Effect of bio-fertilizer and moisture conservation practices on growth and yield behavior of mustard under rainfed condition

Devendra Kumar, RP Singh, UD Awasthi, SK Uttam, Raj Kumar and Mayank Kumar

Abstract
A field experiment “Effect of bio-fertilizer and moisture conservation practices on growth and yield behavior of mustard under rainfed condition” was conducted during rabi season 2013-14 at soil conservation and water management farm, C. S. Azad University of Agriculture and Technology, Kanpur. Twelve treatments were tested in three replicated Randomized Block Design. Results found that the maximum grain yield (16.66 q ha⁻¹) was obtained in RDF (60:30:30) and organic mulch @ 4 t ha⁻¹ followed by combined application of 75% RDF + PSB and organic mulch @4 t ha⁻¹ was 14.43 q ha⁻¹. The minimum grain yield (11.38 q ha⁻¹) was received in control and dust mulch treatment. The application of RDF (60:30:30) + PSB + organic mulch @ 4 t ha⁻¹ were also found higher gross income, net return and B: C ratio Rs 56712 ha⁻¹, Rs 29712 ha⁻¹ and 2.10, respectively followed by 75% RDF + PSB and organic mulch @ 4 t ha⁻¹ the gross income, net return and B: C ratio Rs 49028 ha⁻¹, Rs 22928 ha⁻¹ and 1.87, respectively while the minimum gross income, net return and B:C ratio Rs 37740 ha⁻¹, Rs 14440 ha⁻¹ and 1.61 were obtained in dust mulch and without fertilizer (control).

Keywords: Recommended dose of fertilizer (RDF), bio-fertilizer, Phosphate Solubilizing Bacteria (PSB), organic mulch, moisture conservation practices and mustard

Introduction
Mustard plants have species in the genera Brassica. The botanical name of mustard plant is Brassica juncea L. Mustard is an oil seed crop of family cruciferae. This occupies a prominent place in important oil seed crop bing next to groundnut. Oil seed crops are mostly grown in rainfed area. In meeting the increasing demand for food, rainfed agriculture will continue to play a major role. Mustard seeds are known by different names in different place eg. Sarson, rai or raya, toria or lahi. While sarson and toria (lahi) are generally termed as rapeseed, rai is termed as mustard.

Oilseeds, the second largest agriculture commodity after cereals in India, play a significant role in India economy, sharing 14% of the gross cropped area and accounting for nearly 1.5% of the gross national production and 8% of the value of all agriculture products. A range of oilseed crop viz. groundnut, rapeseed and mustard, soyabean sesame, sunflower, safflower and Niger (edible) and linseed and castor (non-edible) are cultivated in the country. Demand for vegetable oil is increased industrialization and diversion for bio-fules. The gap in supply is being met through huge imports costing more than Rs. 26000 crores during 2009-2010 (HEGDE and Sudhakara, 2011).

In India the overall area under rapeseed mustard has increased by 18.5 lakh ha to 67.17 lakh hectares, while the production is expected to jump by 12.32 lakh tons to 71.12 lakh tons. The average yield of rapeseed and mustard in country is 1103 kg ha⁻¹. In India, Rajasthan ranks first both in area (26.74 lakh ha) and production (33.80 lakh metric tons). Gujarat state has the highest productivity (1485 kg ha⁻¹) of rapeseed mustard. In Uttar Pradesh, mustard is grown on 8 lakh hectare area with production 10 lakh metric tons and productivity of 1250 kg ha⁻¹ (Indian rabi Rapeseed-mustard crop survey, 2012-2013).

Application of bio-fertilizer effect the yield due to presence of sufficient available nutrients and their better utilization often act as limiting factor in crop production on eroded land. It has been observed that fertilizer application to mustard has great importance in raising the production. It’s and enhances growth, various yield contributing characters and ultimate yield of crop rapeseed and mustard have been found to respond well to nitrogen application in dry land.
Material and Method

Details of experiment

The experiment was carried out in Randomized Block Design with the three replications having 12 treatments combination which are allocated randomly in all plots. The details of treatments are given below.

(A). Fertilizer application
- F0 - Control
- F1 - RDF (60:30:30 NPK)
- F2 - 50% RDF + PSB
- F3 - 75% RDF + PSB

(B). Moisture Conservation Practices
- M1 - Dust Mulch
- M2 - Organic Mulch @ 4 t ha⁻¹
- M3 - Weedicide (Pendimetheline @ 3.3 liter / ha⁻¹)

Effect of bio-fertilizer:

Effect of Mulch:

Effect of moisture conservation practices:

Results and Discussion

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fertilizer doses</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>30 DAS</td>
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<tr>
<td>F0</td>
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<tr>
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<td>22.69</td>
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<tr>
<td>F2</td>
<td>21.19</td>
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<tr>
<td>F3</td>
<td>22.60</td>
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<td>S.E. (d)</td>
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<tr>
<td>C.D. at 5%</td>
<td>1.52</td>
</tr>
</tbody>
</table>

Effect of moisture conservation practices:

Effect of bio-fertilizer:

Effect of Mulch:

Effect of moisture conservation practices:

1000-Seed weight:

Effect of bio-fertilizer:

Effect of mulch:

Plant Height (cm): The data pertaining to plant height at different stages of crop growth are presented in table- 01.

Effect of bio-fertilizer: plant height was influenced due to fertilizer (PSB) at all stages of mustard crop growth. The analysis data reveal that the plant height was highest under treatment of RDF (60:30:30 NPK) (F1) followed by 75% RDF and PSB (F3) and 50% RB and PSB (F2) and lowest under control (F0). Same Trend Were recorded in case of 6090 and maturity stages.

Effect of bio-fertilizer: The analyzed data of length of siliquae under treatment of F0, F1, F2, and F3 was found to be 4.43, 4.62, 4.55, 4.55 cm, respectively. The highest values were observed in F1 followed by F3 than F2 and lowest in F0 treatment.

Effect of moisture conservation practices: In case of moisture conservation practices, the length of siliquae in M2 (4.58 cm) was significantly higher as compared to M1 (4.54 cm) and M3 (4.50 cm) treatment. The moisture conservation practices, the number of siliquae in M2 (272) was significantly higher as compared to M3 (259) and M1 (261) treatment.

Effect of bio-fertilizer: It is clear the data that the test weight was found to be highest under F1 (3.76 g) treatment followed by F3 (3.33 g) than F2 (3.20 g) and lowest in F0 (3.06 g) treatment. The treatment F3 gave significantly higher as compared to F0 and F1 but non-significant with F3 treatment.

Effect of mulch: Regarding moisture conservation practices the treatment of organic mulch @ 41 ha⁻¹ gave highest grain yield (14.43 q ha⁻¹) followed by preemergence weedicide (13.78 q ha⁻¹) and lowest grain yield was recorded under control (13.18 q ha⁻¹). The treatment under organic mulch was found significant.
Stover yield (q ha⁻¹): The results pertaining to stover yield of mustard. The data were analyzed statically and presented in table and illustrated graphically through ANOVA is given in appendix.

Effect of Bio-fertilizer: The data clearly reveal that stover yield of mustard was increased with increasing fertilizer doses. The maximum stover yield was observed under F₁ treatment (49.08 q ha⁻¹) followed by F₃ (43.70 q ha⁻¹) and minimum was observed under F₀ (39.12 q ha⁻¹) treatment.

Effect of mulch: Application of moisture conservation practices enhanced considerably obtained in M₂ treatment the maximum stover yield was obtained under F₁ treatment (48.83 q ha⁻¹) followed by F₂ Rs 26100 ha⁻¹, while minimum was in of M₀ (Rs 14.43 q ha⁻¹) treatment.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Total cost of cultivation (Rs/ha)</th>
<th>Gross return (Rs/ha)</th>
<th>Net return (Rs/ha)</th>
<th>B:C ratio</th>
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<tbody>
<tr>
<td>F₀</td>
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<td>37740</td>
<td>14440</td>
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<tr>
<td>F₁</td>
<td>27000</td>
<td>56712</td>
<td>29712</td>
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<td>22602</td>
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Moisture conservation practices

<table>
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<th>Treatments</th>
<th>Total cost of cultivation (Rs/ha)</th>
<th>Gross return (Rs/ha)</th>
<th>Net return (Rs/ha)</th>
<th>B:C ratio</th>
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<tbody>
<tr>
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<td>46852</td>
<td>20352</td>
<td>1:1.76</td>
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<tr>
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<td>49096</td>
<td>24896</td>
<td>1:2.02</td>
</tr>
<tr>
<td>M₂</td>
<td>24420</td>
<td>47022</td>
<td>22602</td>
<td>1:1.92</td>
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<tr>
<td>S.E. (d)</td>
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<tr>
<td>C.D. at 5%</td>
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Treatment cost of cultivation: the total cost of cultivation of mustard crop under control and different fertilizer dose with PSB and moisture conservation practices has been given below table -03.

Effect of bio-fertilizer: The cost of cultivation was maximum in (F₁) plots Rs 27000 per ha followed by (F₃) plots Rs 26100 per ha than (F₂) Rs 25300 ha⁻¹, while minimum was in of control plots which is Rs 23300 per ha.

Effect of mulch: The total cost of cultivation was maximum in (M₁) Rs 26500 ha⁻¹ followed by dust mulch than (M₃) Rs 24420 per ha and the lowest in (M₀) Rs 24200 per ha.

Net return: The bio-fertilizer inoculation was found to be quite to be profitable. The maximum net return was obtained from RDF (60:30:30 NPK) plots, which was Rs 29712 ha⁻¹, followed (F₃) Rs 22928 ha⁻¹ than (F₁) Rs 18288 ha⁻¹ and lowest under (F₀) control plots Rs 14440 ha⁻¹.

Effect of mulch: In case of moisture conservation practice the net return (Rs 24896 ha⁻¹) was highest under M₁ treatment followed by M₃ treatment (Rs 22602 ha⁻¹) and lowest of (Rs 20352 ha⁻¹) under M₀ treatment.

Conclusion
On the basis of the result obtained during the course of investigation the grain yield of crop and B:C ratio of application recommended dose of fertilizer (60:30:30 NPK) was obtained 16.66 q ha⁻¹ and 2.1 followed by the yield and B:C ratio of the application of biofertilizer + 75% (RDF) supplemented with organic mulch @ 4 tha⁻¹ (14.43 qha⁻¹ and 1.87). On the basis of B:C ratio and save in fertilizer cost it is recommended for farmers that the biofertilizers for cultivation of mustard crop is remunerative in rainfed conditio.

References
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