IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 17, Issue 3 Ser. 1 (March 2024), PP 63-65
www.iosrjournals.org

Response of onion (*Allium cepa* L.) to sources and levels of Sulphur

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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. The present investigation to study the effect of sources and levels of sulphur on growth, yield and bulb quality in onion cultivar Bhima Raj was conducted during the year 2023-24 at Jaunpur, Uttar Pradesh, India. The experiment was laid out in randomized block design with three replications and eight treatments viz. T_1 – Control, T_2 - RDF (120:60:60), T_3 - 15 kg ha^{-1} Sulphur through Bentonite + RDF, T_4 - 30 kg ha^{-1} Sulphur through Bentonite + RDF, T_5 - 45 kg ha^{-1} Sulphur through Bentonite + RDF, T_6 - 15 kg ha^{-1} Sulphur through Cosavet + RDF, T_7 - 30 kg ha^{-1} Sulphur through Cosavet + RDF and T_8 - 45 kg ha^{-1} Sulphur through Cosavet + RDF. The results on vegetative growth, yield attributing parameters, total yield and quality revealed significant variations among the levels of sulphur in onion.
Keywords: *onion, levels of sulphur, sources of sulphur,bentonite and cosavet*

I. Introduction

Onion (*Allium cepa* L.) belongs to family Alliaceae is known as the "Queen of the kitchen". It is considered as rich source of carbohydrates, protein, vitamin C, besides minerals like phosphorus and calcium. Onion is known for its flavor, pungency and also eco-friendly stored grain protectant. Among fresh vegetables, onion is a pride item of agricultural export earning valuable foreign exchange to the country and accounts for 70 per cent of the total foreign exchange earning of fresh vegetables (Sirohi and Behera, 2011). India ranks first in area production of onion. In India, the estimated production during 2022-23 is around 318LMT, surpassing last year production of 316.98LMT. Onion is spwn in all the states, however, Maharashtra is the leading producer with share of around 43% and Uttar Pradesh ranked eleventh in area and production of onion. Its area in Uttar Pradesh was 29.00 thousand hectare, production 508.90 thousands tones (Anonymous, 2024). Onion is sulphur loving crops as sulphur play an important role in realizing its yield & quality potential. More specifically, sulphur has been found not only to increase the bulb yield but also its quality in terms of pungency, nutritive value and flavor. Sulphur is a constituent of secondary compound *viz.*, allin, cycloalein and thiopropanol which not only influence the taste, pungency and medicinal properties of onion besides including resistance against pests and diseases. It is also required for the synthesis of three important amino acids such as cystine (27% S), cystein (26 % S) and methionine (21% S) besides increasing only propyl disulphide alkaloid (43 % S), the principle alkaloids responsible for pungency in onion, respectively (Tondon, 1991; Randle and Bussard, 1993; Kumar *et al*. 2011).

II. Material and Methods

The field experiment was conducted at Agronomic Experimental Farm of Sri Ganesh Rai PG College, Dobhi, Jaunpur during 2023-24 located in sub-humid subtropical climatic zone of Indo-Gangetic alluvium of Eastern Uttar Pradesh. The experiment was laid out into randomized block design with three replications and treatment are T_1 – Control, T_2 - RDF (120:60:60), T_3 - 15 kg ha^{-1} Sulphur through Bentonite + RDF, T_4 - 30 kg ha^{-1} Sulphur through Bentonite + RDF, T_5 - 45 kg ha^{-1} Sulphur through Bentonite + RDF, T_6 - 15 kg ha^{-1} Sulphur through Cosavet + RDF, T_7 - 30 kg ha^{-1} Sulphur through Cosavet + RDF and T_8 - 45 kg ha^{-1} Sulphur through Cosavet + RDF. The crop was provided with spacing of 10 cm × 10 cm and plot size of 2 × 2 m. Standard culture practices followed uniformly in all experimental plots. The data regarding growth yield and quality were analysed with statistical analysis and significance of treatments were tested with the help of 'F' test (Panse and Sukhatme, 1985).

III. Results and Discussion

Growth parameters

Effect of Sulphur on growth parameters of onion is presented in Table 1. The growth characters such as plant height and number of leaves at 30 and 90 DAT was not much influenced by sulphur application. The plant height was recorded highest (36.12 cm and 52.22 cm at 30 & 90 DAT respectively) in the treatment of sulphur @ 45 kg ha^{-1} through Bentonite (T_5) followed by sulphur @ 45 kg ha^{-1} (35.42 &51.97 cm) through Cosavet (T_8). There was increase in growth parameters due to sulphur was also reported by Quareshi and Lawande (2004) and Lalrintluanga *et.al,* (2022). The number of leaves per plant in onion was recorded highest 6.52 &8.77 at 30 and 90 days after transplanting respectively in treatment application of sulphur @ 45 kg ha^{-1} through Bentonite (T_5) being at par with sulphur @ 45 kg ha^{-1} through Cosavet (T_8) and significantly superior over rest of the treatment. The similar findings were also reported by Verma *et al.* (2020).

Table 1. Growth parameters in onion bulb as influenced by various treatments at harvest

Treatments	Plant height (cm)		No of leaves plant^{-1}	
	30 DAT	90 DAT	30 DAT	90 DAT
T_1- Control	27.32	48.28	5.14	7.31
T_2- RDF (120:60:60)	32.19	49.36	5.24	8.17
T_3-15kg ha^{-1} Sulphur through Bentonite + RDF	33.39	49.95	5.46	8.39
T_4- 30 kg ha^{-1} Sulphur through Bentonite+ RDF	34.42	50.76	5.61	8.56
T_5- 45 kg ha^{-1} Sulphur through Bentonite+ RDF	36.12	52.22	6.52	8.77
T_6- 15 kg ha^{-1} Sulphur through Cosavet + RDF	32.46	49.68	5.36	8.34
T_7- 30 kg ha^{-1} Sulphur through Cosavet+ RDF	33.67	50.75	5.44	8.53
T_8- 45 kg ha^{-1} Sulphur through Cosavet+ RDF	35.47	51.97	6.22	8.58
SEm ±	**0.63**	**0.16**	**0.12**	**0.12**
CD at 5 %	**NS**	**NS**	**0.25**	**0.36**

Yield attributing parameters and yield

The results on yield and yield attributing parameters revealed significant variations among the sulphur in onion (Table 2). The result indicated that the highest polar diameter 65.63 mm and equatorial diameter 66.75 mm were recorded in the treatment of sulphur @ 45 kg ha^{-1} through Bentonite being at par with sulphur @ 45 kg ha^{-1} through Cosavet and significantly superior over rest of the sources and levels. The lowest polar diameter 52.71 mm and equatorial diameter 52.06 mm were recorded in treatment (T_1). Increased bulb diameter due to sulphur has been reported by Channagouda *et al.,* (2009). The highest fresh weight of bulb 179.86 g was recorded in the treatment of sulphur @ 45 kg ha^{-1} through Bentonite being at par with sulphur @ 45 kg ha^{-1} through Cosavet and significantly superior over rest of the sources and levels. Lowest fresh weight (140.24 g) was recorded in treatment T_1. This indicates that the need of sulphur for increasing the weight of bulb even though there was balanced nutrition of NPK to all treatments. The similar results were also reported by Shamin *et al.* (2003) and Qureshi and Lawande (2004). The significant highest bulb yield (256.22 q ha^{-1}) of onion was recorded in the treatment of sulphur @ 45 kg ha^{-1} through Bentonite being at par with sulphur @ 45 kg ha^{-1} through Cosavet and significantly superior over rest of the treatment. The Lowest bulb yield (207.46 q/ha^{-1}) of onion was recorded in control (T_1). Among the various sources of sulphur application of sulphur i.e. 45 kg ha^{-1} Bentonite was found better in enhancing bulb yield of onion. Hariyappa (2003) reported a significant increase in yield and yield attributes at higher levels of sulphur application. Ipsita Kar *et al.,* (2022) also made similar results.

Table 2. Yield parameters and yield in onion bulb as influenced by various treatments at harvest

Treatments	Bulb diameter (mm)		Fresh wt of bulb/ Plant (g)	Bulbs yield (q/ha)
	Polar	Equatorial		
T_1- Control	52.71	52.06	140.24	207.46
T_2- RDF (120:60:60)	58.78	57.19	150.96	215.46
T_3-15kg ha^{-1} Sulphur through Bentonite + RDF	60.14	59.51	158.42	237.94
T_4- 30 kg ha^{-1} Sulphur through Bentonite+ RDF	61.46	60.63	166.32	243.94
T_5- 45 kg ha^{-1} Sulphur through Bentonite+ RDF	65.63	66.75	179.86	256.22
T_6- 15 kg ha^{-1} Sulphur through Cosavet + RDF	55.45	54.47	156.45	232.82
T_7- 30 kg ha^{-1} Sulphur through Cosavet+ RDF	56.34	55.37	162.67	240.75
T_8- 45 kg ha^{-1} Sulphur through Cosavet+ RDF	64.23	64.66	177.67	255.32
SEm ±	**0.84**	**0.72**	**1.52**	**0.94**
CD at 5 %	**1.74**	**1.48**	**3.14**	**2.77**

Quality parameters

The sulphur content, TSS% in bulbs and storage losses is presented in Table 3. The sulphur content in bulbs (0.48%) recorded higher in treatment of soil application of sulphur @ 45 kg ha^{-1} through Bentonite and

sulphur @ 45 kg ha^{-1} through Cosavet then other treatments. The lowest sulphur content was observed in bulb (0.32%) was recorded in control. Dabhi *et al*. (2004) and Singh *et al*. (2020) reported that sulphur application increased the content of sulphur in onion which might have influenced the synthesis and translocation of stored material by onion. The TSS% has not much influenced by sources and levels of sulphur in onion. It was ranged from 10.46 to 12.00% for various treatments. Similar finding was also made by Singh *et al*. (2020). The total storage losses has been reduced (16.63%) in sulphur applied treatments as compare to control (19.83%) after six months of storage. The L1 level for both sources has not received any sulphur application and it recorded the maximum storage losses after six months. The remaining levels have received sulphur and recorded minimum losses as compared to control. This indicates that the sulphur has role in reducing storage losses in onion bulbs. Beneficial effect of sulphur on storage quality of onion bulbs has been reported by Quareshi and Lawande (2006).

Table 3. Quality Parameters in onion bulb as influenced by various treatments at harvest

Treatments	S Content %	TSS	% Physiological loss in weight	
			60 Days	120 Days
T_1- Control	0.32	10.46	16.56	39.32
T_2- RDF (120:60:60)	0.35	10.56	16.12	37.47
T_3-15kg ha^{-1} Sulphur through Bentonite + RDF	0.39	10.90	15.92	36.75
T_4- 30 kg ha^{-1} Sulphur through Bentonite+ RDF	0.45	11.85	14.93	35.20
T_5- 45 kg ha^{-1} Sulphur through Bentonite+ RDF	0.48	12.00	13.83	34.83
T_6- 15 kg ha^{-1} Sulphur through Cosavet + RDF	0.38	10.86	16.02	37.00
T_7- 30 kg ha^{-1} Sulphur through Cosavet+ RDF	0.45	11.84	15.42	35.60
T_8- 45 kg ha^{-1} Sulphur through Cosavet+ RDF	0.48	11.92	13.32	35.18
SEm ±	**0.06**	**0.24**	**0.01**	**0.13**
CD at 5 %	**NS**	**NS**	**0.03**	**0.39**

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