INFLUENCE OF SULPHUR AND FOLIAR SPRAY OF NUTRIENTS ON YIELD OF BLACK GRAM

Girish T. Limbikai et al.

KEYWORDS
Blackgram
Sulphur
Foliar application
DAP
INTRODUCTION

Among the various pulses, blackgram or urdbean (*Vigna mungo* [L.] Hepper) is an important grain legume with easily digestible protein. It belongs to the family **Fabaceae** with 2n = 22. India is the world’s largest producer as well as consumer of blackgram. It produces about 1.5 to 1.9 million tonnes of blackgram annually from about 3.5 million hectares of area, with an average productivity of 0.5 tonnes per hectare (Agropedia, 2013).

Blackgram grain contains about 25 per cent protein, 56 per cent carbohydrate, 2 per cent fat, 4 per cent minerals and 0.4 per cent vitamins. It forms one of the important constituents in the dietary practices of the population depending on vegetarian diet. Slow pulse production growth has substantially reduced the per capita consumption of pulses, especially in predominantly vegetarian countries (from 63.0 g/day in 1961 to 27.3 g in 2010 in India (Swati Das et al., 2014). Imbalanced use of nutrients is one of the major factors responsible for reduced yield levels. Hence, there is need to enhance its productivity through agronomic means.

Now a day it is being released that apart from major nutrients, the role of secondary nutrients in general and sulphur is particular in increasing in pulse production is well established. In recent years, sulphur deficiency has become an increasing problem in agriculture, which limits the crop production (Wells and Darts, 1986). The role of sulphur in plant nutrition as one of the essential plant nutrients is well documented (Marschner, 1995). Sulphur is recognized as fourth major nutrient after nitrogen, phosphorus, and potassium. It is essential for the growth and development of plant, besides stimulating seed formation. It not only influences yield but also improves grain quality owing to its influence on protein metabolism and oil synthesis. It improves crop management through its favorable effect on environmental stress, resistance against pest and disease (Kruse et al., 2007). Sulphur application is beneficial for enhancing the productivity of blackgramas well as quality of grains.

Foliar application of nutrients for increasing and exploiting genetic potential of the crop is considered as an efficient and economic method of supplementing the nutrient requirement. Application of inorganic nutrient spray will also enhance the nutrient availability, quick absorption and in turn increases the productivity. Nutrients applied through foliage play a pivotal role in increasing the seed yield in pulses (Chandrasekhar and Bangarusamy, 2003).

So far meagre work has been carried out in this direction and there is need to study the response of sulphur and foliar nutrition in blackgram. Further, there is a growing interest in the use of secondary nutrients, sulphur in particular. Keeping these facts...
The present experiment was planned to enhance the productivity of blackgram through sulphur application to soil and foliar sprays of nutrients and growth regulators.

MATERIALS AND METHODS

A field experiment was carried at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad (Karnataka) during the kharif 2011 blackgram crop was grown in the experimental area. The experiment was laid out in split plot design with two main plots (0 and 20 kg S/ha) and nine sub plots of foliar application (2% DAP, urea, ureaphos and 19:19:19 with and without NAA and water spray). Sulphur was applied in the form of gypsum to the soil. Nutrients and combinations of nutrients and growth regulators were applied to foliage through sprays. Blackgram variety DU-1 was used. DU-1 is a medium short duration variety, it grows to a height of 40-60 cm with erect growing habit having more number of clusters and pods per plant and seeds are bold, moderately resistant to powdery mildew and it comes to harvest at 85-90 days after sowing. The fertilizers were applied to all sub plots of foliar application (2% DAP, urea, ureaphos and 19:19:19 with and without NAA and water spray). Sulphur was applied in the form of gypsum to the soil. Nutrients and combinations of nutrients and growth regulators were applied to foliage through sprays. Blackgram variety DU-1 was used. DU-1 is a medium short duration variety, it grows to a height of 40-60 cm with erect growing habit having more number of clusters and pods per plant and seeds are bold, moderately resistant to powdery mildew and it comes to harvest at 85-90 days after sowing. The fertilizers were applied to all sub plots of foliar application (2% DAP, urea, ureaphos and 19:19:19 with and without NAA and water spray). Sulphur was applied in the form of gypsum. Full dose of fertilizers was applied at the time of sowing. Two foliar sprays of nutrients and growth regulators, treatment wise were applied at 45 and 55 days after sowing which coincides with flowering and pod filling stage. The interaction of sulphur and foliar sprays revealed that, sulphur at 20 kg/ha with 2% DAP and 40 ppm NAA recorded significantly higher number of pods per plant (31.35) over others (20.08-27.78) and significantly lower number of pods per plant was recorded with water spray (20.08). The interaction of sulphur and foliar sprays revealed that, sulphur at 20 kg/ha with 2% DAP and 40 ppm NAA recorded significantly higher number of pods per plant (41.23) over other treatment combinations. Significantly lower number of pods per plant was recorded in RDF with water spray (18.47).

Pod weight at harvest

Pod weight of blackgram was significantly influenced by application of sulphur and foliar application of nutrients during flowering and pod filling stage. Higher pod weight (g) was recorded with application of sulphur at 20 kg/ha (20.85g) over no sulphur (14.83g). Among the foliar sprays, 2% DAP + 40 ppm NAA recorded significantly higher pod weight compared to water spray (21.06). But it was on par with 2% DAP (20.17), 2% Urea (19.70g), 2% Ureaphos + 40ppm NAA (20.00g) and 2% 19:19:19 + 40ppm NAA (19.43g) and significantly lower pod weight (13.54g) was recorded with water spray. The interaction of sulphur and foliar sprays revealed that, sulphur at 20 kg/ha with 2% DAP and 40 ppm NAA recorded significantly higher pod weight (23.00g), than RDF with water spray (17.59g). And significantly lower pod weight was recorded with RDF with water spray (17.59g).

Thousand seed weight (g)

There was a positive influence on test weight by the sulphur application and foliar spray of nutrients on blackgram (Table 2). Higher thousand seed weight (g) was recorded with application of sulphur at 20 kg/ha (51.24g) over no sulphur (41.23g). Among the foliar sprays, 2% DAP + 40 ppm NAA recorded significantly higher thousand seed weight (g) over no sulphur (17.59g).

Table 1: Number of pods per plant of black gram as influenced by sulphur and foliar application of nutrients and growth regulators at different growth stages

<table>
<thead>
<tr>
<th>Treatment</th>
<th>60 DAS</th>
<th>At harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With sulphur</td>
<td>Without sulphur</td>
</tr>
<tr>
<td>DAP (2%) spray</td>
<td>32.17</td>
<td>22.52</td>
</tr>
<tr>
<td>Urea (2%) spray</td>
<td>24.47</td>
<td>20.77</td>
</tr>
<tr>
<td>Ureaphos (2%) spray</td>
<td>30.60</td>
<td>22.00</td>
</tr>
<tr>
<td>DAP (2%) + NAA (40 ppm) spray</td>
<td>33.47</td>
<td>23.47</td>
</tr>
<tr>
<td>Urea (2%) + NAA (40 ppm) spray</td>
<td>25.07</td>
<td>21.07</td>
</tr>
<tr>
<td>Ureaphos (2%) + NAA (40 ppm) spray</td>
<td>31.23</td>
<td>22.25</td>
</tr>
<tr>
<td>19:19:19 (2%) + NAA (40 ppm) spray</td>
<td>26.20</td>
<td>21.56</td>
</tr>
<tr>
<td>Water spray</td>
<td>23.50</td>
<td>20.27</td>
</tr>
<tr>
<td>Mean</td>
<td>28.04</td>
<td>21.68</td>
</tr>
<tr>
<td>For comparing</td>
<td>SEm ± CD at 5%</td>
<td>SEm ± CD at 5%</td>
</tr>
<tr>
<td>Main plot</td>
<td>0.40</td>
<td>2.42</td>
</tr>
<tr>
<td>Sub plot</td>
<td>0.73</td>
<td>2.11</td>
</tr>
<tr>
<td>Interaction</td>
<td>1.06</td>
<td>3.52</td>
</tr>
</tbody>
</table>

DAS = Days after sowing; NS = Non-significant
Recorded significantly higher thousand seed weight (54.17g) over other sprays except 2% DAP (52.13g). Significantly lower thousand seed weight was recorded with water spray (40.00g). Interaction of sulphur and foliar sprays revealed that, sulphur at 20 kg/ha with 2% DAP and 40 ppm NAA recorded significantly higher thousand weight (65.34g) over other treatment combinations except sulphur at 20 kg/ha with 2% DAP (61.59g).

Seed yield per plant (g)
The higher seed yield per plant (g) was recorded with application of sulphur at 20 kg/ha (1088kg/ha) over RDF (824kg/ha) alone. Among the foliar sprays, 2% DAP + 40 ppm NAA recorded significantly higher seed yield (1202 kg/ha) over other sprays except 2% DAP (1138kg/ha) and significantly lower seed yield was recorded with water sprays (820 kg/ha). The interaction of sulphur and foliar sprays revealed that, sulphur at 20 kg/ha with 2% DAP and 40 ppm NAA recorded significantly higher seed yield (1415 kg/ha) over other treatment combinations except sulphur at 20 kg/ha with 2% DAP (1319kg/ha) and significantly lower seed yield was recorded by RDF with water spray (708 kg/ha) [Table 3].

**DISCUSSION**
The present study, application of 20 kg S per ha recorded significantly higher seed yield (1088 kg/ha) compared to no sulphur (824 kg/ha) . The increase was 32% higher than RDF alone. The reason behind increased seed yield owing to sulphur application might be due to increased metabolic and enzymatic processes including photosynthesis and legume-rhizobium symbiotic nitrogen fixation. Successive increase in

### Table 2: Pod weight per plant, 1000 seed weight and seed yield per plant of black gram as influenced by sulphur and foliar application of nutrients and growth regulators at different growth stages

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pod weight per plant (g) Mean</th>
<th>1000 seed weight (g) Mean</th>
<th>Seed yield per plant (g) Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With sulphur</td>
<td>Without sulphur</td>
<td>With sulphur</td>
</tr>
<tr>
<td>DAP (2%) spray</td>
<td>21.67</td>
<td>18.67</td>
<td>20.17</td>
</tr>
<tr>
<td>Urea (2%) spray</td>
<td>19.67</td>
<td>7.78</td>
<td>13.73</td>
</tr>
<tr>
<td>Ureaphos (2%) spray</td>
<td>21.00</td>
<td>18.41</td>
<td>19.70</td>
</tr>
<tr>
<td>19: 19: 19 (2%) spray</td>
<td>20.33</td>
<td>17.33</td>
<td>18.83</td>
</tr>
<tr>
<td>DAP (2%) + NAA (40 ppm) spray</td>
<td>23.00</td>
<td>19.12</td>
<td>21.06</td>
</tr>
<tr>
<td>Urea (2%) + NAA (40 ppm) spray</td>
<td>20.00</td>
<td>8.23</td>
<td>14.12</td>
</tr>
<tr>
<td>Ureaphos (2%) + NAA (40 ppm) spray</td>
<td>21.48</td>
<td>18.51</td>
<td>20.00</td>
</tr>
<tr>
<td>19: 19: 19 (2%) + NAA (40 ppm) spray</td>
<td>21.00</td>
<td>17.86</td>
<td>19.43</td>
</tr>
<tr>
<td>Water spray</td>
<td>19.48</td>
<td>7.59</td>
<td>13.54</td>
</tr>
</tbody>
</table>

**Table 3: Seed yield of black gram as influenced by sulphur and foliar application of nutrients and growth regulators at different growth stages**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Seed yield (kg/ha) Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With sulphur</td>
</tr>
<tr>
<td>DAP (2%) spray</td>
<td>1319</td>
</tr>
<tr>
<td>Urea (2%) spray</td>
<td>944</td>
</tr>
<tr>
<td>Ureaphos (2%) spray</td>
<td>1050</td>
</tr>
<tr>
<td>19: 19: 19 (2%) spray</td>
<td>984</td>
</tr>
<tr>
<td>DAP (2%) + NAA (40 ppm) spray</td>
<td>1415</td>
</tr>
<tr>
<td>Urea (2%) + NAA (40 ppm) spray</td>
<td>981</td>
</tr>
<tr>
<td>Ureaphos (2%) + NAA (40 ppm) spray</td>
<td>1166</td>
</tr>
<tr>
<td>19: 19: 19 (2%) + NAA (40 ppm) spray</td>
<td>1007</td>
</tr>
<tr>
<td>Water spray</td>
<td>932</td>
</tr>
</tbody>
</table>

**Main plot** 2 15

**Sub plot** 26 74

**Interaction** 34 99

**DAS – Days after sowing; NS – Non-significant**

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Recorded significantly higher thousand seed weight (54.17g) over other sprays except 2% DAP (52.13g). Significantly lower thousand seed weight was recorded with water spray (40.00g). Interaction of sulphur and foliar sprays revealed that, sulphur at 20 kg/ha with 2% DAP and 40 ppm NAA recorded significantly higher thousand weight (65.34g) over other treatment combinations except sulphur at 20 kg/ha with 2% DAP (61.59g).

**Seed yield per plant (g)**

The higher seed yield per plant (g) was recorded with application of sulphur at 20 kg/ha (5.62g) over RDF (5.38 g) alone (Table 2). Among the foliar sprays, of 2% DAP + 40 ppm NAA spray recorded significantly higher seed yield per plant (7.03g) over other sprays (4.81 - 5.97g). The interaction of sulphur and foliar sprays revealed that, sulphur at 20 kg/ha with 2% DAP and 40 ppm NAA recorded significantly higher thousand weight (7.55g) over other treatment combinations (4.78 - 6.05g).

**Seed yield (kg/ha)**

Sulphur and foliar application of nutrients had significant variation in the seed yield of blackgram. The higher seed yield (kg) was recorded with application of sulphur at 20 kg/ha (1088kg/ha) over RDF (824kg/ha) alone. Among the foliar sprays, 2% DAP + 40 ppm NAA recorded significantly higher seed yield (1202 kg/ha) over other sprays except 2% DAP (1138kg/ha) and significantly lower seed yield was recorded with water sprays (820 kg/ha). The interaction of sulphur and foliar sprays revealed that, sulphur at 20 kg/ha with 2% DAP and 40 ppm NAA recorded significantly higher seed yield (1415 kg/ha) over other treatment combinations except sulphur at 20 kg/ha with 2% DAP (1319kg/ha) and significantly lower seed yield was recorded by RDF with water spray (708 kg/ha) [Table 3].

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**Discussion**

The present study, application of 20 kg S per ha recorded significantly higher seed yield (1088 kg/ha) compared to no sulphur (824 kg/ha) . The increase was 32% higher than RDF alone. The reason behind increased seed yield owing to sulphur application might be due to increased metabolic and enzymatic processes including photosynthesis and legume-rhizobium symbiotic nitrogen fixation. Successive increase in
The improvement in yield could be attributed to substantial increase in yield components like, number of pods per plant, pod weight per plant, thousand seed weight and seed yield per plant (Table 1 and 2). In present investigation, the application of 20 kg S/ha in combination with foliar sprays of 2% DAP +40 ppm NAA at 45 and 55 DAS recorded significantly higher number of pods per plant (41.23), pod weight per plant (23.00g), thousand seed weight (65.34g) and seed yield per plant (7.55g) compared to other treatment combinations. The increase in these yield attributes may be associated with increased yield attributes.

REFERENCES

Agropedia 2013. Area, Production and Productivity of major pulses, Internet browsing.


