Performance of Rapeseed (*Brassica campestris* L.) CV. SAU Sarisha-1 under Different Row Spacings and Irrigation Levels

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**Abstract:** A newly released rapeseed variety SAU sarisha-1 was grown at the research field of Sher-e-Bangla Agricultural University (SAU), Dhaka-1207, Bangladesh during the period from October, 2004 to January, 2005 under different row spacings and irrigation levels to investigate its plant characters, yield attributes and seed yield. Row spacings and irrigation levels significantly affected the growth and yield of rapeseed. Among the row spacing (20 cm, 30 cm and 40 cm) and irrigation levels (no irrigation, one irrigation at 30 DAS and two irrigations at 30 and 60 DAS), 30 cm row spacing and two irrigation had significant and overriding influence on plants. Plants were grown at 30 cm row spacing along with two irrigation – one at 30 DAS (pre-flowering stage) and another at 60 DAS (silique development stage) gave highest seed yield and harvest index. The seed yield was associated with the yield attributes which was signifies with the relationship studied between yield attributes and seed yield.

**Keywords:** Rapeseed, row spacing, irrigation, yield

**INTRODUCTION**

Rapeseed (*Brassica campestris* L.) belongs to the family Cruciferae is an important oil crop and currently it is the principal oil crop of Bangladesh. Rapeseed contains 40 - 45% oil and 20 - 25% protein in seed. The annual oil seed production is 376000 metric tons of which rapeseed covers 62%.[1] It is top of the list in respect of area and production of oilseed crops cultivated in this country. The average seed yield of rapeseed 0.71 t ha⁻¹ in this country[2], which is very low as compared to that of the advanced countries[3]. The major reasons for such poor yield of rapeseed in Bangladesh may be attributed to the lack of using improved varieties and poor management practices in the farmers’ field.

Establishment of optimum plant population by maintaining proper row spacing is one of the important factors to secure a good yield in any crop[4,5]. In Bangladesh rapeseed is mostly grown on the residual soil moisture in Rabi (winter) season[6]. But irrigation is a vital factor for proper growth and development of this crop in dry season[7]. Mondal *et al.*[8] reported that one irrigation at flowering and another at silique development stages of mustard gave the highest seed yield (2.56 t ha⁻¹).

Taking the above mentioned points in view, the field trial was undertaken to study the impact of suitable row spacing and optimum irrigation levels on the performance of the rapeseed cv. SAU sarisha-1.

**MATERIALS AND METHODS**

The experiment was conducted at the research field of Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh during the period from October 2004 to January 2005. The soil of the experimental site belongs to the agro-ecological region of “Madhupur Tract” (AEZ No. 28). It was Deep Red Brown Terrace soil and belonged to “Nodda” cultivated series. The experiment was done with a new variety of rapeseed (*Brassica campestris*) named SAU Sarisha-1. There were two factors in this experiment, viz. row spacing and irrigation level. The row spacings were 20 cm (S₃), 30 cm (S₄) and 40 cm (S₅). Irrigation levels were no irrigation (I₁), one irrigation at 30 DAS (I₁) and two irrigations at 30 and 60 DAS (I₂). The experiment was laid out in split plot design with four replications. Irrigation was given in main plot and row spacing in sub-plots. The experimental plots were fertilized with a recommended dose of 135, 85, 60, 35, 4 and 4 kg ha⁻¹ of N, P₂O₅, K₂O, S, Zn and B in the form of urea, triple super phosphate (TSP), muriate of potash (MP), gypsum, zinc Oxide (ZnO) and boric aid, respectively. Seeds were sown on October 26, 2004. Light irrigation was given immediate after sowing to ensure maximum, germination. Others appropriate cultural management practices were done properly to ensure a good stand of the crop.
Ten plants were taken out randomly from each plot leaving the border plants to collect data on plant characters and yield attributes. Seed yield were determined from 2.4 m² area of center of each plot. The data were analyzed following Analysis of Variance (ANOVA) technique and mean differences were adjusted by using the statistical computer programme ALPHA and MSTAT-C v.2.10 Means were compared by using LSD test at 5% level of significance. The correlation analysis was done by SPSS v. 13.1 Software. Regression analysis was made following Microsoft Excel 2003 Software.

RESULTS AND DISCUSSIONS

Effect on Plant characters: It was seen from the Table 1 that the significant effect of row spacing, irrigation levels and their interactions on plant height and number of branches per plant. The maximum plant height (91.8 cm) was observed at 20 cm row spacing (S₁) which was statistically at per with 30 cm row spacing (S₂). The widest row spacing of 40 cm (S₃) gave the lowest plant height (87.38 cm). The plant probably tended to be taller for getting the light in closed spacing. Sharma and Thakur⁹ reported that the highest plant height was observed from the closest row spacing (20 cm). The treatment I₁ (two irrigation 30 and 60 DAS) gave significantly tallest plant (99.32 cm). The lowest plant height was found for the control treatment, I₀ (75.02 cm). Similar result was reported by Siag et al.¹⁰ in mustard. 20 cm row spaced plant was given two irrigation 30 DAS and 60 DAS (I₁S₁) produced the tallest plant (100.84 cm). Wider spaced plant along with no irrigation treatment (I₁S₃) gave the lowest plant height. Siag et al.¹⁰ also found tallest plant of mustard at 30 cm row spacing with 2 irrigations at branching and flowering stage.

The highest number of branches per plant (7.83) was found in the 40 cm row spaced plant and the lowest (6.38) from the closer row spacing, 20 cm. Wider spacing increased the number of branches per plant by 22.7% over control. In rapeseed reduced number of branches per plant due to increasing population density has been reported by Singh and Dhillon¹¹ and Singh and Verma¹². Number of irrigation also significantly increased the number of branches per plant. The maximum number of branches (9.45) was found from a plant subjected to two irrigations, one at 30 DAS and other at 60 DAS. The lowest numbers of branches (4.49) were found from control treatment. Treatment I₁ showed the maximum increases in branches per plant and was 110.5% higher over control. Rahman¹³ reported two irrigations for highest number of branches plant⁻¹ and no irrigation for lowest number of branches per plant. Maximum number of branches per plant (9.57) was found from the interaction between two irrigations at 30 and 60 DAS and 40 cm row spacing (I₁S₃). Tomer et al.¹⁴ obtained maximum number of branches per plant with 40 cm row spacing and 2 irrigations at pre-flowering and fruiting stage.

Effect on Yield Attributes: Significant difference was found in number of silique per plant, number of seeds per silique and 1000-seed weight at different row spacing (Table 1). These parameters gradually declined with the increase in number of plants per unit area due to closer spacing. The highest number of silique per plant (79.47), number of seeds per silique (20.30) and higher 1000 seed weight (2.94 g) were recorded at wider spacing of 40 cm (S₃) which were similar at 30 cm row spacing and the lowest at closest spacing (20 cm). This result confirmed the findings of Ali et al.¹¹, Singh and Dhillon¹¹, Misra and Rana⁶, Chauhan et al.¹⁷ and Roy et al.¹⁸. Closer spacing increases population density which decreases the number of seeds per silique due to the competition between plants that had a detrimental effect on silique formation in rapeseed¹⁹.

In the present study, number of irrigation showed significant variation in producing silique plant⁻¹, seed silique⁻¹ and 1000-seed weight (Table 1). Among the treatment I₁ produced the highest number of silique plant⁻¹ (120.3), seed silique⁻¹ (21.37) and maximum 1000-seed weight (3.07 g) which were statistically different from I₀ and I₅. In case of I₃ the second irrigation at silique formation stage helped in producing more number of silique without dropping of them. This was confirmed when reduced number of silique per plant was observed in I₁ (one irrigation applied at 30 DAS, e.g. flowering stage). Tomer et al.¹⁴ found that number of silique per plant was significantly increased up to two irrigations at pre-flowering and fruiting stages. More seed weight was gained with more irrigation. The results obtained in the study were supported by Sarkar and Hassan²⁰, Sharma and Kumar²¹ and Sarkar et al.²² who reported that increasing frequency of irrigation increased 1000-seed weight.

Significant difference in yield parameters was found due to the interaction of irrigation and row spacing (Table 1). Two irrigation along with 40 cm row spacing (I₁S₃) produced the highest number of silique per plant (131.40), seeds per silique (22.44) and 1000-seed weight (3.21 g) which confirmed the results of Tomer et al.¹⁴. The lower yield parameters were resulted with the interaction of any row spacing.
with no irrigation. It revealed that two irrigations had contributed more for wider spaced plant in formation of silique per plant and seeds in the silique.

**Effect on Yields and Harvest Index:** It was observed from Table 2 that row spacing, irrigation levels and their interaction have significant influence on seed yield plant\(^{-1}\), seed yield ha\(^{-1}\), stover yield ha\(^{-1}\), biological yield ha\(^{-1}\) and harvest index of rapeseed. Off the treatment, S\(_1\) (30 cm row spacing) produced highest seed yield ha\(^{-1}\) (1793.50 kg), stover yield ha\(^{-1}\) (2933.20 kg), biological yield ha\(^{-1}\) (6162.20 kg) and harvest index (36.20%). S\(_1\) gave the maximum seed yield plant\(^{-1}\) (4.76 g). It also proved as second influencing row spacing treatment. The closer spacing (S\(_2\)) gave lower yields and harvest index except stover yield. Stover yield was attributed to the maximum plant population at closer space. Treatment S\(_3\) produced 19.40% and 4.0% increased seed yield ha\(^{-1}\) and harvest index than S\(_1\). These results were attributed due to maximum photosynthesis and photosynthetic unit area might be favored with wider individual plant area. This results was supported by Alam\(^{[1]}\).

The four different yields and harvest index were significantly affected by irrigation levels. It was I\(_1\) (one irrigation at 30 DAS and another at 60 DAS) and I\(_c\) (no irrigation), which produced the highest and lowest different yields and harvest index (Table 2). This result corroborated with the results of Siddique\(^{[13]}\). The increased seed yield ha\(^{-1}\) with two irrigation (I\(_2\)) was 102.50% and 392.40% higher than one irrigation (I\(_1\)) and no irrigation (I\(_c\)), respectively. Rahman\(^{[14]}\) reported highest seed yield with two irrigations.

Interaction between row spacing and irrigation levels was found influencing to produce significant variation in yield and harvest index (Table 2). Treatment I\(_1\)S\(_2\) (two irrigation and 30 cm row spacing)
Table 2: Yield and harvest index of rapeseed cv. SAU sarisah-1 as affected by row spacing, irrigation levels and their combined effect

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Seed yield plant⁻¹ (g)</th>
<th>Seed yield (kg ha⁻¹)</th>
<th>Stover yield (kg ha⁻¹)</th>
<th>Biological yield (kg ha⁻¹)</th>
<th>Harvest index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S₁</td>
<td>3.68</td>
<td>1502.20</td>
<td>2767.40</td>
<td>4585.10</td>
<td>32.17</td>
</tr>
<tr>
<td>S₂</td>
<td>4.70</td>
<td>1793.50</td>
<td>2933.20</td>
<td>6162.20</td>
<td>36.20</td>
</tr>
<tr>
<td>S₃</td>
<td>4.76</td>
<td>1652.30</td>
<td>2558.60</td>
<td>5218.30</td>
<td>33.58</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>0.42</td>
<td>196.80</td>
<td>75.86</td>
<td>211.30</td>
<td>2.20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Irrigation level</th>
<th>Seed yield (kg ha⁻¹)</th>
<th>Stover yield (kg ha⁻¹)</th>
<th>Biological yield (kg ha⁻¹)</th>
<th>Harvest index (％)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I₁</td>
<td>1.61</td>
<td>592.00</td>
<td>1232.10</td>
<td>1824.10</td>
</tr>
<tr>
<td>I₂</td>
<td>4.06</td>
<td>1439.40</td>
<td>3247.50</td>
<td>5218.40</td>
</tr>
<tr>
<td>I₃</td>
<td>7.48</td>
<td>2915.10</td>
<td>3778.30</td>
<td>6162.30</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>0.744</td>
<td>356.00</td>
<td>58.26</td>
<td>332.2</td>
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<thead>
<tr>
<th>Irrigation levels x Row spacing</th>
<th>Seed yield (kg ha⁻¹)</th>
<th>Stover yield (kg ha⁻¹)</th>
<th>Biological yield (kg ha⁻¹)</th>
<th>Harvest index (％)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I₁S₁</td>
<td>1.56</td>
<td>664.70</td>
<td>1313.10</td>
<td>1978.40</td>
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<tr>
<td>I₁S₂</td>
<td>2.06</td>
<td>479.90</td>
<td>932.90</td>
<td>1564.20</td>
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<tr>
<td>I₁S₃</td>
<td>3.31</td>
<td>1607.20</td>
<td>3131.70</td>
<td>5730.10</td>
</tr>
<tr>
<td>I₂S₁</td>
<td>4.82</td>
<td>1729.10</td>
<td>3363.60</td>
<td>5447.10</td>
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<tr>
<td>I₂S₂</td>
<td>4.04</td>
<td>981.90</td>
<td>1394.50</td>
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<tr>
<td>I₂S₃</td>
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<td>2683.10</td>
<td>2718.30</td>
<td>6047.10</td>
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<tr>
<td>I₃S₁</td>
<td>7.99</td>
<td>3169.40</td>
<td>4123.40</td>
<td>6300.40</td>
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<tr>
<td>I₃S₂</td>
<td>8.25</td>
<td>2891.20</td>
<td>3247.20</td>
<td>6138.10</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>0.73</td>
<td>340.80</td>
<td>131.40</td>
<td>366.10</td>
</tr>
<tr>
<td>CV (%)</td>
<td>11.30</td>
<td>13.91</td>
<td>3.21</td>
<td>5.60</td>
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</table>

I₁ = No irrigation
I₂ = One irrigation at 30 DAS
I₃ = Two irrigations at 30 and 60 DAS
S₁ = 20 cm row spacing
S₂ = 30 cm row spacing
S₃ = 40 cm row spacing

Fig. 1: Relationship between number of branches and seed yield
gave higher seed yield ha⁻¹, stover yield, biological yield and harvest index. Treatment combination of I₂S₃ (two irrigation and 40 cm row spacing) gave higher seed yield plant⁻¹. Any row spacing with no irrigation failed to produce any comparable yields or harvest index. The wider spaced plants with two irrigations...
Fig. 3: Relationship between 1000-seed weight and seed yield

were grown favorably without intra plant competition thus producing maximum yield components which ultimately elevated the yields and harvest index. The closer plant space had higher intra plant competition due to limited land area and mutual shading effect. Giri[23] found maximum seed yield with two irrigations at flowering and siliqua development stage of wider row spaced mustard plants. Patel et al.[24] and Chauhan et al.[17] found maximum stover yield with 30 cm row spacing in mustard. There was a significant positive linear relationships between number of branches, number of siliqueae, 1000-seed weight and seed yield (Fig. 1, 2, 3), which strongly supported the above arguments of seed yield increment of rapeseed due to different imposed treatments.

Conclusion: Among the row spacings, the widest spacing (40 cm) influenced plant to have maximum growth and yield attributers which resulted maximum yield. Maximum seed yield plant\(^{-1}\) at 40 cm row spacing was 29.34\% and 1.3\% higher than 20 cm row spacing (S\(_1\)) and 30 cm row spacing (S\(_2\)), respectively. Two irrigation – one at 30 DAS (pre-flowering stage) and another at 60 DAS (pod development stage) increased economic yield with higher values of harvest index as the yield attributers The increased seed yield plant\(^{-1}\) with two irrigations was 364.6 \% and 84.2\% higher than no irrigation and one irrigation, respectively. In most of the cases the wider row spacing coupled with two irrigations were found to be influenced for better growth and yield of plant. It is concluded that rapeseed cv. SAU sarisha-1 may be cultivated at 30 cm row spacing along with two irrigation, one at 30 DAS (pre-flowering) and another at 60 DAS (siliqueae development stage) for optimum growth and yield production.

REFERENCES


