YIELD AND YIELD COMPONENTS OF CANOLA AFFECTED BY SULPHUR LEVELS AND APPLICATION TIMINGS

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Abstract

Canola (Brassica napus L.) a conventional oil seed crop, as winter season crop which can be successfully grown in Pakistan. Present research was conducted to study “yield of canola as affected by different sulphur (S) levels and application timings” at Agronomy Res. Farm, Univ. of Agriculture, Peshawar in season 2014-15. Canola crop was sown under sulphur levels of 30 and 40 (kg S ha⁻¹) with three timing of S application (full at sowing, split application and rosette stage). Experiment was designed in randomized complete block design replicated four times. Results showed that more number of pods plant⁻¹ (278), grain pod⁻¹ (21), thousand grain weight (4.1 g), biological yield (3911 kg ha⁻¹), grain yield (1317 kg ha⁻¹) and harvest index (29 %) were significantly affected by different sulphur levels and application timings. Data revealed that equal split application at rate of 30 kg S ha⁻¹ was more efficient as compared with full at sowing or rosette stage. From this study, it was concluded that yield and yield components were substantially improved by the split application of S at 30 kg S ha⁻¹ at sowing and rosette stage.

Key Words: Sulphur levels, split application, canola yield, yield components

INTRODUCTION

Rapeseed (Brassica napus L.) belongs to the Cruciferaeae (Brassicaceae) family, common species are B. nigra, B. carinata, B. juncea, B. oleracea and B. compestris (Holmes, 1980). Rapeseed or mustard was grown from 300 BC in Indus valley of Pakistan as a fodder crop. Rapeseed and mustard are traditional oil seed crops of Pakistan which are grown in large area of four provinces of country (Khan et al., 2004). Canola was introduced in Pakistan during 1995 for general cultivation to replace traditional oilseed crops like rapes and mustards because of its low erusic acid contents and high yielding capacity (Chaudhry et al., 2011). During 2011-12 in Pakistan the Canola crop was cultivated in 14700 ha with the production of 7000 tones, while Khyber Pakhtunkhwa the area under cultivation was 1300 ha with a total production of 1800 tones (MNFSR, 2012).

Like all other crops, growth, developmental process and grain yield of canola depends upon biotic and abiotic factors. Sulfur is the fourth major plant nutrient after nitrogen, phosphorus and potassium. It is essential for synthesis of the amino acids like cystine, and methionine, a component of vitamin A and activates certain enzyme systems in plants (Havlín et al., 2004). It is also an important soil fertility factor to consider when growing canola (Ghosh et al., 2000) because of high requirement of S by Cruciferaeae family (Scherer, 2001). The seed yield,
total dry matter and harvest index in some genotypes of *Brassica napus* and *Brassica juncea* has been found to improve with higher rate of sulphur (Chandel et al., 2002; Malhi et al., 2007). Sulphur deficiency adversely reduces yield, protein and enzyme synthesis (Scherer, 2001). Sometimes, Plant immobility makes the nutrient deficient and S deficiency at any growth stage can cause considerable reduction in seed yield of canola and thus a regular supply of available S is required throughout the growing season (Malhi and Gill, 2002). Plant nutrients availability at appropriate time and amount is predictable to harvest optimal yields (Habtegebrial and Singh, 2006). Sulphur content in canola plants range from 1 and 16 g kg\(^{-1}\) dry mass, depending on the exogenous supply (Balint and Rengel, 2009). Sulphur is a component of certain amino acids which is required for protein synthesis in canola crop. Despite this formation of proteins in growth and development of canola, S can also influence seed yield and enhancing oil percentage (Zhao et al., 1993; Jan et al., 2002; Sattar et al., 2011). Less sulphur content will greatly reduce N uptake hence the application of S needs to be balanced with N for optimum yields and yield components (Ceccoti, 1996; Fismes et al., 2000; Brennan and Bolland, 2008). The present investigation was undertaken to determine the optimum level and timing for S-fertilizer application for obtaining higher seed yield of canola.

**MATERIAL AND METHODS**

**Site and Experiment:** “Yield of canola as affected by different Sulphur (S) levels and application timings” was conducted at the Palatoo Research Farm Department of Agronomy, Amir Muhammad Khan Campus, Mardan during Rabi Season 2014-2015. Treatments consist of different sulphur levels (30 & 40 kg ha\(^{-1}\)) and their application timings (full at sowing, split application at sowing and rosette stage). The experiment was laid out in randomized complete block with four replications. The plot size was 3×3 m\(^2\). The basal dose N and P at the rate of 70 and 40 kg ha\(^{-1}\) was applied. All the agronomic practices were applied according to crop need.

**Statistical analysis:** The data recorded was analyzed statistically using analysis of variance techniques appropriate for randomized complete block design. Means were compared using LSD test at 0.05 level of probability, when the F-values were significant (Jan et al., 2009);

**RESULTS AND DISCUSSION**

**Number of pods plant\(^{-1}\):** Number of pods per plant as affected by different Sulphur levels and application timings is shown in Fig.1. Statistical analysis of the data indicated that sulphur levels and S ha\(^{-1}\) (194). Likewise, maximum number of pods plant\(^{-1}\) (278) were obtained with equal split application followed by full at rosette stage (242), while minimum pods (234) were measured full application of S at sowing time. These results are in conformity with Sattar et al. (2011) who found that sulphur application resulted in more numbers of pods per plant.

**Grain pods\(^{-1}\):** Number of grains pods\(^{-1}\) as affected by different Sulphur levels and application timings is shown in Fig.2. Statistical analysis of the data indicated that sulphur levels and application timing significantly affected grains pods\(^{-1}\). Maximum number of grains pod\(^{-1}\) (21) were obtained with split application of 30 kg S ha\(^{-1}\) as compared with split application of S at rate of 40 kg ha\(^{-1}\)(14 pod plant\(^{-1}\)). Likewise, maximum grains pod\(^{-1}\)(21) was obtained with equal splits application followed by full at sowing time (17) while minimum number of grains pod\(^{-1}\) were recorded at full application of S at rosette stage (16). These results are in line with Sharifi et al. (2012) and Mirzashahi et al. (2009) who reported that higher number of grains pod\(^{-1}\) for higher S application.

**Thousand grain weight (g):** Analysis of the Data had shown that different Sulphur levels and application timings have significant effect on thousand grain weight (Fig.5). Highest thousands grain weight (4.1 g) was recorded with split application of 30 kg S ha\(^{-1}\) as compared to S applied at rate of 40 kg S ha\(^{-1}\) full at rosette stage (3.8 g). Similarly, higher thousand grain weight (4.1 g) was obtained with equal split application followed by full at sowing time (3.3 g) while minimum thousands
grain weight was obtained at full application of Sulphur at rosette stage (4.0 g). These results are in conformity with Sattar et al. (2011), Anjum et al. (2016) and Mirzashahi et al. (2009) who found sulphur application resulted in higher thousands grain weight.

**Biological yield (kg ha\(^{-1}\))**: Data regarding biological yield as affected by different Sulphur levels and application timings is shown in Fig.3. Analysis of the data revealed that sulphur levels and application timing significantly affected Biological yield. Highest biological yield (3911 kg ha\(^{-1}\)) was obtained with Split application of 30 kg S ha\(^{-1}\) as compared to S at rate of 40 kg S ha\(^{-1}\) split application (3626 kg ha\(^{-1}\)). Similarly, maximum biological yield (3911 kg ha\(^{-1}\)) was produced when split application of S was applied followed by full at sowing time (3659 kg ha\(^{-1}\)) while minimum biological yield was obtained at full application of S at rosette stage (3363 kg ha\(^{-1}\)). These results are in line with Vasehgi et al. (2011) who found that higher S application produced more biological yield.

**Grain yield (kg ha\(^{-1}\))**: Different Sulphur levels and application timings has shown a significant effect on grain yield (Fig.4). Maximum grain yield was recorded (1317 kg ha\(^{-1}\)) with split application of 30 kg S ha\(^{-1}\) as compared with (974 kg ha\(^{-1}\)) split application of S at 40 kg ha\(^{-1}\). Correspondingly, maximum grain yield (1317 kg ha\(^{-1}\)) were obtained with equal split application followed by full at sowing time (1142 kg ha\(^{-1}\)) while minimum grain yield was obtained under full application of Sulphur at rosette stage (1056 kg ha\(^{-1}\)). These results are in line with Anjum et al. (2016) who found that higher Sulphur application produced more grain yield.

**Harvest index (%):** Harvest Index of canola crop has shown a significant effect by different levels and application timing of Sulphur (Fig. 6). Analysis of the data has revealed that higher harvest index (35 %) was recorded with split application of 30 kg S ha\(^{-1}\) as compared with (28 %) @ 40 kg S ha\(^{-1}\) full at sowing. Similarly, higher harvest index were (35 %) obtained with equal split application followed by (29 %) full at sowing time while minimum harvest index was obtained at full application of Sulphur at rosette stage (27 %). These results are also in agreement with Sattar et al. (2011);Anjum et al. (2016) and Mirzashahi et al. (2009) who found Sulphur application resulted in higher thousands grain weight.
LSD = 2.47
Fig. 4. Biological yield (kg ha\(^{-1}\)) of Canola as affected by different levels and timings of Sulphur application

LSD = 2.04
Fig. 5. Thousands grain weight of Canola as affected by different levels and timings of Sulphur application

LSD = 2.25
Fig. 5. Grain yield (kg ha\(^{-1}\)) of Canola as affected by different levels and timings of Sulphur application

LSD = 2.24
Fig. 6. Harvest index (%) as affected by different levels and timings of Sulphur application
Table.1. Number of pods plant$^{-1}$, grains pod$^{-1}$, biological yield (kg ha$^{-1}$), grain yield (kg ha$^{-1}$), thousand grain weight (g) and harvest index (%) of Canola as affected by different levels and timings of Sulphur application

<table>
<thead>
<tr>
<th>Observations</th>
<th>Stages</th>
<th>30 kg S ha$^{-1}$</th>
<th>40 kg S ha$^{-1}$</th>
<th>LSD values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pods plant$^{-1}$</td>
<td>Full at Sowing</td>
<td>16</td>
<td>12</td>
<td>2.28</td>
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<tr>
<td></td>
<td>Split application</td>
<td>19</td>
<td>15</td>
<td></td>
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<tr>
<td></td>
<td>Rosette stage</td>
<td>15</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Grains pod$^{-1}$</td>
<td>Full at Sowing</td>
<td>233</td>
<td>189</td>
<td>2.29</td>
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<tr>
<td></td>
<td>Split application</td>
<td>295</td>
<td>198</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rosette stage</td>
<td>252</td>
<td>187</td>
<td></td>
</tr>
<tr>
<td>Biological yield (kg ha$^{-1}$)</td>
<td>Full at Sowing</td>
<td>3534</td>
<td>3099</td>
<td>2.27</td>
</tr>
<tr>
<td></td>
<td>Split application</td>
<td>3876</td>
<td>3546</td>
<td></td>
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<tr>
<td></td>
<td>Rosette stage</td>
<td>3224</td>
<td>3133</td>
<td></td>
</tr>
<tr>
<td>Grain yield (kg ha$^{-1}$)</td>
<td>Full at Sowing</td>
<td>1044</td>
<td>870</td>
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<td></td>
<td>Split application</td>
<td>1375</td>
<td>954</td>
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<td></td>
<td>Rosette stage</td>
<td>956</td>
<td>775</td>
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<tr>
<td>Thousand grain weight (g)</td>
<td>Full at Sowing</td>
<td>3.2</td>
<td>3.1</td>
<td>2.04</td>
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<tr>
<td></td>
<td>Split application</td>
<td>4.3</td>
<td>3.6</td>
<td></td>
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<td></td>
<td>Rosette stage</td>
<td>3.9</td>
<td>3.78</td>
<td></td>
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<tr>
<td>Harvest index (%)</td>
<td>Full at Sowing</td>
<td>29.6</td>
<td>28.1</td>
<td>2.24</td>
</tr>
<tr>
<td></td>
<td>Split application</td>
<td>35.5</td>
<td>26.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rosette stage</td>
<td>29.7</td>
<td>24.7</td>
<td></td>
</tr>
</tbody>
</table>

CONCLUSION

On the basis of the experimental findings, it can be concluded that split application of S at the rate of 30 kg ha$^{-1}$ (half at sowing and half at rosette) improved yield and yield components of Canola. Therefore, split application of S is recommended for achieving yield goals of Canola to overcome oil deficiency in the country.

REFERENCES


