International Journal of Current Trends in
Pharmacobiology and Medical Sciences
Volume 1 • Number 3 (August-2016) • ISSN: 2456-2432
Journal homepage: www.ijctpms.com

Original Research Article

Yield Performance of Canola as Affected by Different 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 the yield performance of canola as affected by different sulphur (S) levels and application timings at Agronomy Research Farm, University of Agriculture, Peshawar in season 2014-15. Canola crop was sown under different sulphur levels with 30 and 40 (kg S ha^{-1}) with three times of S application (full at sowing, split application and rosette stage). Experiment was designed in randomized complete block design (RCBD) replicated four times. Results Showed that more number of pods $plant^{-1}$ (278), grain pod^{-1} (21), biological yield (3911 kg ha^{-1}), grain yield (1317 kg ha^{-1}), thousand grain weight (4.1 g) and harvest index (29 %) were significantly affected by different sulphur levels and application timings. Data revealed that equal split application @ 30 kg S ha^{-1} was more efficient as compared with full at sowing or rosette stage. From this study it was concluded that all the yield parameters were significantly influenced by the equal split application of S @ 30 kg S ha^{-1}.

Article Info

Accepted: 18 August 2016
Available Online: 25 August 2016

Keywords

Canola yield
Split application
Sulphur levels
Yield components

Introduction

Rapeseed (*Brassica napus* L.) belongs to the Cruciferaceae (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 Phukhtunkhwa 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 (Havlin 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 Cruciferae 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 to obtain maximum seed yield of canola.

Materials and methods

Site and experiment

"Yield performance of canola as affected by different Sulphur (S) levels and application timings" was conducted at the Palatoo research farm Department of Agronomy, Amir Muhmmad khan Campus, Mardan during rabi season 2014-2015. Treatments consist of Sulphur different levels (30 & 40 kg ha^{-1}) and their application timings (full at sowing, split application 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 k 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., 2008).

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 application timing significantly affected number of pods per plant. Maximum number of pod $plant^{-1}$ (278) were obtained with application of 30 kg S ha^{-1}as compared with (194) from 40 kg S ha^{-1}. Likewise, maximum number of pods $plant^{-1}$ were (278) obtained with equal split application followed by full at rosette stage (242), while minimum (234) pods 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.

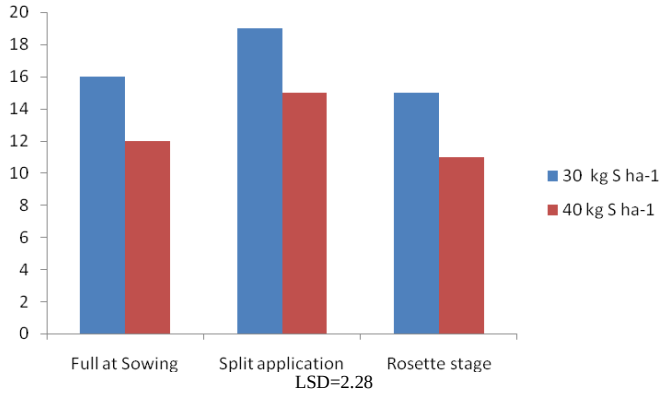
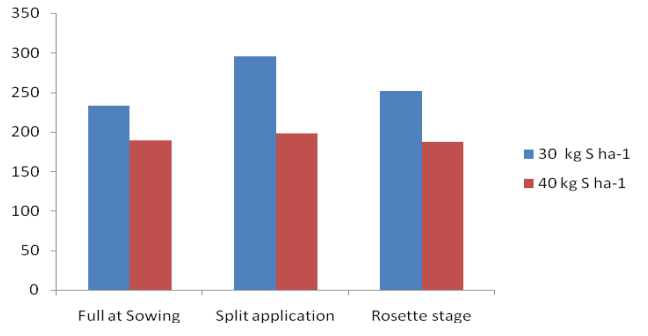


Fig. 1: Number of pods per plant of Canola as affected by different levels and timings of Sulphur application.

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 (14 pod $plant^{-1}$) from split application of S @ 40 kg ha^{-1}.Likeiwse, maximum grains $pods^{-1}$ were

(21) obtained with equal split application followed by (17) full at sowing time while minimum numbers of grain pods^{-1} were recorded at full application of sulphur at rosette stage (16). These results are in line with Sharifi et al. (2012) and Mirzashahi et al. (2009) who reported that higher numbers of grain per pod for high S application.



LSD=2.29

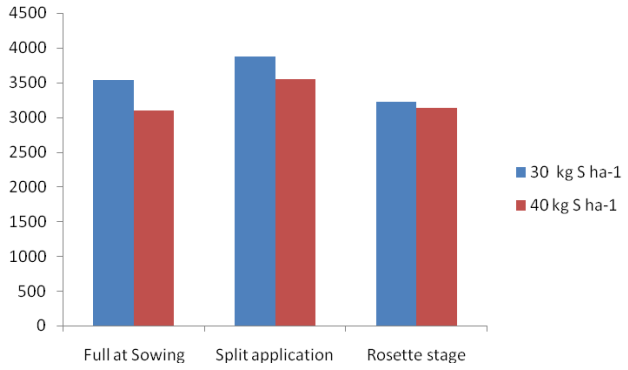
Fig. 2: Number of grains per pod of Canola as affected by different levels and timings of Sulphur application.

Biological yield

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 with (3626 kg ha^{-1}) @ 40 kg S ha^{-1} split application .Similarly, maximum Biological yield were (3911 kg ha^{-1}) obtained with equal split application followed by (3659 kg ha^{-1}) full at sowing time while minimum Biological yield was obtained at full application of Sulphur at rosette stage (3363 kg ha^{-1}). These results are in line with Vasehgi et al. (2011) and Jan et al. (2008) who found that higher S application produced more biological yield.

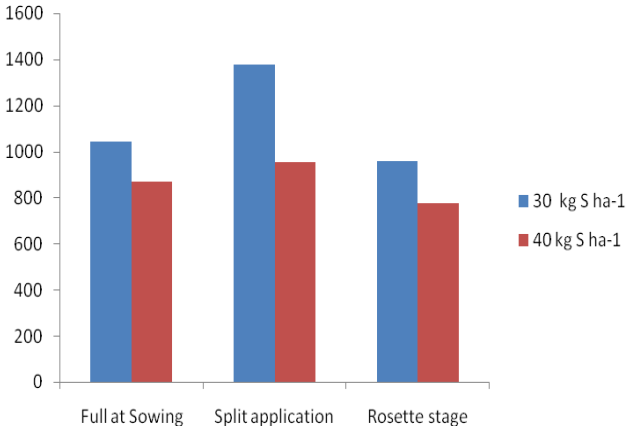
Grain yield

Different Sulphur levels and application timings have 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 @ 40 kg ha^{-1}. Correspondingly, maximum grain yield were (1317 kg ha^{-1}) obtained with equal split application followed by (1142 kg ha^{-1}) full at sowing time while minimum Grains yield was obtained at 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.



LSD=2.27

Fig. 4: Biological yield (kg ha^{-1}) of Canola as affected by different levels and timings of Sulphur application.



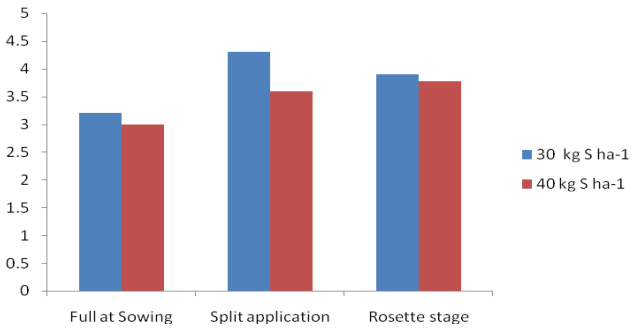
LSD=2.25

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

Thousand grain weight (g)

Analysis of the Data had shown that different Sulphur levels and application timings have significant affect on thousand grain weight (Fig.5). Highest thousands grain weight was recorded (4.1 g) with split application of 30 kg S ha^{-1} as compared with (3.8 g)@ 40 kg S ha^{-1} full at rosette stage. Similarly, higher thousand grain weight were (4.1 g) obtained with equal split application followed by (3.3 g) full at sowing time while minimum thousands grain weight was obtained at full application of Sulphur at rosette stage (4.0g) 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.

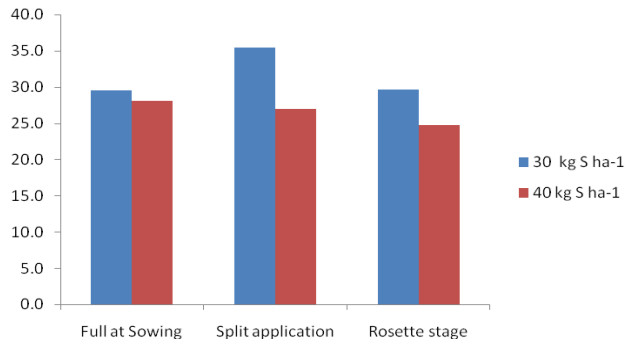


LSD=2.04

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

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=2.24

Fig. 6: Harvest index (%) as affected by different levels and timings of Sulphur application.

Conflict of interest statement

Authors declare that they have no conflict of interest.

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How to cite this article:
Author, B., Author, A., 2016. Yield performance of canola as affected by different sulphur levels and application timings. Int. J. Curr. Trend. Pharmacobiol. Med. Sci. 1(3), 78-82.