



# International Journal of Research in Agronomy

E-ISSN: 2618-0618  
P-ISSN: 2618-060X  
© Agronomy  
NAAS Rating (2026): 5.20  
[www.agronomyjournals.com](http://www.agronomyjournals.com)  
2026; 9(8): 1011-1017  
Received: 24-05-2026  
Accepted: 28-06-2026

**Madhuri Devi Bhagat**  
Ph.D. Research Scholar,  
Department of Agronomy, IGKV,  
Raipur, Chhattisgarh, India

**Ambika Tandon**  
Professor, Department of  
Agronomy, IGKV, Raipur,  
Chhattisgarh, India

**Rajeshwari Dhurve**  
Ph.D. Research Scholar,  
Department of Agronomy, IGKV,  
Raipur, Chhattisgarh, India

**Ganga Dhar**  
Assistant Professor, SG CoA&RS,  
Jagdalpur, Chhattisgarh, India

**Urmila Bhagat**  
Ph.D., R.P. CoA&RS, Kanker,  
Chhattisgarh, India

**Corresponding Author:**  
**Madhuri Devi Bhagat**  
Ph.D. Research Scholar,  
Department of Agronomy, IGKV,  
Raipur, Chhattisgarh, India

## Effect of different sources and levels of sulphur on growth, yield attributes and yield of rice (*Oryza sativa* L.)

**Madhuri Devi Bhagat, Ambika Tandon, Rajeshwari Dhurve, Ganga Dhar and Urmila Bhagat**

**DOI:** <https://www.doi.org/10.33545/2618060X.2026.v9.i8m.6373>

### Abstract

A field experiment was conducted during the *kharif* seasons of 2021 and 2022 at the Instructional-cum-Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, to study the “Effect of different sources and levels of sulphur on growth, yield attributes and yield of rice (*Oryza sativa* L.)”. The experiment was laid out in a randomized block design with nine treatments and three replications. The treatments comprised sulphur application through elemental sulphur and ammonium sulphate at 20, 30 and 40 kg S ha<sup>-1</sup>, along with DAP and SSP-based fertilizer treatments and an absolute control. The rice variety MTU 10-10 was transplanted at a spacing of 20 cm × 10 cm under a recommended fertilizer dose of 100:60:40 kg N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O ha<sup>-1</sup>. Sulphur management markedly influenced crop growth and yield performance. The treatment receiving 40 kg S ha<sup>-1</sup> through ammonium sulphate (T<sub>8</sub>) recorded the highest values for major growth and yield attributes, including plant height, number of tillers, dry matter accumulation, number of leaves, leaf area, effective tillers, panicle length, filled grains panicle<sup>-1</sup> and test weight. The highest mean grain yield (52.49 q ha<sup>-1</sup>), straw yield (61.40 q ha<sup>-1</sup>) and harvest index (50.29%) were also recorded under T<sub>8</sub>, whereas the absolute control (T<sub>9</sub>) recorded the lowest grain yield (38.17 q ha<sup>-1</sup>), straw yield (49.42 q ha<sup>-1</sup>) and harvest index (39.04%). The grain yield under T<sub>8</sub> was 37.5% higher than the absolute control. The treatment receiving 30 kg S ha<sup>-1</sup> through ammonium sulphate (T<sub>7</sub>) generally ranked next to T<sub>8</sub>, while 40 kg S ha<sup>-1</sup> through elemental sulphur (T<sub>5</sub>) was another comparatively superior treatment. The results indicated that sulphur management, particularly through ammonium sulphate at 40 kg S ha<sup>-1</sup> under the present fertilizer regime, improved growth, yield attributes and productivity of rice under the experimental conditions.

**Keywords:** Ammonium sulphate, elemental sulphur, rice, sulphur management, growth, yield attributes, grain yield

### 1. Introduction

Rice (*Oryza sativa* L.) is one of the most important cereal crops and serves as a major source of food and energy for a large proportion of the world's population. Sustaining and increasing rice productivity requires balanced and efficient management of plant nutrients. Although nitrogen, phosphorus and potassium receive considerable attention in rice production, secondary nutrients such as sulphur are also important for maintaining optimum crop growth and productivity.

Sulphur is an essential plant nutrient involved in several physiological and biochemical processes. It is a constituent of sulphur-containing amino acids and plays an important role in protein synthesis and enzyme activity. Adequate sulphur nutrition is therefore important for vigorous vegetative growth, reproductive development and ultimately grain formation and yield. The importance of sulphur nutrition becomes particularly relevant under intensive cropping systems, where continuous removal of nutrients through crop harvest can gradually reduce soil sulphur availability.

The availability of sulphur to plants is influenced not only by the amount applied but also by its chemical form and source. Different sulphur-containing fertilizers differ in their nutrient composition, behaviour in soil and availability to crops. Elemental sulphur requires oxidation before it becomes available in sulphate form, whereas ammonium sulphate supplies sulphur in a

readily available form along with nitrogen. Consequently, the response of rice may vary according to the source and level of sulphur applied.

In the present experiment, sulphur was supplied through elemental sulphur and ammonium sulphate at three levels, viz. 20, 30 and 40 kg S ha<sup>-1</sup>. The experiment also included treatments based on diammonium phosphate, single super phosphate and an absolute control, allowing comparison of different fertilizer combinations.

Therefore, the present investigation was undertaken to evaluate the effect of different sources and levels of sulphur on growth, yield attributes and yield of rice (*Oryza sativa* L.), and to identify the sulphur source and level giving the most favourable crop response under the experimental conditions.

## 2. Materials and Methods

### 2.1 Experimental site

A field experiment was conducted during the *kharif* seasons of 2021 and 2022 at the Instructional-cum-Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India.

The experimental soil was Kanhar soil, which was neutral in reaction, with a pH of approximately 7.1. The soil was characterized by low organic carbon, low available nitrogen, medium available phosphorus, high available potassium and low available sulphur status.

### 2.2 Experimental design and treatments

The experiment was laid out in a randomized block design (RBD) comprising nine treatments with three replications. The gross plot size was 7.0 × 5.5 m.

The treatments consisted of different sources and levels of sulphur along with fertilizer treatments and an absolute control. Elemental sulphur and ammonium sulphate were used as sources of sulphur at 20, 30 and 40 kg S ha<sup>-1</sup>.

| Treatment      | Treatment details                                                                                                           |
|----------------|-----------------------------------------------------------------------------------------------------------------------------|
| T <sub>1</sub> | 100% P <sub>2</sub> O <sub>5</sub> through DAP + 76.53% N through urea                                                      |
| T <sub>2</sub> | 100% P <sub>2</sub> O <sub>5</sub> through SSP + 100% N through urea                                                        |
| T <sub>3</sub> | 100% P <sub>2</sub> O <sub>5</sub> through DAP + 76.53% N through urea + 20 kg S ha <sup>-1</sup> through elemental sulphur |
| T <sub>4</sub> | 100% P <sub>2</sub> O <sub>5</sub> through DAP + 76.53% N through urea + 30 kg S ha <sup>-1</sup> through elemental sulphur |
| T <sub>5</sub> | 100% P <sub>2</sub> O <sub>5</sub> through DAP + 76.53% N through urea + 40 kg S ha <sup>-1</sup> through elemental sulphur |
| T <sub>6</sub> | 100% P <sub>2</sub> O <sub>5</sub> through DAP + 59.03% N through urea + 20 kg S ha <sup>-1</sup> through ammonium sulphate |
| T <sub>7</sub> | 100% P <sub>2</sub> O <sub>5</sub> through DAP + 50.28% N through urea + 30 kg S ha <sup>-1</sup> through ammonium sulphate |
| T <sub>8</sub> | 100% P <sub>2</sub> O <sub>5</sub> through DAP + 41.53% N through urea + 40 kg S ha <sup>-1</sup> through ammonium sulphate |
| T <sub>9</sub> | Absolute control                                                                                                            |

### 2.3 Crop establishment

The rice variety MTU 1010 was used as the test crop. Rice was established through transplanting during the *kharif* seasons of 2021 and 2022. A spacing of 20 × 10 cm was maintained.

### 2.4 Fertilizer application

The recommended dose of fertilizer for rice was 100:60:40 kg N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O ha<sup>-1</sup>. Nitrogen, phosphorus and potassium were applied according to the recommended fertilizer schedule and respective experimental treatments.

Phosphorus was supplied through either diammonium phosphate (DAP) or single super phosphate (SSP), according to the treatment. Sulphur was supplied through elemental sulphur or

ammonium sulphate at 20, 30 and 40 kg S ha<sup>-1</sup>. The corresponding quantity of nitrogen supplied through fertilizer sources was adjusted according to the treatment structure.

### 2.5 Crop management

All other recommended agronomic practices for rice cultivation were followed uniformly throughout the experimental period. Crop establishment, irrigation, weed management and plant protection measures were carried out as required for raising a healthy crop.

### 2.6 Observations recorded

Observations were recorded on different growth parameters, yield attributes and yield of rice. Growth parameters included plant height, number of tillers hill<sup>-1</sup>, dry matter accumulation, number of leaves hill<sup>-1</sup> and leaf area at different crop growth stages. Yield attributes included number of effective tillers hill<sup>-1</sup>, number of panicles hill<sup>-1</sup>, panicle length, filled grains panicle<sup>-1</sup>, unfilled grains panicle<sup>-1</sup> and test weight. At harvest, grain yield, straw yield and harvest index were recorded.

### 2.7 Statistical analysis

The experimental data were subjected to statistical analysis appropriate for the randomized block design with nine treatments and three replications. Data for the individual years 2021 and 2022 and their mean values were considered for interpretation.

## 3. Results and Discussion

### 3.1 Growth parameters

#### 3.1.1 Plant height

Plant height increased progressively with crop growth and was significantly influenced by sulphur management at later stages. T<sub>8</sub> recorded the highest mean plant height at 60 DAT (87.66 cm), followed by T<sub>7</sub> (85.28 cm), while T<sub>9</sub> recorded the lowest (65.31 cm). At 90 DAT and harvest, T<sub>8</sub> again recorded the highest values, whereas T<sub>9</sub> remained the lowest. The improvement in plant height with sulphur application may be attributed to better nutrient utilization and enhanced protein synthesis. Similar improvement in rice growth with sulphur application has been reported by Ram *et al.* (2014) [7].

#### 3.1.2 Number of tillers hill<sup>-1</sup>

The number of tillers hill<sup>-1</sup> increased with crop growth and was significantly affected by sulphur management from 60 DAT onwards. T<sub>8</sub> recorded the highest mean number of tillers at 60 DAT (11.20 hill<sup>-1</sup>), 90 DAT (11.71 hill<sup>-1</sup>) and harvest (11.67 hill<sup>-1</sup>), followed by T<sub>7</sub>, whereas T<sub>9</sub> recorded the lowest values (7.50, 7.54 and 7.50 hill<sup>-1</sup>, respectively). The enhanced tillering under sulphur application may be related to improved nutrient availability and vegetative growth. Similar increases in tillering with sulphur fertilization have been reported by Chandel *et al.* (2003) [3].

#### 3.1.3 Number of leaves hill<sup>-1</sup>

Number of leaves hill<sup>-1</sup> increased up to the later growth stages and was significantly influenced by sulphur management at 60 and 90 DAT. T<sub>8</sub> recorded the highest mean values at 60 DAT (43.36 leaves hill<sup>-1</sup>) and 90 DAT (42.25 leaves hill<sup>-1</sup>), followed by T<sub>7</sub> (42.86 and 41.36), whereas T<sub>9</sub> recorded the lowest values (29.43 and 27.79, respectively). At 30 DAT, treatment differences were non-significant. The greater leaf production with sulphur application indicates improved vegetative growth and nutrient assimilation. Similar findings were reported by Chandel *et al.* (2003) [3].

### 3.1.4 Leaf area

Leaf area increased progressively with crop growth and was significantly improved by sulphur application at 60 and 90 DAT. T<sub>8</sub> recorded the highest mean leaf area, reaching 1036.45 cm<sup>2</sup> at 60 DAT and 1091.00 cm<sup>2</sup> at 90 DAT, followed by T<sub>7</sub> (990.13 and 1044.00 cm<sup>2</sup>), while T<sub>9</sub> recorded the lowest values (859.78 and 875.00 cm<sup>2</sup>, respectively). The greater leaf area under sulphur application may have enhanced the photosynthetic surface and contributed to greater biomass production. Similar positive effects of sulphur on leaf area and growth of rice have been reported by Ram *et al.* (2014) [7].

### 3.1.5 Dry matter accumulation

Dry matter accumulation increased progressively with crop growth and was significantly influenced by sulphur management from 60 DAT onwards. T<sub>8</sub> recorded the highest mean dry matter accumulation, with 16.04 g hill<sup>-1</sup> at 60 DAT, 32.97 g hill<sup>-1</sup> at 90 DAT and 38.96 g hill<sup>-1</sup> at harvest, followed by T<sub>7</sub> (15.85, 32.58 and 37.98 g hill<sup>-1</sup>), whereas T<sub>9</sub> recorded the lowest values. The greater dry matter accumulation under sulphur application may be attributed to enhanced leaf development, photosynthetic activity and nutrient utilization. Similar improvement in dry matter production with sulphur application in rice has been reported by Chandel *et al.* (2003) [3] and Ram *et al.* (2014) [7].

## 3.2 Yield attributes

### 3.2.1 Number of effective tillers hill<sup>-1</sup>

The number of effective tillers hill<sup>-1</sup> was significantly influenced by sulphur management. T<sub>8</sub> recorded the highest mean value (8.57 hill<sup>-1</sup>), followed by T<sub>7</sub> (8.44 hill<sup>-1</sup>), whereas T<sub>9</sub> recorded the lowest (6.14 hill<sup>-1</sup>). The higher number of effective tillers under T<sub>8</sub> may be attributed to improved vegetative growth and better nutrient availability under adequate sulphur supply. Similar improvement in effective tillers with sulphur application has been reported by Ram *et al.* (2014) [7].

### 3.2.2 Number of panicles hill<sup>-1</sup>

A similar trend was observed for the number of panicles hill<sup>-1</sup>. T<sub>8</sub> recorded the highest mean value (8.46 hill<sup>-1</sup>), followed by T<sub>7</sub> (8.32 hill<sup>-1</sup>), while T<sub>9</sub> recorded the lowest (6.03 hill<sup>-1</sup>). The increase in panicle number was associated with greater production of effective tillers under sulphur application.

### 3.2.3 Panicle length

Panicle length was significantly improved by sulphur management. T<sub>8</sub> recorded the longest mean panicle (22.03 cm), followed by T<sub>7</sub> (21.44 cm), whereas T<sub>9</sub> recorded the shortest (16.00 cm). The greater panicle length under sulphur application may have provided better space for grain development. Similar improvement in panicle length due to sulphur application has been reported by Chandel *et al.* (2003) [3].

### 3.2.4 Filled grains panicle<sup>-1</sup>

The number of filled grains panicle<sup>-1</sup> increased significantly with

sulphur application. T<sub>8</sub> recorded the highest mean value (113.41 grains panicle<sup>-1</sup>), followed by T<sub>7</sub> (110.70), while T<sub>9</sub> recorded the lowest (77.99). The greater number of filled grains under sulphur application may be attributed to improved reproductive growth and better assimilate availability during grain formation. Similar improvement in grains panicle<sup>-1</sup> with sulphur fertilization has been reported by Ram *et al.* (2014) [7].

### 3.2.5 Unfilled grains panicle<sup>-1</sup>

The number of unfilled grains panicle<sup>-1</sup> was not significantly influenced by sulphur management. Numerically, T<sub>8</sub> recorded the lowest mean value (9.78 grains panicle<sup>-1</sup>), followed by T<sub>7</sub> (10.39), whereas T<sub>9</sub> recorded the highest (11.99). Thus, the numerical reduction in unfilled grains under T<sub>8</sub> suggests better grain filling, although the differences were statistically non-significant.

### 3.2.6 Test weight

Test weight was significantly influenced by sulphur management. T<sub>8</sub> recorded the highest mean test weight (25.13 g), followed by T<sub>7</sub> (23.96 g) and T<sub>5</sub> (22.96 g), whereas T<sub>9</sub> recorded the lowest (19.09 g). The increase in test weight under sulphur application indicates improved grain development and assimilate accumulation. Similar responses have been reported in rice with sulphur fertilization.

## 3.3 Yield

### 3.3.1 Grain yield

Grain yield was significantly increased by sulphur management. T<sub>8</sub> recorded the highest mean grain yield (52.49 q ha<sup>-1</sup>), followed by T<sub>7</sub> (50.28 q ha<sup>-1</sup>) and T<sub>5</sub> (48.13 q ha<sup>-1</sup>), whereas T<sub>9</sub> recorded the lowest (38.17 q ha<sup>-1</sup>). Thus, T<sub>8</sub> produced about 37.5% higher grain yield than the absolute control. The higher yield under T<sub>8</sub> may be attributed to its favourable effect on tillering, panicle development, filled grains and test weight. Similar positive effects of sulphur on rice productivity have been reported by Ram *et al.* (2014) [7] and Chandel *et al.* (2003) [3].

### 3.3.2 Straw yield

Straw yield followed a trend similar to grain yield. T<sub>8</sub> recorded the highest mean straw yield (61.40 q ha<sup>-1</sup>), followed by T<sub>7</sub> (60.72 q ha<sup>-1</sup>) and T<sub>5</sub> (55.30 q ha<sup>-1</sup>), whereas T<sub>9</sub> recorded the lowest (49.42 q ha<sup>-1</sup>). The greater straw production under sulphur application was consistent with the higher plant growth and dry matter accumulation observed under these treatments.

### 3.3.3 Harvest index

Harvest index was significantly influenced by sulphur management. T<sub>8</sub> recorded the highest mean harvest index (50.29%), followed by T<sub>7</sub> (47.44%) and T<sub>6</sub> (47.35%), whereas T<sub>9</sub> recorded the lowest (39.04%). The higher harvest index under T<sub>8</sub> indicates more efficient partitioning of assimilates towards grain production.

**Table 1:** Effect of sulphur management on plant height of rice at 30 DAT and 60 DAT

| Treatment                                                                                              | Plant height (cm) |       |       |        |       |       |
|--------------------------------------------------------------------------------------------------------|-------------------|-------|-------|--------|-------|-------|
|                                                                                                        | 30 DAT            |       |       | 60 DAT |       |       |
|                                                                                                        | 2021              | 2022  | Mean  | 2021   | 2022  | Mean  |
| T <sub>1</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U)                                 | 54.00             | 60.48 | 57.24 | 73.15  | 74.01 | 73.58 |
| T <sub>2</sub> : 100% P <sub>2</sub> O <sub>5</sub> (S) + 100% N (U)                                   | 54.09             | 61.61 | 57.85 | 73.28  | 74.14 | 73.71 |
| T <sub>3</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 20 kg S ha <sup>-1</sup> (ES) | 54.32             | 62.49 | 58.41 | 73.78  | 75.32 | 74.55 |
| T <sub>4</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 30 kg S ha <sup>-1</sup> (ES) | 58.19             | 67.41 | 62.80 | 75.70  | 79.77 | 77.73 |
| T <sub>5</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 40 kg S ha <sup>-1</sup> (ES) | 61.08             | 66.72 | 63.90 | 80.45  | 87.72 | 84.09 |
| T <sub>6</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 59.03% N (U) + 20 kg S ha <sup>-1</sup> (AS) | 58.13             | 66.50 | 62.32 | 75.30  | 79.44 | 77.37 |

|                                                                                                        |       |       |       |       |       |       |
|--------------------------------------------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|
| T <sub>7</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 50.28% N (U) + 30 kg S ha <sup>-1</sup> (AS) | 63.30 | 67.78 | 65.54 | 82.11 | 88.45 | 85.28 |
| T <sub>8</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 41.53% N (U) + 40 kg S ha <sup>-1</sup> (AS) | 64.33 | 68.04 | 66.19 | 84.89 | 90.43 | 87.66 |
| T <sub>9</sub> : Absolute control                                                                      | 47.00 | 50.00 | 48.50 | 64.52 | 66.11 | 65.31 |
| SEm±                                                                                                   | 4.05  | 4.75  | 3.31  | 3.08  | 3.55  | 2.77  |
| CD (P=0.05)                                                                                            | NS    | NS    | NS    | 9.22  | 10.64 | 8.32  |

\*D = DAP, U = Urea, S = SSP, ES = Elemental sulphur & AS = Ammonium sulphate

**Table 2:** Effect of sulphur management on plant height of rice at 90 DAT and at harvest

| Treatment                                                                                              | Plant height (cm) |        |        |            |        |        |
|--------------------------------------------------------------------------------------------------------|-------------------|--------|--------|------------|--------|--------|
|                                                                                                        | 90 DAT            |        |        | At harvest |        |        |
|                                                                                                        | 2021              | 2022   | Mean   | 2021       | 2022   | Mean   |
| T <sub>1</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U)                                 | 98.17             | 99.75  | 98.96  | 98.23      | 99.83  | 99.03  |
| T <sub>2</sub> : 100% P <sub>2</sub> O <sub>5</sub> (S) + 100% N (U)                                   | 98.46             | 101.68 | 100.07 | 98.52      | 101.74 | 100.13 |
| T <sub>3</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 20 kg S ha <sup>-1</sup> (ES) | 99.25             | 102.53 | 100.89 | 99.31      | 102.59 | 100.95 |
| T <sub>4</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 30 kg S ha <sup>-1</sup> (ES) | 101.21            | 103.40 | 102.31 | 101.40     | 104.60 | 103.00 |
| T <sub>5</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 40 kg S ha <sup>-1</sup> (ES) | 108.70            | 110.45 | 109.58 | 108.78     | 110.97 | 109.88 |
| T <sub>6</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 59.03% N (U) + 20 kg S ha <sup>-1</sup> (AS) | 101.17            | 103.21 | 102.19 | 101.33     | 103.47 | 102.40 |
| T <sub>7</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 50.28% N (U) + 30 kg S ha <sup>-1</sup> (AS) | 109.48            | 111.72 | 110.60 | 109.55     | 111.81 | 110.68 |
| T <sub>8</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 41.53% N (U) + 40 kg S ha <sup>-1</sup> (AS) | 110.70            | 113.11 | 111.91 | 110.76     | 113.41 | 112.08 |
| T <sub>9</sub> : Absolute control                                                                      | 90.33             | 86.61  | 88.47  | 81.58      | 86.61  | 84.10  |
| SEm±                                                                                                   | 3.17              | 3.22   | 2.63   | 3.30       | 3.14   | 2.66   |
| CD (P=0.05)                                                                                            | 9.49              | 9.66   | 7.89   | 9.90       | 9.42   | 7.98   |

\*D = DAP, U = Urea, S = SSP, ES = Elemental sulphur & AS = Ammonium sulphate

**Table 3:** Effect of sulphur management on dry matter accumulation of rice at 30 DAT and 60 DAT

| Treatment                                                                                              | Dry matter accumulation (g hill <sup>-1</sup> ) |      |      |        |       |       |
|--------------------------------------------------------------------------------------------------------|-------------------------------------------------|------|------|--------|-------|-------|
|                                                                                                        | 30 DAT                                          |      |      | 60 DAT |       |       |
|                                                                                                        | 2021                                            | 2022 | Mean | 2021   | 2022  | Mean  |
| T <sub>1</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U)                                 | 3.31                                            | 3.62 | 3.47 | 12.90  | 14.18 | 13.54 |
| T <sub>2</sub> : 100% P <sub>2</sub> O <sub>5</sub> (S) + 100% N (U)                                   | 3.39                                            | 3.68 | 3.54 | 13.27  | 14.40 | 13.84 |
| T <sub>3</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 20 kg S ha <sup>-1</sup> (ES) | 3.42                                            | 3.80 | 3.61 | 13.40  | 14.45 | 13.93 |
| T <sub>4</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 30 kg S ha <sup>-1</sup> (ES) | 3.74                                            | 4.10 | 3.92 | 13.83  | 14.70 | 14.27 |
| T <sub>5</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 40 kg S ha <sup>-1</sup> (ES) | 3.93                                            | 4.26 | 4.09 | 13.90  | 14.72 | 14.31 |
| T <sub>6</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 59.03% N (U) + 20 kg S ha <sup>-1</sup> (AS) | 3.48                                            | 3.94 | 3.71 | 13.57  | 14.50 | 14.04 |
| T <sub>7</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 50.28% N (U) + 30 kg S ha <sup>-1</sup> (AS) | 4.01                                            | 4.32 | 4.16 | 15.11  | 16.58 | 15.85 |
| T <sub>8</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 41.53% N (U) + 40 kg S ha <sup>-1</sup> (AS) | 4.14                                            | 4.45 | 4.30 | 15.32  | 16.77 | 16.04 |
| T <sub>9</sub> : Absolute control                                                                      | 2.52                                            | 2.97 | 2.75 | 11.96  | 12.88 | 12.42 |
| SEm±                                                                                                   | 0.31                                            | 0.29 | 0.27 | 0.45   | 0.67  | 0.41  |
| CD (P=0.05)                                                                                            | NS                                              | NS   | NS   | 1.35   | 2.01  | 1.23  |

\*D = DAP, U = Urea, S = SSP, ES = Elemental sulphur & AS = Ammonium sulphate

**Table 4:** Effect of sulphur management on dry matter accumulation of rice at 90 DAT and at harvest

| Treatment                                                                                              | Dry matter accumulation (g hill <sup>-1</sup> ) |       |       |            |       |       |
|--------------------------------------------------------------------------------------------------------|-------------------------------------------------|-------|-------|------------|-------|-------|
|                                                                                                        | 90 DAT                                          |       |       | At harvest |       |       |
|                                                                                                        | 2021                                            | 2022  | Mean  | 2021       | 2022  | Mean  |
| T <sub>1</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U)                                 | 27.55                                           | 29.62 | 28.59 | 31.51      | 33.00 | 32.26 |
| T <sub>2</sub> : 100% P <sub>2</sub> O <sub>5</sub> (S) + 100% N (U)                                   | 28.89                                           | 29.98 | 29.43 | 32.67      | 34.05 | 33.36 |
| T <sub>3</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 20 kg S ha <sup>-1</sup> (ES) | 28.00                                           | 30.09 | 29.05 | 33.08      | 34.20 | 33.64 |
| T <sub>4</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 30 kg S ha <sup>-1</sup> (ES) | 28.20                                           | 30.42 | 29.31 | 33.72      | 35.00 | 34.36 |
| T <sub>5</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 40 kg S ha <sup>-1</sup> (ES) | 28.27                                           | 31.49 | 29.88 | 33.80      | 35.11 | 34.46 |
| T <sub>6</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 59.03% N (U) + 20 kg S ha <sup>-1</sup> (AS) | 28.09                                           | 30.18 | 29.14 | 33.50      | 34.88 | 34.19 |
| T <sub>7</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 50.28% N (U) + 30 kg S ha <sup>-1</sup> (AS) | 32.01                                           | 33.15 | 32.58 | 37.25      | 38.72 | 37.98 |
| T <sub>8</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 41.53% N (U) + 40 kg S ha <sup>-1</sup> (AS) | 32.18                                           | 33.76 | 32.97 | 38.18      | 39.73 | 38.96 |
| T <sub>9</sub> : Absolute control                                                                      | 25.30                                           | 27.15 | 26.22 | 29.65      | 30.00 | 29.82 |
| S.Em±                                                                                                  | 1.05                                            | 1.07  | 1.05  | 1.45       | 1.51  | 1.35  |
| CD (P=0.05)                                                                                            | 3.16                                            | 3.20  | 3.14  | 4.36       | 4.54  | 4.05  |

\*D = DAP, U = Urea, S = SSP, ES = Elemental sulphur & AS = Ammonium sulphate

**Table 5:** Effect of sulphur management on numbers of tillers of rice at 30 DAT and 60 DAT

| Treatment                                                                                              | Number of tillers (hill <sup>-1</sup> ) |      |      |        |       |       |
|--------------------------------------------------------------------------------------------------------|-----------------------------------------|------|------|--------|-------|-------|
|                                                                                                        | 30 DAT                                  |      |      | 60 DAT |       |       |
|                                                                                                        | 2021                                    | 2022 | Mean | 2021   | 2022  | Mean  |
| T <sub>1</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U)                                 | 5.00                                    | 5.24 | 5.12 | 9.00   | 9.70  | 9.35  |
| T <sub>2</sub> : 100% P <sub>2</sub> O <sub>5</sub> (S) + 100% N (U)                                   | 5.16                                    | 5.30 | 5.23 | 9.47   | 9.77  | 9.62  |
| T <sub>3</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 20 kg S ha <sup>-1</sup> (ES) | 5.29                                    | 5.88 | 5.59 | 9.50   | 9.80  | 9.65  |
| T <sub>4</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 30 kg S ha <sup>-1</sup> (ES) | 5.76                                    | 6.09 | 5.92 | 9.60   | 10.18 | 9.89  |
| T <sub>5</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 40 kg S ha <sup>-1</sup> (ES) | 5.81                                    | 6.11 | 5.96 | 9.77   | 10.30 | 10.04 |
| T <sub>6</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 59.03% N (U) + 20 kg S ha <sup>-1</sup> (AS) | 5.54                                    | 5.94 | 5.74 | 9.55   | 9.88  | 9.72  |
| T <sub>7</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 50.28% N (U) + 30 kg S ha <sup>-1</sup> (AS) | 6.12                                    | 6.20 | 6.16 | 10.11  | 11.05 | 10.58 |
| T <sub>8</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 41.53% N (U) + 40 kg S ha <sup>-1</sup> (AS) | 6.15                                    | 6.24 | 6.20 | 10.92  | 11.48 | 11.20 |
| T <sub>9</sub> : Absolute control                                                                      | 4.51                                    | 5.09 | 4.80 | 7.13   | 7.87  | 7.50  |
| SEm±                                                                                                   | 0.43                                    | 0.37 | 0.31 | 0.39   | 0.44  | 0.20  |
| CD (P=0.05)                                                                                            | NS                                      | NS   | NS   | 1.18   | 1.31  | 0.60  |

\*D = DAP, U = Urea, S = SSP, ES = Elemental sulphur &amp; AS = Ammonium sulphate

**Table 6:** Effect of sulphur management on numbers of tillers of rice at 90 DAT and at harvest

| Treatment                                                                                              | Number of tillers (hill <sup>-1</sup> ) |       |       |            |       |       |
|--------------------------------------------------------------------------------------------------------|-----------------------------------------|-------|-------|------------|-------|-------|
|                                                                                                        | 90 DAT                                  |       |       | At harvest |       |       |
|                                                                                                        | 2021                                    | 2022  | Mean  | 2021       | 2022  | Mean  |
| T <sub>1</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U)                                 | 9.14                                    | 9.60  | 9.37  | 9.11       | 9.80  | 9.46  |
| T <sub>2</sub> : 100% P <sub>2</sub> O <sub>5</sub> (S) + 100% N (U)                                   | 9.73                                    | 9.67  | 9.70  | 9.69       | 9.97  | 9.83  |
| T <sub>3</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 20 kg S ha <sup>-1</sup> (ES) | 10.00                                   | 9.70  | 9.85  | 9.98       | 10.00 | 9.99  |
| T <sub>4</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 30 kg S ha <sup>-1</sup> (ES) | 10.49                                   | 9.97  | 10.23 | 11.00      | 10.17 | 10.58 |
| T <sub>5</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 40 kg S ha <sup>-1</sup> (ES) | 10.60                                   | 10.08 | 10.34 | 11.20      | 10.25 | 10.73 |
| T <sub>6</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 59.03% N (U) + 20 kg S ha <sup>-1</sup> (AS) | 10.11                                   | 9.75  | 9.93  | 10.06      | 10.05 | 10.06 |
| T <sub>7</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 50.28% N (U) + 30 kg S ha <sup>-1</sup> (AS) | 11.05                                   | 11.40 | 11.23 | 11.24      | 11.36 | 11.30 |
| T <sub>8</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 41.53% N (U) + 40 kg S ha <sup>-1</sup> (AS) | 11.88                                   | 11.54 | 11.71 | 11.84      | 11.50 | 11.67 |
| T <sub>9</sub> : Absolute control                                                                      | 7.18                                    | 7.90  | 7.54  | 7.15       | 7.84  | 7.50  |
| SEm±                                                                                                   | 0.44                                    | 0.53  | 0.39  | 0.55       | 0.46  | 0.45  |
| CD (P=0.05)                                                                                            | 1.32                                    | 1.60  | 1.18  | 1.66       | 1.38  | 1.35  |

\*D = DAP, U = Urea, S = SSP, ES = Elemental sulphur &amp; AS = Ammonium sulphate

**Table 7:** Effect of sulphur management on number of leaves hill<sup>-1</sup> of rice

| Treatment                                                                                              | Number of leaves hill <sup>-1</sup> |       |       |        |       |       |        |       |       |
|--------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|--------|-------|-------|--------|-------|-------|
|                                                                                                        | 30 DAT                              |       |       | 60 DAT |       |       | 90 DAT |       |       |
|                                                                                                        | 2021                                | 2022  | Mean  | 2021   | 2022  | Mean  | 2021   | 2022  | Mean  |
| T <sub>1</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U)                                 | 19.75                               | 20.14 | 19.94 | 36.24  | 38.09 | 37.16 | 35.44  | 36.54 | 35.99 |
| T <sub>2</sub> : 100% P <sub>2</sub> O <sub>5</sub> (S) + 100% N (U)                                   | 20.43                               | 20.49 | 20.46 | 36.94  | 38.15 | 37.55 | 35.57  | 36.69 | 36.13 |
| T <sub>3</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 20 kg S ha <sup>-1</sup> (ES) | 21.10                               | 20.88 | 20.99 | 37.09  | 38.54 | 37.82 | 36.05  | 37.25 | 36.65 |
| T <sub>4</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 30 kg S ha <sup>-1</sup> (ES) | 22.55                               | 23.32 | 22.93 | 37.73  | 38.82 | 38.28 | 36.80  | 37.71 | 37.26 |
| T <sub>5</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 40 kg S ha <sup>-1</sup> (ES) | 23.61                               | 24.60 | 24.10 | 41.01  | 43.62 | 42.32 | 40.15  | 41.80 | 40.98 |
| T <sub>6</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 59.03% N (U) + 20 kg S ha <sup>-1</sup> (AS) | 21.70                               | 22.64 | 22.17 | 37.66  | 38.67 | 38.16 | 36.83  | 37.48 | 37.15 |
| T <sub>7</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 50.28% N (U) + 30 kg S ha <sup>-1</sup> (AS) | 24.32                               | 25.88 | 25.10 | 41.71  | 44.01 | 42.86 | 40.67  | 42.05 | 41.36 |
| T <sub>8</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 41.53% N (U) + 40 kg S ha <sup>-1</sup> (AS) | 25.83                               | 26.03 | 25.93 | 42.62  | 44.11 | 43.36 | 41.68  | 42.82 | 42.25 |
| T <sub>9</sub> : Absolute control                                                                      | 16.30                               | 17.45 | 16.88 | 27.03  | 31.82 | 29.43 | 25.76  | 29.82 | 27.79 |
| SEm±                                                                                                   | 1.84                                | 1.87  | 1.31  | 1.60   | 1.78  | 1.44  | 1.54   | 1.73  | 1.39  |
| CD (P=0.05)                                                                                            | 5.51                                | 5.60  | 3.93  | 4.81   | 5.33  | 4.32  | 4.63   | 5.19  | 4.16  |

\*D = DAP, U = Urea, S = SSP, ES = Elemental sulphur &amp; AS = Ammonium sulphate

**Table 8:** Effect of sulphur management on leaf area at 30 DAT, 60 DAT and 90 DAT

| Treatment                                                                                              | Leaf area (cm <sup>2</sup> ) |        |        |        |        |        |        |        |        |
|--------------------------------------------------------------------------------------------------------|------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
|                                                                                                        | 30 DAT                       |        |        | 60 DAT |        |        | 90 DAT |        |        |
|                                                                                                        | 2021                         | 2022   | Mean   | 2021   | 2022   | Mean   | 2021   | 2022   | Mean   |
| T <sub>1</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U)                                 | 328.02                       | 335.52 | 331.77 | 496.71 | 524.70 | 510.70 | 447.33 | 479.33 | 463.33 |
| T <sub>2</sub> : 100% P <sub>2</sub> O <sub>5</sub> (S) + 100% N (U)                                   | 332.68                       | 339.48 | 336.08 | 533.43 | 568.69 | 551.06 | 484.00 | 523.33 | 503.67 |
| T <sub>3</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 20 kg S ha <sup>-1</sup> (ES) | 334.33                       | 340.02 | 337.18 | 556.17 | 598.04 | 577.11 | 506.67 | 552.67 | 529.67 |
| T <sub>4</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 30 kg S ha <sup>-1</sup> (ES) | 340.57                       | 354.09 | 347.33 | 600.08 | 633.39 | 616.74 | 550.67 | 588.00 | 569.33 |
| T <sub>5</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 40 kg S ha <sup>-1</sup> (ES) | 344.86                       | 360.27 | 352.56 | 622.06 | 695.42 | 658.74 | 572.67 | 650.00 | 611.33 |
| T <sub>6</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 59.03% N (U) + 20 kg S ha <sup>-1</sup> (AS) | 336.70                       | 343.56 | 340.13 | 562.69 | 600.06 | 581.38 | 513.33 | 554.67 | 534.00 |
| T <sub>7</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 50.28% N (U) + 30 kg S ha <sup>-1</sup> (AS) | 352.84                       | 361.58 | 357.21 | 673.40 | 748.75 | 711.07 | 624.00 | 703.33 | 663.67 |
| T <sub>8</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 41.53% N (U) + 40 kg S ha <sup>-1</sup> (AS) | 363.37                       | 372.67 | 368.02 | 700.00 | 766.78 | 733.39 | 650.67 | 721.33 | 686.00 |
| T <sub>9</sub> : Absolute control                                                                      | 302.00                       | 323.33 | 312.67 | 436.70 | 446.73 | 441.71 | 387.33 | 401.33 | 394.33 |
| SEm±                                                                                                   | 65.92                        | 62.69  | 63.01  | 27.10  | 29.25  | 18.94  | 27.12  | 29.25  | 18.95  |
| CD (P=0.05)                                                                                            | 197.64                       | 187.93 | 188.91 | 81.25  | 87.68  | 56.79  | 81.30  | 87.71  | 56.80  |

\*D = DAP, U = Urea, S = SSP, ES = Elemental sulphur &amp; AS = Ammonium sulphate

**Table 9:** Effect of sulphur management on number of effective tillers hill<sup>-1</sup>, number of panicle hill<sup>-1</sup> and panicle length of rice

| Treatment                                                                                              | Number of effective tillers (hill <sup>-1</sup> ) |      |      | Number of panicle hill <sup>-1</sup> |      |      | Panicle length (cm) |       |       |
|--------------------------------------------------------------------------------------------------------|---------------------------------------------------|------|------|--------------------------------------|------|------|---------------------|-------|-------|
|                                                                                                        | 2021                                              | 2022 | Mean | 2021                                 | 2022 | Mean | 2021                | 2022  | Mean  |
| T <sub>1</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U)                                 | 7.24                                              | 7.55 | 7.40 | 7.15                                 | 7.41 | 7.28 | 18.64               | 18.92 | 18.78 |
| T <sub>2</sub> : 100% P <sub>2</sub> O <sub>5</sub> (S) + 100% N (U)                                   | 7.26                                              | 7.57 | 7.42 | 7.17                                 | 7.43 | 7.30 | 18.77               | 19.13 | 18.95 |
| T <sub>3</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 20 kg S ha <sup>-1</sup> (ES) | 7.29                                              | 7.60 | 7.45 | 7.19                                 | 7.46 | 7.33 | 19.03               | 19.27 | 19.15 |
| T <sub>4</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 30 kg S ha <sup>-1</sup> (ES) | 7.47                                              | 7.64 | 7.56 | 7.47                                 | 7.52 | 7.50 | 19.36               | 19.50 | 19.43 |
| T <sub>5</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 40 kg S ha <sup>-1</sup> (ES) | 7.49                                              | 7.65 | 7.57 | 7.49                                 | 7.55 | 7.52 | 19.60               | 19.78 | 19.69 |
| T <sub>6</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 59.03% N (U) + 20 kg S ha <sup>-1</sup> (AS) | 7.32                                              | 7.63 | 7.48 | 7.22                                 | 7.49 | 7.36 | 19.11               | 19.27 | 19.19 |
| T <sub>7</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 50.28% N (U) + 30 kg S ha <sup>-1</sup> (AS) | 8.20                                              | 8.68 | 8.44 | 8.11                                 | 8.53 | 8.32 | 20.87               | 22.01 | 21.44 |
| T <sub>8</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 41.53% N (U) + 40 kg S ha <sup>-1</sup> (AS) | 8.40                                              | 8.75 | 8.57 | 8.31                                 | 8.60 | 8.46 | 22.01               | 22.06 | 22.03 |
| T <sub>9</sub> : Absolute control                                                                      | 5.88                                              | 6.41 | 6.14 | 5.78                                 | 6.27 | 6.03 | 15.49               | 16.50 | 16.00 |
| SEm±                                                                                                   | 0.30                                              | 0.36 | 0.23 | 0.30                                 | 0.36 | 0.23 | 0.82                | 0.87  | 0.57  |
| CD (P=0.05)                                                                                            | 1.08                                              | 1.08 | 0.70 | 0.90                                 | 1.08 | 0.70 | 2.46                | 2.60  | 1.70  |

\*D = DAP, U = Urea, S = SSP, ES = Elemental sulphur & AS = Ammonium sulphate

**Table 10:** Effect of sulphur management on number of grains panicle<sup>-1</sup> and test weight of rice

| Treatment                                                                                              | Number of grains panicle <sup>-1</sup> |        |        |                 |       |       | Test weight (g) |       |       |
|--------------------------------------------------------------------------------------------------------|----------------------------------------|--------|--------|-----------------|-------|-------|-----------------|-------|-------|
|                                                                                                        | Filled grains                          |        |        | Unfilled grains |       |       | 2021            | 2022  | Mean  |
|                                                                                                        | 2021                                   | 2022   | Mean   | 2021            | 2022  | Mean  | 2021            | 2022  | Mean  |
| T <sub>1</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U)                                 | 85.10                                  | 88.40  | 86.75  | 11.11           | 12.40 | 11.76 | 19.36           | 21.08 | 20.22 |
| T <sub>2</sub> : 100% P <sub>2</sub> O <sub>5</sub> (S) + 100% N (U)                                   | 85.41                                  | 90.76  | 88.08  | 11.18           | 12.19 | 11.69 | 20.16           | 21.55 | 20.85 |
| T <sub>3</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 20 kg S ha <sup>-1</sup> (ES) | 88.72                                  | 91.54  | 90.13  | 10.66           | 12.01 | 11.34 | 20.22           | 21.88 | 21.05 |
| T <sub>4</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 30 kg S ha <sup>-1</sup> (ES) | 96.90                                  | 100.09 | 98.50  | 10.49           | 11.65 | 11.07 | 22.36           | 22.47 | 22.41 |
| T <sub>5</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 40 kg S ha <sup>-1</sup> (ES) | 99.50                                  | 107.33 | 103.42 | 10.40           | 11.34 | 10.87 | 23.31           | 22.60 | 22.96 |
| T <sub>6</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 59.03% N (U) + 20 kg S ha <sup>-1</sup> (AS) | 90.10                                  | 92.60  | 91.35  | 10.47           | 11.78 | 11.13 | 20.40           | 22.03 | 21.22 |
| T <sub>7</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 50.28% N (U) + 30 kg S ha <sup>-1</sup> (AS) | 110.00                                 | 111.40 | 110.70 | 10.10           | 10.67 | 10.39 | 23.13           | 24.78 | 23.96 |
| T <sub>8</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 41.53% N (U) + 40 kg S ha <sup>-1</sup> (AS) | 110.50                                 | 116.32 | 113.41 | 9.20            | 10.36 | 9.78  | 25.05           | 25.21 | 25.13 |
| T <sub>9</sub> : Absolute control                                                                      | 75.87                                  | 80.12  | 77.99  | 11.33           | 12.65 | 11.99 | 15.30           | 17.84 | 16.57 |
| SEm±                                                                                                   | 4.08                                   | 4.56   | 2.93   | 0.58            | 0.77  | 0.46  | 1.01            | 0.96  | 0.74  |
| CD (P=0.05)                                                                                            | 12.23                                  | 13.67  | 8.79   | NS              | NS    | NS    | 3.02            | 2.88  | 2.22  |

\*D = DAP, U = Urea, S = SSP, ES = Elemental sulphur & AS = Ammonium sulphate

**Table 11:** Effect of sulphur management on grain yield, straw yield of rice and harvest index

| Treatment                                                                                              | Grain yield (q ha <sup>-1</sup> ) |       |       | Straw yield (q ha <sup>-1</sup> ) |       |       | Harvest index |       |       |
|--------------------------------------------------------------------------------------------------------|-----------------------------------|-------|-------|-----------------------------------|-------|-------|---------------|-------|-------|
|                                                                                                        | 2021                              | 2022  | Mean  | 2021                              | 2022  | Mean  | 2021          | 2022  | Mean  |
| T <sub>1</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U)                                 | 43.57                             | 46.58 | 45.07 | 50.97                             | 53.11 | 52.04 | 45.45         | 45.97 | 45.71 |
| T <sub>2</sub> : 100% P <sub>2</sub> O <sub>5</sub> (S) + 100% N (U)                                   | 44.37                             | 47.16 | 45.76 | 51.93                             | 53.87 | 52.90 | 46.06         | 46.26 | 46.16 |
| T <sub>3</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 20 kg S ha <sup>-1</sup> (ES) | 45.60                             | 47.21 | 46.41 | 52.78                             | 54.01 | 53.40 | 45.92         | 45.92 | 45.92 |
| T <sub>4</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 30 kg S ha <sup>-1</sup> (ES) | 46.20                             | 47.83 | 47.02 | 53.48                             | 55.38 | 54.43 | 46.16         | 46.83 | 46.50 |
| T <sub>5</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 76.53% N (U) + 40 kg S ha <sup>-1</sup> (ES) | 48.02                             | 48.23 | 48.13 | 54.53                             | 56.07 | 55.30 | 47.05         | 46.47 | 46.76 |
| T <sub>6</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 59.03% N (U) + 20 kg S ha <sup>-1</sup> (AS) | 46.17                             | 47.27 | 46.72 | 53.11                             | 54.15 | 53.63 | 47.94         | 46.77 | 47.35 |
| T <sub>7</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 50.28% N (U) + 30 kg S ha <sup>-1</sup> (AS) | 49.33                             | 51.22 | 50.28 | 59.43                             | 62.00 | 60.72 | 46.47         | 48.41 | 47.44 |
| T <sub>8</sub> : 100% P <sub>2</sub> O <sub>5</sub> (D) + 41.53% N (U) + 40 kg S ha <sup>-1</sup> (AS) | 51.85                             | 53.13 | 52.49 | 60.67                             | 62.13 | 61.40 | 51.43         | 49.15 | 50.29 |
| T <sub>9</sub> : Absolute control                                                                      | 37.67                             | 38.67 | 38.17 | 48.17                             | 50.67 | 49.42 | 39.39         | 38.69 | 39.04 |
| SEm±                                                                                                   | 1.87                              | 1.93  | 1.55  | 2.33                              | 2.35  | 1.49  | 1.92          | 1.77  | 1.55  |
| CD (P=0.05)                                                                                            | 5.62                              | 5.80  | 4.66  | 6.98                              | 7.04  | 4.47  | 5.77          | 5.30  | 4.64  |

\*D = DAP, U = Urea, S = SSP, ES = Elemental sulphur & AS = Ammonium sulphate

#### 4. Conclusion

The present investigation revealed that sulphur management significantly influenced the growth, yield attributes and yield of rice under the agro-climatic conditions of Raipur, Chhattisgarh. Among the treatments, application of 40 kg S ha<sup>-1</sup> through ammonium sulphate (T<sub>8</sub>) consistently recorded the highest values for major growth and yield attributes and resulted in the highest mean grain yield (52.49 q ha<sup>-1</sup>), straw yield (61.40 q ha<sup>-1</sup>) and harvest index (50.29%). The treatment receiving 30 kg S ha<sup>-1</sup> through ammonium sulphate (T<sub>7</sub>) generally followed T<sub>8</sub>, while 40 kg S ha<sup>-1</sup> through elemental sulphur (T<sub>5</sub>) was another comparatively superior treatment. In contrast, the absolute control (T<sub>9</sub>) recorded the lowest growth, yield attributes and yield. Overall, under the conditions of the present investigation, application of 40 kg S ha<sup>-1</sup> through ammonium sulphate along with the recommended fertilizer regime was the most promising

treatment for improving growth and productivity of rice.

#### References

1. Biswas BC, Sarkar MC, Tanwar SPS, Das S, Kalwe SP. Sulfur deficiency in soils and crops and response to fertilizer sulfur in India. *Fertilizer News*. 2004;49(10):13-33.
2. Blair GJ, Momuat EO, Mamaril CP. Sulfur nutrition of rice. II. Effect of source and rate of sulfur on growth and yield under flooded conditions. *Agronomy Journal*. 1979;71.
3. Chandel RS, Sudhakar PC, Singh K. Response of sulphur in rice: a review. *Agricultural Reviews*. 2003;24(3):167-174.
4. Islam AKMS, Rana MS, Rahman MM, Mian MJA, Rahman MA, Naher N. Growth, yield and nutrient uptake capacity of rice under different sulphur levels. *Turkish Journal of Agriculture-Food Science and Technology*. 2016;4(7):557-565.

5. Padma PV, Vidyasagar GECH, Suresh P, Sharma HK. Effect of different sources and levels of sulphur on growth and yield of maize (*Zea mays* L.). International Journal of Current Microbiology and Applied Sciences. 2018;7(8):1548-1559.
6. Prasad R. Rice-wheat cropping systems. Advances in Agronomy. 2005;86:255-339.
7. Ram A, Kumar D, Singh N, Anand A. Effect of sulphur on growth, productivity and economics of aerobic rice (*Oryza sativa*). Indian Journal of Agronomy. 2014;59(3):404-409.
8. Ram A, Kumar D, Babu S, Prasad D, Dev I. Effect of sulphur on soil biological properties, residual fertility and yield of aerobic rice grown under aerobic rice-wheat cropping system in Inceptisols. Journal of Environmental Biology. 2017;38(8):587-593.
9. Shivay YS, Prasad R, Pal M. Effect of levels and sources of sulphur on yield, sulphur and nitrogen concentration and uptake and S-use efficiency in Basmati rice. Communications in Soil Science and Plant Analysis. 2014;45:2468-2479.