1} recorded significantly higher plant height (54.51 cm), number of leavesplant^{-1} (14.80), polar diameter (5.17 cm), equatorial diameter (5.17 cm), average bulb weight (60.83 g) , total bulb yield (211.23 q ha^{-1}) and TSS (11.90%) than other levels. However, *statistically parity* was observed with application of sulphur @15 and 30 kg ha^{-1} for above mentioned parameters. Application of sulphur @ 30 kg ha^{-1} in form of gypsum may be recommended in onion crop for obtaining higher bulb yield having better keeping quality.

1. Introduction

Onion (*Allium cepa* L.) is one of the commercial vegetable and spice crops of India. India produces 15.93 mt of onion from 1.110 mha area (FAOSTAT, 2011). India ranks first in area, second in production and third in export in the world. In India, onion is predominantly cultivated during *rabi* (60%) followed by 20% each in *kharif* and late *kharif* season. The higher productivity could be determined by selection of suitable varieties, balanced nutrition, optimum water management as well as need based plant protection measures. In recent times, the deficiency of sulphur is increasing in Indian soils as a result of indiscriminate use of fertilizers (Tondon, 1995). Sulphur has been recognized as an important nutrient for higher yield and quality of onion bulbs (Lakkineni and Abrol, 1994; Jaggi and Dixit, 1999). Severe sulphur deficiency during bulb development has detrimental effect on yield and quality of onion (Ajay and Singh, 1994). Sulphur containing secondary compounds is not only important for nutritive value or flavours but also for resistance against pest and diseases (Bell, 1981). Onion storage is important to provide product for fresh market, export and processing. Keeping this in view, a field experiment was conducted at AINRP on Onion and Garlic, College of Horticulture, Sambalpur, Odisha, India during *rabi*, 2010-11 to study about the effect of sources and levels of sulphur on growth, yield and bulb quality in onion.

2. Materials and Methods

A field experiment was conducted during *rabi,* 2010-11 at All India Network Research Project on Onion and Garlic (ICAR), College of Horticulture (OUAT), Chiplima, Sambalpur, Odisha, India. Soil of the experiment area was sandy loam having pH of 5.89; available NPK 151.25:15.78:178.75 kg ha^{-1} with low sulphur content (9.75 ppm).The treatment consists of two sources of sulphur (gypsum and elemental sulphur) and four levels of sulphur (0, 15, 30 and 45 kg ha^{-1}) by adopting Factorial RBD with three replications. The gypsum as source

of sulphur as per the treatments was applied at the time of transplanting while the elemental sulphur was applied after 20-25 days of transplanting. The recommended full dose of phosphorus, potassium and half dose of nitrogen were applied as basal dose while the remaining nitrogen was applied as top dressing at 30 days after transplanting. The seedlings of seven weeks old were transplanted at a spacing of 15×10 cm^2. All the recommended package of practices was adapted uniformly to all the treatments to raise a good onion crop of variety Agrifound dark red. The well cured bulbs, 5 kg^{-1} from each treatment were stored in low cost onion storage structure for storage study for a period of four months. The data recorded on various parameters were subjected to statistical analysis as per the procedure suggested by Sukhatme and Amble (1995).

3. Results and Discussion

The data on vegetative, yield and yield attributing parameters as well as storage life as influenced by different sources and levels of sulphur in onion variety Agrifound dark red are presented in Table 1 and 2.

3.1. Effect of sources of sulphur

The results on vegetative parameters as influenced by two sources of sulphur indicated non-significant variations (Table 1). However, Gypsum recorded higher plant height (40.07 cm) and neck thickness (0.61 cm) than application of elemental sulphur as source (39.07 cm and 0.59 cm, respectively). But, application of elemental sulphur produced relatively higher number of leaves $plant^{-1}$ (10.72) than gypsum, although both were statistically non-significant. No significant differences were observed due to different sources of sulphur for yield and yield attributing parameters (Table 1). The result indicated that between the sources of sulphur, no significant differences were recorded except in average bulb weight. Significantly highest average bulb weight of 43.37 g was recorded by application of gypsum than elemental sulphur (37.48 g), as source of sulphur. Gypsum also recorded higher polar diameter (3.71 cm) as well as total bulb yield (128.11 kg ha^{-1}) than elemental sulphur as source of sulphur (3.59 cm and 124.01 kg ha^{-1} , respectively), although they were statistically non significant. In onion, production of less number of doubles and bolter bulbs are essential for producing higher marketable bulb yield. In the present study, gypsum as source of sulphur indicated better efficacy towards reduction of both bulbs of doubles (0.04%) as well as bolter (1.41%) than elemental sulphur. Similar results in onion were also reported by Dudhat et al. (2011) at Junagadh Agricultural University, Junagadh (Gujarat) India and Yaduvanshi and Yadav (2007).

Keeping quality and TSS of onion bulbs not significantly influenced by different sources of sulphur. However, application of gypsum indicated higher bulb TSS (8.48%) and better keeping quality parameters such as PLW (18.25%), rotting (10.09%) and sprouting (17.35%) as against elemental sulphur (18.85%, 11.19% and 18.76%, respectively) after four months of storage of onion bulbs (Table 2).

The present study thus indicated the better efficacy of gypsum as source of sulphur for vegetative growth, yield and yield attributing parameters as well as keeping quality of onion than elemental sulphur.

3.2. Effect of levels of sulphur

The data on vegetative parameters as influenced by different levels of sulphur indicated significant variations among them. In all the case, application of sulphur @ 30 kg ha^{-1} recorded

Table 1: Effect of sources and levels of sulphur on growth and yield attributing parameters in onion variety Agrifound dark red

Treatments	Plant height (cm)	Number of leaves $plant^{-1}$	Neck thickness (cm)	Bulb weight (g)	Equatorial diameter (cm)	Polar diameter (cm)	Doubles (%)	Bolters (%)	Total bulb yield (q ha^{-1})
Sources									
S_1(Gypsum)	40.07	10.56	0.61	43.37	3.75	3.71	0.04	1.41	128.11
S_2 (Elemental sulphur)	39.07	10.72	0.59	37.48	3.77	3.59	0.18	1.44	124.01
CD (p=0.05) S	NS	NS	NS	4.97	NS	NS	NS	NS	NS
Levels (kg ha^{-1})									
L_1 (0)	48.36	13.37	0.67	48.02	4.64	4.65	0.08	1.39	118.36
L_2 (15)	54.44	14.33	0.87	52.95	5.16	4.82	0.16	2.81	172.19
L_3 (30)	54.51	14.80	0.84	60.83	5.17	5.17	0.06	1.23	211.23
L_4 (45)	53.75	14.25	0.83	53.80	5.11	4.86	0.30	2.16	170.52
CD (p=0.05) L	3.95	0.93	0.10	7.03	0.41	0.36	NS	NS	26.04
S×L	52.76	14.19	0.80	53.90	5.02	4.87	0.15	1.90	168.08
CD (p=0.05) S×L	NS	NS	NS	NS	NS	NS	NS	NS	36.82

Table 2: Effect of sources and levels of sulphur on TSS and shelf life of onion variety Agrifound dark red

Treatments	TSS (%)	PLW (%)	Rotting (%)	Sprouting (%)
Sources				
S_1 (Gypsum)	8.48	18.25	10.09	17.35
S_2 (Elemental sulphur)	8.29	18.85	11.19	18.76
CD (p=0.05) S	NS	NS	NS	NS
Levels (kg ha^{-1})				
L_1 (0)	10.32	31.25	20.00	28.87
L_2 (15)	10.98	26.78	12.78	24.07
L_3 (30)	11.90	16.81	9.46	20.03
L_4 (45)	11.53	24.08	14.51	23.31
CD (p=0.05) L	1.13	NS	NS	NS
S×L	11.18	37.10	14.19	24.07
CD (p=0.05) S×L	NS	NS	NS	NS

PLW: Physiological weight loss; TSS: Total soluble solids

significantly higher plant height (54.51 cm) and number of leaves plant^{-1} (14.80) than control. However, statistical parity was recorded with application of sulphur @ 15 or 45 kg ha^{-1} (Table 1).

The results on yield and yield attributing parameters revealed significant variations among the levels of sulphur in onion variety Agrifound dark red (Table 1), except for doubles and bolters. Among the levels of sulphur, irrespective of sources, sulphur @ 30 kg ha^{-1} recorded significantly heaviest bulb (60.83 g) and total bulb yield (211.23 q ha^{-1}) than other levels. However, statistically parity was observed with application of sulphur @ 15 and 45 kg ha^{-1}. Relatively lower doubles and bolters were recorded by application of sulphur @ 30 kg ha^{-1} than other levels, although all were statistically non-significant. Hence, by considering yield and other parameters application of sulphur @ 30 kg ha^{-1} showed better results in onion. These results confirm the earlier results of Kumar and Singh (1995) and Channagouda et al. (2009) in onion.

Significantly highest TSS of 11.90% was recorded with application of sulphur @ 30 kg ha^{-1} than the control (10.32%). However, statistical parity was observed among the levels of sulphur @ 15 or 45 kg ha^{-1} (Table 2). Similar result was also reported by Channagouda et al. (2009).

Although no significant variations were observed among the treatments with respect to shelf life such as PLW (%), rotting (%) and sprouting (%) after four months of storage, irrespective of sources of sulphur; but relatively less PLW, rotting and sprouting was recorded with all the treatments having sulphur as sources than control, least being with 30 kg S ha^{-1} (16.81%, 9.46% and 20.03%, respectively). As a whole, application of sulphur @ 30 kg ha^{-1} indicated better efficacy than other levels for keeping quality and TSS.

All the interaction effects on plant height, average bulb weight, TSS and PLW were found non-significant, except total bulb yield which was significant.

4. Conclusion

The results can be summarized that application of sulphur in the form of gypsum @ 30 kg ha^{-1} was found to be applied for production of better growth, yield, and quality of onion bulbs during *rabi* season under Odisha condition.

5. Further Research

There is urgent need for further study on efficacy of sulphur to both biotic and abiotic stresses as well as biochemical study in the onion crop.

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