Impact of sulphur, boron and its combinations on growth and yield of onion (*Allium cepa* L.)

Priyanka Gurjar, Khushboo Tandon and Dr. Rajesh Lakhi

**Abstract**

The investigation was conducted during *Rabi* seasons of 2017-18 at the horticulture farm nursery, College of Agriculture, Gwalior. The study involve Sixteen treatment combinations consisting of four sulphur levels viz. S1: Control, S2: 20 kg S ha−1, S3: 40 kg S ha−1, S4: 60 kg S ha−1 and four doses of Boron, i.e. B1: Control, B2: 0.5 kg B ha−1, B3: 1.0 kg B ha−1 and B4: 2.0 kg B ha−1 in factorial randomized block design with three replications. The recommended dose of fertilizer (RDF) adopted was 100:60: 80 kg of N: P: K ha−1. The increasing level of sulphur and boron up to 60 kg ha−1 and 2.0 kg B ha−1 increased growth and bulb yield significantly over control respectively.

**Keywords:** Sulphur, boron, combinations, growth, yield, onion (*Allium cepa* L.)

**Introduction**

Onion (*Allium cepa* L.) is one of the most important vegetable crops widely grown in India and is consumed by almost everybody either raw or cooked along with spices and vegetable. The major Onion producing states are Maharashtra, Madhya Pradesh, Karnataka, Gujarat, Rajasthan, Bihar, Haryana, Andhra Pradesh, Tamil Nadu, and West Bengal in the country. These States account for almost 90% of the total onion production of the country. The production of onion during the year 2017-18 (First Advance Estimate) is estimated to be 4.5% lower as compared to the previous year. However as compared to past 5 year’s average production, it is 8.6% higher. (NHB data base, 2018) [9]

In Madhya Pradesh, onion is cultivated in an area of 120.14 thousand hectares with production of 37.21 lakh tones and the average productivity is 18.40 tons per hectare which is low compared to world average. In the year 2017, India exported about 84.70 MT of fresh onion fetching about Rs. 9761.11 crores, besides meeting the demand for internal consumption. (NHB Data base, 2017) [10]. With the increase of 30% the production of onion in the current year is estimated at 216 lakh tones as against 209 lakh tones in 2015-16. Similarly the area under onion crop in the current year is estimated at 12.7 lakh hectares as against 13.2 lakh hectares in 2015-16 i.e. decline of about 4% over the previous year.

Onion is a sulphur loving plant and is required much for proper growth and yield of onion. Role of sulphur is particularly important in the nutrition of onion as it is constituent of allin, cycloallin and thiopropanol. In onion crop, sulphur plays a significant role in quality and development of bulbs. Probably for these reasons onion crop needs comparatively higher amounts of sulphur for proper growth, development and higher yield of bulbs. Sulphur has been found not only to increase the bulb yield of onion but also improves its quality, especially pungency and flavours (Jaggi and Dixit, 1999) [3]. Lakkineni and Abort (1994) reported sulphur have a key role in the plant metabolism as it is a constituent of number of organic compounds. Majority of it i.e. 80-90 per cent of total sulphur is utilised in the synthesis of sulphur amino acids, while rest is required for the synthesis of other sulphur containing compounds, taking pest in the metabolic functions of the plants. Sulphur containing secondary compounds was not only important for nutritive value and flavours, but also for resistance against pest and disease. The yield potential of onion has not been exploited fully the sulphur as fertilizer is used in very low quantity instead of its very high requirement (Bell, 1981). The pungency in the onion bulb is due to a volatile oil known as allyl-propyl – disulphide (C6H12S2) and the red colour is because of the pigment “anthocyanin” and yellow colour because of “quercetin”. The nutritive value of onion varies from variety to variety. Nutritionally, fresh onion contains about 86.6 per cent moisture, 11.6 per cent carbohydrates, 0.2 to 0.5 per cent calcium, 0.05 per cent phosphorus and traces of iron and ascorbic acid (Dev Raj et al., 2004) [11]. Boron is one of the important micro-nutrients having different function in plants. It is one of the most widely applied micro-elements though required in small quantity (Rao and Deshpande, 1971). Its shortage in may hamper crop yield to a great extent. Boron is
known to play many soil important functions in plant metabolism. In the absence of boron, proper development of meristematic tissues of plant does not take place. Boron is necessary for cell division, nitrogen and carbohydrate metabolism, salt absorption and water relation in plant. Boron is also required in the translocation of sugars, starches, nitrogen and phosphorus and synthesis of amino acids and proteins (Tisdale et al., 1984, Varma et al., 2005)\textsuperscript{12}.

**Materials and methods**

The experiment entitled “Impact of sulphur, boron and its combinations on growth and yield of onion (Allium cepa L.)” was carried out, during Rabi season of 2017-18 at the horticulture nursery, College of Agriculture, Gwalior. The soil of the experimental field was alluvial, sandy clay loam in texture. The field of research farm having homogenous fertility and uniform textural make up was selected for the field experimentation. The experiment was conducted at the Horticulture Nursery, college of agriculture, Gwalior, during the rabi seasons of 2017-18 with 16 treatments (Combination of 4 levels of each $S$ and $B$). During the research Agri Found Light Red variety was transplanted with the spacing of 15 cm row to row and 10 cm plant to plant. The treatments included in the investigation comprised of the sixteen combinations of 4 doses of sulphur with four doses of boron. A recommended nursery beds (2.0 m x 1.0 m) were raised 15 cm above the soil surface in the departmental nursery field at the end of November of 2017. Then the prepared bedding mixture was evenly spread in the form of 5.0 cm thick layer over the nursery. Rows were made 1.5 to 2.0 cm deep at 10.0 cm apart and seeds sown, covered and watered. The seedlings became ready for transplanting at 45 Days after Sowing (DAS).

**Result and Discussion**

**Growth parameters**

The plant height and number of leaves is presented in table: 3. The present results are closely related with the findings of Earlier Nagaich et al. (1999)\textsuperscript{6}, Sharma et al. (2002)\textsuperscript{11}, Joshi et al. (2005)\textsuperscript{3}, and Mishu et al. (2013)\textsuperscript{19}.

![Image](https://example.com/image.png)

**Table 1:** Treatments detail

<table>
<thead>
<tr>
<th>A.</th>
<th>Sulphur Doses</th>
<th>Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>$S_0$</td>
<td></td>
</tr>
<tr>
<td>20 kg ha(^{-1})</td>
<td>$S_1$</td>
<td></td>
</tr>
<tr>
<td>40 kg ha(^{-1})</td>
<td>$S_2$</td>
<td></td>
</tr>
<tr>
<td>60 kg ha(^{-1})</td>
<td>$S_3$</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B.</th>
<th>Boron Doses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>$B_0$</td>
</tr>
<tr>
<td>0.5 kg ha(^{-1})</td>
<td>$B_1$</td>
</tr>
<tr>
<td>1.0 kg ha(^{-1})</td>
<td>$B_2$</td>
</tr>
<tr>
<td>2.0 kg ha(^{-1})</td>
<td>$B_3$</td>
</tr>
</tbody>
</table>

**Table 2:** Treatment combination

<table>
<thead>
<tr>
<th>$T_1$: $S_0 B_0$</th>
<th>$T_2$: $S_0 B_1$</th>
<th>$T_3$: $S_0 B_2$</th>
<th>$T_4$: $S_0 B_3$</th>
<th>$T_5$: $S_1 B_0$</th>
<th>$T_6$: $S_1 B_1$</th>
<th>$T_7$: $S_1 B_2$</th>
<th>$T_8$: $S_1 B_3$</th>
<th>$T_9$: $S_2 B_0$</th>
<th>$T_{10}$: $S_2 B_1$</th>
<th>$T_{11}$: $S_2 B_2$</th>
<th>$T_{12}$: $S_2 B_3$</th>
<th>$T_{13}$: $S_3 B_0$</th>
<th>$T_{14}$: $S_3 B_1$</th>
<th>$T_{15}$: $S_3 B_2$</th>
<th>$T_{16}$: $S_3 B_3$</th>
</tr>
</thead>
</table>

**Table 3:** Impact of different levels of sulphur and boron on plant height and number of leaves of onion

<table>
<thead>
<tr>
<th>Treats</th>
<th>Height of Plant</th>
<th></th>
<th>No. of leaves</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At 30 DAP</td>
<td>At 60 DAP</td>
<td>At 90 DAP</td>
<td>At 120 DAP</td>
<td>At 30 DAP</td>
</tr>
<tr>
<td>$B_0$ (Control)</td>
<td>$S_0$</td>
<td>15.45</td>
<td>26.88</td>
<td>38.00</td>
<td>43.00</td>
</tr>
<tr>
<td>$B_1$: 0.5 kg ha(^{-1})</td>
<td>$S_1$</td>
<td>16.35</td>
<td>29.48</td>
<td>42.20</td>
<td>47.66</td>
</tr>
<tr>
<td>$B_2$: 1.0 kg ha(^{-1})</td>
<td>$S_2$</td>
<td>17.57</td>
<td>31.58</td>
<td>45.44</td>
<td>52.51</td>
</tr>
<tr>
<td>$B_3$: 2.0 kg ha(^{-1})</td>
<td>$S_3$</td>
<td>17.58</td>
<td>31.69</td>
<td>46.18</td>
<td>52.82</td>
</tr>
<tr>
<td>S.E. (m)±</td>
<td>0.27</td>
<td>0.79</td>
<td>1.04</td>
<td>1.12</td>
<td>0.08</td>
</tr>
<tr>
<td>C.D. (5%)</td>
<td>0.77</td>
<td>2.27</td>
<td>2.99</td>
<td>3.23</td>
<td>0.24</td>
</tr>
<tr>
<td>$S_4$: 20 kg ha(^{-1})</td>
<td>16.31</td>
<td>29.16</td>
<td>41.57</td>
<td>47.31</td>
<td>6.67</td>
</tr>
<tr>
<td>$S_5$: 40 kg ha(^{-1})</td>
<td>17.60</td>
<td>31.64</td>
<td>45.68</td>
<td>52.10</td>
<td>6.73</td>
</tr>
<tr>
<td>S.E. (m)±</td>
<td>0.27</td>
<td>0.79</td>
<td>1.04</td>
<td>1.12</td>
<td>0.08</td>
</tr>
<tr>
<td>C.D. (5%)</td>
<td>0.77</td>
<td>2.27</td>
<td>2.99</td>
<td>3.23</td>
<td>0.24</td>
</tr>
<tr>
<td>$S_6$: 60 kg ha(^{-1})</td>
<td>17.62</td>
<td>32.77</td>
<td>47.50</td>
<td>53.74</td>
<td>6.91</td>
</tr>
<tr>
<td>S.E. (m)±</td>
<td>0.27</td>
<td>0.79</td>
<td>1.04</td>
<td>1.12</td>
<td>0.08</td>
</tr>
<tr>
<td>C.D. (5%)</td>
<td>0.77</td>
<td>2.27</td>
<td>2.99</td>
<td>3.23</td>
<td>0.24</td>
</tr>
<tr>
<td>$S_7$: 120 kg ha(^{-1})</td>
<td>16.00</td>
<td>29.05</td>
<td>40.65</td>
<td>45.12</td>
<td>6.60</td>
</tr>
<tr>
<td>$S_8$: 240 kg ha(^{-1})</td>
<td>16.93</td>
<td>31.60</td>
<td>46.04</td>
<td>52.82</td>
<td>6.91</td>
</tr>
<tr>
<td>$S_9$: 360 kg ha(^{-1})</td>
<td>17.30</td>
<td>29.89</td>
<td>43.55</td>
<td>49.97</td>
<td>6.82</td>
</tr>
<tr>
<td>$S_{10}$</td>
<td>17.05</td>
<td>30.81</td>
<td>44.89</td>
<td>51.50</td>
<td>6.74</td>
</tr>
<tr>
<td>$S_{11}$</td>
<td>18.46</td>
<td>33.50</td>
<td>48.81</td>
<td>56.00</td>
<td>6.74</td>
</tr>
<tr>
<td>$S_{12}$</td>
<td>18.87</td>
<td>33.51</td>
<td>48.83</td>
<td>56.02</td>
<td>6.83</td>
</tr>
</tbody>
</table>
Yield and yield parameters: Table 4. indicated that there was a significant response in bulb yield and yield parameters due to different levels of sulphur and boron as compared to respective control. The maximum length (4.48 cm), diameter of bulb (5.00 cm) fresh weight of bulb (78.32g) and bulb yield (330.3q/ha) were observed with 60 kg S ha^{-1} (S) which was significantly higher to control and 20 kg S ha^{-1} but statistically at par with 40 kg S ha^{-1}. In respect to boron Application of 2.0 kg B ha^{-1} resulted significantly maximum length (4.43cm), diameter of bulb (4.98cm) fresh weight of bulb (76.55g) and bulb yield (331.1 q/ha) bulb length as compared to control and 0.5 kg B ha^{-1} and followed by 1.0 kg B ha^{-1} treatment. The yield attributes viz. diameter of bulb, length of bulb and fresh weight of bulb increased due to increasing levels of sulphur and boron. The present results are closely related with the findings of Nagaich et al. (1998), Salimath (1990) [10], Earlier Nagaich et al. (1999) [6], Sharma et al. (2002) [11], Joshi et al. (2005) [3], and Mishu et al. (2013) [5].

Table 4: Impact of sulphur and boron on yield and yield parameters of bulb (cm) of onion

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Length of bulb (cm)</th>
<th>Diameter of bulb (cm)</th>
<th>Fresh weight of bulb(g)</th>
<th>Bulb Yield (kg plot-1)</th>
<th>(q ha-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B0 (Control)</td>
<td>3.71</td>
<td>4.07</td>
<td>64.88</td>
<td>14.56</td>
<td>289.0</td>
</tr>
<tr>
<td>B1: 0.5 kg ha^{-1}</td>
<td>4.01</td>
<td>4.54</td>
<td>70.14</td>
<td>15.56</td>
<td>308.8</td>
</tr>
<tr>
<td>B2: 1.0 kg ha^{-1}</td>
<td>4.40</td>
<td>4.93</td>
<td>75.84</td>
<td>16.63</td>
<td>329.9</td>
</tr>
<tr>
<td>B3: 2.0 kg ha^{-1}</td>
<td>4.43</td>
<td>4.98</td>
<td>76.55</td>
<td>16.68</td>
<td>331.1</td>
</tr>
<tr>
<td>S.E. (m)±</td>
<td>0.07</td>
<td>0.08</td>
<td>1.50</td>
<td>0.27</td>
<td>5.4</td>
</tr>
<tr>
<td>C.D. (5%)</td>
<td>0.21</td>
<td>0.24</td>
<td>4.33</td>
<td>0.79</td>
<td>15.6</td>
</tr>
<tr>
<td>S0 (Control)</td>
<td>3.62</td>
<td>4.09</td>
<td>62.55</td>
<td>14.74</td>
<td>292.4</td>
</tr>
<tr>
<td>S1: 20 kg ha^{-1}</td>
<td>4.05</td>
<td>4.52</td>
<td>70.77</td>
<td>15.45</td>
<td>306.5</td>
</tr>
<tr>
<td>S2: 40 kg ha^{-1}</td>
<td>4.41</td>
<td>4.90</td>
<td>75.76</td>
<td>16.61</td>
<td>329.5</td>
</tr>
<tr>
<td>S3: 60 kg ha^{-1}</td>
<td>4.48</td>
<td>5.00</td>
<td>78.32</td>
<td>16.65</td>
<td>330.3</td>
</tr>
<tr>
<td>S.E. (m)±</td>
<td>0.07</td>
<td>0.08</td>
<td>1.50</td>
<td>0.27</td>
<td>5.4</td>
</tr>
<tr>
<td>C.D. (5%)</td>
<td>0.21</td>
<td>0.24</td>
<td>4.33</td>
<td>0.79</td>
<td>15.6</td>
</tr>
<tr>
<td>S+B</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>S.E. (m)±</td>
<td>0.15</td>
<td>0.17</td>
<td>3.01</td>
<td>8.66</td>
<td></td>
</tr>
<tr>
<td>C.D. (5%)</td>
<td>0.43</td>
<td>0.49</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Conclusion
From present study, it can be concluded that application of 40 kg sulphur and 1.0 kg Boron may be beneficial for higher bulb yield and net return as well as B:C ratio in onion in Gwalior district.

References