

Original Research Article

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## Response of Different Sources and Levels of Sulphur on Quality and Grading of Onion (*Allium cepa* L.)

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### ABSTRACT

Onion is one of the important and commercial vegetable crops of India. Onion is sulphur loving crop and its requirement is high for improved yield and quality. Sulphur has been recognized as an important nutrient for higher yield, quality and nutrient uptake of onion bulbs. Keeping these in view, a field experiment was conducted at ICAR- National Institute on Abiotic Stress Management (ICAR – NIASM), Baramati, during Rabi, 2017-18 to study the effect of sources and levels of sulphur on bulb quality and grading in onion (cv. Bhima Kiran). The treatments consisted of three sources of sulphur (Elemental sulphur- Bentonite clay, Potassium schoenite and ammonium sulphate) and four levels of sulphur viz., 0, 30, 45 and 60 kg S ha<sup>-1</sup> by adopting RBD with three replications. The results on phenol, flavonoid, ascorbic acid, pyruvic acid, total soluble solids (TSS %) and grading of onion bulb viz., of A, B, C % revealed significance variations among the levels of sulphur in onion. Maximum phenol content was registered @ 45 kg S ha<sup>-1</sup> as elemental sulphur + *thiobacillus* by soil application. There was equal behaviour of three rates of application of sulphur viz., 30, 45 and 60 kg S ha<sup>-1</sup> through three sources in relation to flavonoid content. Sulphur fertilization significantly increased the ascorbic acid content of onion when applied through potassium schoenite, elemental sulphur and ammonium sulphate. Maximum ascorbic acid content of 4.69 mg g<sup>-1</sup> was noted @ 60 kg S ha<sup>-1</sup> through potassium schoenite by soil application. The production of pyruvic acid content in onion was enhanced significantly owing to sulphur fertilization. Maximum total soluble solids to the tune of 12.93% were noticed @ 45 kg S ha<sup>-1</sup> as elemental sulphur + *thiobacillus* by soil application (45 and 60 kg S ha<sup>-1</sup>). The grading of onion is judged by grading of the bulbs significantly higher percentage of 'A' grade onion bulbs were obtained by 45 kg S ha<sup>-1</sup> through potassium schoenite through nutripellet pack noted (95.2%).

#### Keywords

Onion, Nutripellet pack, Yield

#### Article Info

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### Introduction

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops and is widely grown in almost all over the world. In India, onion crop is under cultivation for the last 5000 years mainly in tropical condition. India ranks first in area and second in production after China, but the productivity are much lower as compared to the leading producers namely China, USA and The Netherlands etc. India is second largest

producer of onion next to China in the world, cultivating onion over an area of 1320 thousand hectare with total production of 20931 thousand metric tonnes accounting for 26.8 percent of world area and 19.9 percent of onion production., with an average yield of 14.2 tha<sup>-1</sup> (Anonymous, 2017). The yield is very low as compared to the world average yield of 19.1t ha<sup>-1</sup>. Intensive cropping, imbalanced fertilization and minimal usages of micronutrients and limited application of organic manures have resulted in the depletion

of soil fertility in India. Maharashtra is leading state in onion production in India. Total area was 441.9 thousand ha, production was 5362 thousand MT and productivity was 12.13t ha<sup>-1</sup>. Onion has its own distinctive flavour and is widely grown in almost all over the world. It is used in soups, different dishes, sandwiches and is also cooked alone as a vegetable. Onion is a temperate crop but can be grown under a wide range of climatic conditions such as temperate, tropical and subtropical climate. The best performance can be obtained in a mild weather without the extremes of cold and heat and excessive rainfall. In India, short day onion is grown in the plains and requires 10-12 hours day length. Its pungency is due to the presence of *allyl propyl disulphide*, a volatile oil (Malik, 1994). Onion can be grown in all types of soils such as sandy loam, clay loam, silt loam and heavy soils. At present, pungency in onion is decreased and similarly taste and quality of bulb is also hampered due to the application of imbalanced chemical fertilizers. The pungency in onion is due to the presence of sulphur bearing compound in the volatile oil known as allyl-propyl disulphide (C<sub>6</sub>H<sub>12</sub>S<sub>2</sub>). The colour of the outer skin of onion bulb is due to the presence of quercetin. Catechol is a phenolic factor present in onion which has anti-fungal properties. Onion is known to possess several medicinal and therapeutic properties, its effectiveness range against common cold to diabetes, heart diseases, osteoporosis and diseases, Sulphur is associated with the production of crop of superior nutritional and market quality. Sulphur is also required for the synthesis of three important essential amino acids such as cystine (27% S), cysteine (26% S) and methionine (21% S) besides increasing allyl propyl disulphide alkaloid (43% S) and the capsaicin, the principle alkaloids responsible for pungency in onion (Randle and Bassard, 1993). Onion is an important sulphur -loving crop. Sulphur improves the yield and quality of onion. Sulphur is recognized as the fourth

major plant nutrient after nitrogen, phosphorus and potassium in crops. Hence the present study was carried out to evaluate the effect of different sources and levels of sulphur on quality and grading of onion.

## Materials and Methods

A field experiment was conducted at National Institute on Abiotic Stress Management (ICAR-NIASM), Malegaon Kurd, Baramati, Pune, Maharashtra during *rabi* season 2017-18 and 2018-19 with onion cv. Bhima Kiran. The soil of the experimental field was clay loam in texture, pH (1:2.5) 8.2, electrical conductivity 0.26 dSm<sup>-1</sup>, organic carbon 4.40 g kg<sup>-1</sup>, available N 93.99 kg ha<sup>-1</sup>, P 10.75 kg ha<sup>-1</sup>, K 277 kg ha<sup>-1</sup> and S 6.30 ppm. The irrigation water contained 1.6 ppm of sulphur. A field experiment was conducted in randomized block design. Four levels of sulphur (0, 30, 45 and 60 S kg ha<sup>-1</sup>) were applied through elemental sulphur (80 % S as Bentonite clay), potassium schoenite (22% S) and ammonium sulphate (24% S) The experiment comprised 14 treatments: T<sub>1</sub>- Absolute Control; T<sub>2</sub>- RDF + S @ 30 kg ha<sup>-1</sup> soil application; T<sub>3</sub>- RDF+S@ 45kg ha<sup>-1</sup> as elemental S+ *Thiobacillus* -Soil application; T<sub>4</sub>. RDF + S@ 60 kg ha<sup>-1</sup> as elemental S+ *Thiobacillus* - Soil application; T<sub>5</sub>. RDF+S@ 45 kg ha<sup>-1</sup> as elemental S +*Thiobacillus* by Nutripellet Pack; T<sub>6</sub> -RDF+S@60 kgha<sup>-1</sup> as elemental S+ *Thiobacillus* by Nutripellet Pack; T<sub>7</sub> -RDF +S@ 45 kg ha<sup>-1</sup> as Potassium Schoenite by Soil application; T<sub>8</sub> - RDF +S@ 60 kg ha<sup>-1</sup> as Potassium Schoenite-Soil application; T<sub>9</sub> - RDF +S@ 45 kg ha<sup>-1</sup> as Potassium Schoenite - Nutripellet Pack; T<sub>10</sub> - RDF +S@ 60 kg ha<sup>-1</sup> as Potassium Schoenite - Nutripellet Pack ; T<sub>11</sub>- RDF +S@ 45 kg ha<sup>-1</sup> as Ammonium Sulphate -Soil application ; T<sub>12</sub> - RDF +S@60 kg ha<sup>-1</sup> as Ammonium Sulphate -Soil application; T<sub>13</sub> - RDF +S@ 45 kg ha<sup>-1</sup> as Ammonium Sulphate - Nutripellet Pack; T<sub>14</sub> - RDF +S@60 kg ha<sup>-1</sup> as Ammonium Sulphate - Nutripellet Pack.

The experiment was laid out in randomized block design with three replications. Individual plot size was 3 x 4 m and plant spacing was 15 x 10 cm. Recommended dose of N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O (110:40:60 kg ha<sup>-1</sup>) was applied to all the plots except control. The sources of nitrogen, phosphorus and potassium were Urea, Di ammonium phosphate and Murate of potash respectively. 50 percent nitrogen and full dose of phosphorus, potassium and sulphur were applied at the time of transplanting. Remaining 50 per cent nitrogen was applied in two equal splits at 30 and 45 days after transplanting. Onion cultivar Bhima Kiran was selected for the study. Transplanting of onion was done on 20<sup>th</sup> January, 2018. Standard package of practices were followed to grow onion crop. The crop was harvested at 120 days after transplanting on 20<sup>th</sup> May, 2018. Bulbs were covered by its top and left in the field for curing for 3-4 days. After neck cutting, bulb yield was recorded.

Representative bulb samples were collected for the biochemical and nutritional analysis. Chopped bulb samples were dried in oven at 60<sup>o</sup> C till the constant weight was attained. While the plant samples were digested using nitric acid and perchloric acid mixture, the plant digests and soil extractant were used for estimating the sulphur content using Turbidimetric method (Chesnin and Yien, 1950). The total soluble solid (TSS) of onion bulbs were estimated using hand refractometer and the percent TSS was noted down. Pyruvic acid content was estimated using dinitro phenyl hydrazine (DNPH) reagent method. Two opposite quarters of onion bulbs were selected and made into pieces after removing the neck, basal plate and skin. The onion tissues were crushed in a stainless steel mixer grinder without adding water. Bulb tissues were blended with equal volumes of water for 10 minutes. The homogenate was filtered through Whatman No. 4 filter paper and the filtrate was used for pyruvic acid analysis

(Schwimmer and Weston, 1961). The quality parameters viz., phenol, flavonoids, ascorbic acid, pyruvic acid and total soluble solids were recorded at the time of harvest. After harvesting, bulbs were graded on the basis of size. The onion having equatorial diameter less than 35.00 mm recorded as “unmarketable grade”. 35.00 to 45.00 mm as “C grade”, 45.00 to 55.00 mm as “B grade” and 55.00 to 65.00 mm as “A grade”. The data recorded on various parameters were subjected to statistical analysis as per the procedure suggested by Sukhatme and Amble (1995)

## Results and Discussion

The data on quality parameters such as phenols, flavonoids, ascorbic acid, pyruvic acid, total soluble solids and grading of onion bulbs as influenced by different sources and levels of sulphur in onion variety Bhima Kiran are presented in table 1.

### Phenols

The phenol content of onion was increased significantly due to sulphur application through different sources over control treatment. Phenol content was maximum due to application of 45 kg S ha<sup>-1</sup> through elemental sulphur + *thiobacillus* (4.95 mg g<sup>-1</sup>) which was significantly superior over all other treatments receiving sulphur through different sources at different rate of application.

### Flavonoids

A application of sulphur at different rates and through different sources increased the flavonoid content of onion. Maximum flavonoid content of 327 μ mole g<sup>-1</sup> was obtained at 60 kg S ha<sup>-1</sup> through elemental sulphur and *thiobacillus*, which was statistically at par with 45 kg S ha<sup>-1</sup> for both elemental sulphur + *Thiobacillus* and potassium schoenite.

**Table.1** Response of different sources and levels of sulphur on quality and grading of bellary onion

Treatments	Phenols mg/g	Flavonoide μ mole/g	Ascorbic acid mg/g	Pyruvic acid μ mole/g	TSS %	A grade bulb (%)	B grade bulb (%)	C grade bulb (%)
<b>T<sub>1</sub> Absolute Control</b>	1.34	161	2.44	0.64	9.70	70.57	4.62	0.93
<b>T<sub>2</sub> RDF + S @ 30 kg ha<sup>-1</sup> soil application</b>	2.73	203	3.39	1.31	11.76	83.89	3.35	0.35
<b>T<sub>3</sub> RDF+ S @ 45 kg ha<sup>-1</sup> as elemental S+ Thiobacillus -Soil application</b>	4.95	296	4.48	1.74	12.93	83.61	2.64	0.17
<b>T<sub>4</sub> RDF + S @ 60 kg ha<sup>-1</sup> as elemental S+ Thiobacillus - Soil application</b>	3.36	327	4.02	2.64	11.93	84.22	3.48	0.23
<b>T<sub>5</sub> RDF +S @ 45 kg ha<sup>-1</sup> as elemental S + Thiobacillus –Nutripellet Pack</b>	3.56	195	4.30	1.42	12.06	90.24	1.72	0.80
<b>T<sub>6</sub> RDF +S @ 60 kg ha<sup>-1</sup> as elemental S + Thiobacillus –Nutripellet Pack</b>	3.6	204	3.88	1.31	11.96	84.45	2.34	0.52
<b>T<sub>7</sub> RDF +S @ 45 kg ha<sup>-1</sup> as Potassium Schoenite-Soil application</b>	2.45	230	4.15	1.48	11.46	84.79	1.49	0.13
<b>T<sub>8</sub> RDF +S @ 60 kg ha<sup>-1</sup> as Potassium Schoenite-Soil application</b>	2.76	219	4.69	1.58	12.3	84.19	2.92	0.78
<b>T<sub>9</sub> RDF +S @ 45 kg ha<sup>-1</sup> as Potassium Schoenite - Nutripellet Pack</b>	3.41	265	4.20	1.25	11.46	95.20	0.36	0.80
<b>T<sub>10</sub> RDF +S @ 60 kg ha<sup>-1</sup> as Potassium Schoenite - Nutripellet Pack</b>	2.90	217	3.64	1.79	11.73	84.87	3.02	0.14
<b>T<sub>11</sub> RDF +S @ 45 kg ha<sup>-1</sup> as Ammonium Sulphate - Soil application</b>	2.53	195	3.22	1.46	12.26	85.00	2.30	0.20
<b>T<sub>12</sub> RDF +S @ 60 kg ha<sup>-1</sup> as Ammonium Sulphate - Soil application</b>	2.25	204	3.95	1.4	11.13	83.37	2.05	0.51
<b>T<sub>13</sub> RDF +S @ 45 kg ha<sup>-1</sup> as Ammonium Sulphate - Nutripellet Pack</b>	2.53	203	3.84	1.24	10.7	82.37	2.86	0.60
<b>T<sub>14</sub> RDF +S @ 60 kg ha<sup>-1</sup> as Ammonium Sulphate - Nutripellet Pack</b>	2.26	241	4.17	1.02	10.83	84.64	2.84	0.26
<b>SED</b>	0.084	19.24	0.08	0.11	0.05	1.92	1.77	0.91
<b>CD (p = 0.05)</b>	0.199	46.28	0.19	0.28	0.13	3.95	2.52	1.01

RDF: STCR based of NPK fertilizers

There was equal behavior of three rates of application of sulphur *viz.* 30, 45 and 60 kg S ha<sup>-1</sup> through three sources in relation to flavonoid content.

### Ascorbic acid

Sulphur fertilization significantly increased the ascorbic acid content of onion when applied through three sources of sulphur. Maximum ascorbic acid content of 4.69 mg g<sup>-1</sup> was noted @ 60 kg S ha<sup>-1</sup> through potassium schoenite by soil application, which was significantly higher over 0, 30, 45 kg S ha<sup>-1</sup> and other sources of sulphur. Navaldey and Ram (2014) reported that higher ascorbic acid (11.86 mg 100 g<sup>-1</sup>) in bulb was recorded at 40 kg S ha<sup>-1</sup>. There was equal response to onion crop to elemental sulphur and potassium schoenite applied @ 45 and 60 kg S ha<sup>-1</sup> by either soil application or nutripellet pack. A significant increase in ascorbic acid content of bulbs with 40 and 60 kg S ha<sup>-1</sup> application was reported by Bharti *et al.*, (2016).

### Pyruvic acid

The data pertaining to pyruvic acid content of onion bulb indicating degree of pungency in onion are presented in table, which revealed that the production of pyruvic acid content in onion was enhanced significantly owing to sulphur fertilization. Application of RDF (NPK) + 30 kg S ha<sup>-1</sup> significantly increased the pyruvic acid content (0.67 μ moles g<sup>-1</sup>) which was statistically at par with 45 and 60 kg S ha<sup>-1</sup> through elemental sulphur, potassium schoenite and ammonium sulphate by soil application. The previous studies indicated that the pungency level significantly increased with increasing the sulphur level in low sulphur soils (Qureshi and Lawande, 2006). Low pyruvic acid content of 3.20 μ moles g<sup>-1</sup> fresh weight was registered in control treatment. Pyruvic acid content was increased with increasing sulphur level up to 50 kg S ha<sup>-1</sup> (Thangasamy *et al.* 2013). Zeinani *et al.*, (2010) reported that the sulphur had positive effect on the pyruvic acid of the onion bulbs. Increasing the level of

sulphur up to 150 kg ha<sup>-1</sup> resulted in increase of pyruvic acid of the bulbs. The present study showed that rate of increase in pyruvic acid content declined with increasing sulphur level.

### Total Soluble Solids

In the present study, the total soluble solid content of onion bulb was not significantly influenced by sulphur application. Maximum total soluble solid content to the tune of 12.93 percent was noticed @ 45 kg S ha<sup>-1</sup> as elemental sulphur + *Thiobacillus* by soil application, which were slightly higher than 45 and 60 kg S ha<sup>-1</sup> and other sources of sulphur. Channagoudra *et al.*, (2009) revealed that significantly higher pyruvic acid (3.10 μ mole g<sup>-1</sup> and TSS (12.26 per cent), content in onion bulbs were observed in 60 kg S ha<sup>-1</sup> over 20 kg S ha<sup>-1</sup> and no sulphur application but was at par with 40 kg S ha<sup>-1</sup>. Application of elemental sulphur @ 45 and 60 kg S ha<sup>-1</sup> with *Thiobacillus* significantly increased the TSS content of onion over 30 kg S ha<sup>-1</sup> through same sources. Sulphur application @ 30 kg S ha<sup>-1</sup> though elemental sulphur is sufficient to meet the sulphur requirement of onion crop as compared to 45 and 60 kg S ha<sup>-1</sup>. Tripathy *et al.*, (2013) found that keeping quality and TSS of onion bulbs were not significantly influenced by different sources of sulphur. Significantly highest TSS of 11.90 percent was recorded with the application of 30 kg S ha<sup>-1</sup> than control (10.32%).

### Grading of bulbs

The quality of the onion can be judged by grading of the bulbs. Significantly higher percentage of 'A' grade onion bulbs were produced only in application of 45 kg S ha<sup>-1</sup> through potassium schoenite by nutripellet pack (95.2%) and 45 kg S ha<sup>-1</sup> through elemental sulphur with *thiobacillus* through nutripellet pack (90.2%). Thus potassium schoenite is the best source to increase the number of 'A' grade bulb. The study showed equal behaviour of different sources of sulphur fertilizer applied at 45 and 60 kg S ha<sup>-1</sup> with soil application or nutripellet pack method in respect of production



of 'A' grade bulb is concerned. The lowest percentages of 'A' grade bulb to the extent of 70.57 percent are recorded in control, showing the importance of sulphur. Maximum number of 'B' grade onion was obtained at 45 kg S ha<sup>-1</sup> as potassium schoenite by nutri-pellet pack method. The differences in percentage of 'C' grade onion produced in various levels and sources were nonsignificant. Although maximum production of 'C' grade onions to the tune of 0.93 percent was recorded in control.

Application of 45 kg S ha<sup>-1</sup> is found to be advantageous for achieving good quality and 'A' grade onion bulb in both the forms of sulphur such as elemental sulphur and potassium schoenite. Application of potassium schoenite is recommended in onion crop for better quality. The phenol content of onion is increased significantly due to sulphur application. Onion crop give equal response to elemental sulphur and potassium schoenite applied at 45 and 60 kg sulphur ha<sup>-1</sup> in respect of ascorbic acid is concern. Sulphur applied @ 30 kg sulphur ha<sup>-1</sup> through elemental sulphur is sufficient as compared to 45 and 60 kg sulphur ha<sup>-1</sup>.

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