



E-ISSN: 2278-4136  
P-ISSN: 2349-8234  
JPP 2018; 7(1): 2038-2041  
Received: 21-11-2017  
Accepted: 22-12-2017

**Devendra Kumar**  
Department of Soil conservation  
and Water Management, C.S.A.  
University of Agriculture and  
Technology Kanpur, Uttar  
Pradesh, India

**RP Singh**  
Department of Soil conservation  
and Water Management, C.S.A.  
University of Agriculture and  
Technology Kanpur, Uttar  
Pradesh, India

**UD Awasthi**  
Department of Soil conservation  
and Water Management, C.S.A.  
University of Agriculture and  
Technology Kanpur, Uttar  
Pradesh, India

**SK Uttam**  
Department of Soil conservation  
and Water Management, C.S.A.  
University of Agriculture and  
Technology Kanpur, Uttar  
Pradesh, India

**Raj Kumar**  
Department of Soil conservation  
and Water Management, C.S.A.  
University of Agriculture and  
Technology Kanpur, Uttar  
Pradesh, India

**Mayank Kumar**  
Department of Soil conservation  
and Water Management, C.S.A.  
University of Agriculture and  
Technology Kanpur, Uttar  
Pradesh, India

**Correspondence**  
**Devendra Kumar**  
Department of Soil conservation  
and Water Management, C.S.A.  
University of Agriculture and  
Technology Kanpur, Uttar  
Pradesh, India

## 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<sup>-1</sup>) was obtained in RDF (60:30:30) and organic mulch @ 4t ha<sup>-1</sup> followed by combined application of 75% RDF + PSB and organic mulch @4t ha<sup>-1</sup> was 14.43 q ha<sup>-1</sup>. The minimum grain yield (11.38 q ha<sup>-1</sup>) was received in control and dust mulch treatment. The application of RDF (60:30:30) + PSB + organic mulch @ 4 t ha<sup>-1</sup> were also found higher gross income, net return and B: C ratio Rs 56712 ha<sup>-1</sup>, Rs 29712 ha<sup>-1</sup> and 2.10, respectively followed by 75% RDF + PSB and organic mulch @ 4 t ha<sup>-1</sup> the gross income, net return and B: C ratio Rs 49028 ha<sup>-1</sup>, Rs 22928 ha<sup>-1</sup> and 1.87, respectively while the minimum gross income, net return and B:C ratio Rs 37740 ha<sup>-1</sup>, Rs 14440 ha<sup>-1</sup> 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 being 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 nigher (edible) and linseed and castor (non-edible) are cultivated in the country. Demand for vegetable oil is increased industrialization and diversion for bio-fuels. 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<sup>-1</sup>. 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<sup>-1</sup>) 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<sup>-1</sup> (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**

F<sub>0</sub> -Control

F<sub>1</sub> -RDF (60:30:30 NPK)

F<sub>2</sub> -50 % RDF + PSB

F<sub>3</sub> -75% RDF + PSB

(RDF- Recommended dose of fertilizer)

(PSB -Phosphate Soluble Bacteria)

**(B). Moisture Conservation Practices**

M<sub>1</sub> -Dust Mulch

M<sub>2</sub> -Organic Mulch @4 t ha<sup>-1</sup>

M<sub>3</sub> -Weedicide (Pendimetheline @ 3.3 liter / ha<sup>-1</sup>)

(Uniform application of sulphur @ 25 kg ha<sup>-1</sup> will be applied in all treatments)

**Results and Discussion**

Treatments	Plant height (cm)			
	30 DAS	60 DAS	90 DAS	Maturity
<b>Fertilizer doses</b>				
F <sub>0</sub>	18.19	111.21	142.08	154.41
F <sub>1</sub>	22.69	120.73	153.39	165.68
F <sub>2</sub>	21.19	116.36	146.32	158.67
F <sub>3</sub>	22.60	119.36	151.76	164.10
S.E. (d)	0.73	1.55	1.20	1.19
C.D. at 5%	1.52	3.22	2.48	2.48
<b>Moisture conservation practices</b>				
M <sub>1</sub>	20.49	115.03	146.11	156.10
M <sub>2</sub>	22.38	119.29	150.84	165.85
M <sub>3</sub>	20.63	116.42	148.21	160.20
S.E. (d)	0.63	1.34	1.03	1.03
C.D. at 5%	1.31	2.79	2.15	2.15

Treatments	No. of siliquae per plant	Length of siliquae (cm)	No. of seed per siliquae	1000-seed weight
<b>Fertilizer doses</b>				
F <sub>0</sub>	251.92	4.43	11.69	3.06
F <sub>1</sub>	274.36	4.62	12.55	3.76
F <sub>2</sub>	262.60	4.55	12.17	3.20
F <sub>3</sub>	269.05	4.58	12.42	3.33
S.E. (d)	1.71	0.07	0.19	0.09
C.D. at 5%	3.56	0.13	0.40	0.20
<b>Moisture conservation practices</b>				
M <sub>1</sub>	259.14	4.50	12.04	3.25
M <sub>2</sub>	272.68	4.58	12.40	3.44
M <sub>3</sub>	261.63	4.54	12.18	3.33
S.E. (d)	1.48	0.06	0.16	0.07
C.D. at 5%	3.08	0.11	0.34	0.15

**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) (F<sub>1</sub>) followed by 75% RDF and PSB (F<sub>3</sub>) and 50% RBD and PSB (F<sub>2</sub>) and lowest under control (F<sub>0</sub>). Same Trend Were recorded in case of 6090 and maturity stages.

**Effect of Mulch:** Moisture conservation practices further exhibited the significant variation due to mulch application. The highest plant height was recorded in the treatment of organic mulch @4 t ha<sup>-1</sup> (m<sub>2</sub>) followed by weedicide premergence (M<sub>3</sub>) and lowest value were in dust mulch (m<sub>3</sub>). In all stages of crop the data were analyzed and depicted.

**Effect of bio- fertilizer:** The analyzed data of length of siliquae under treatment of F<sub>0</sub>, F<sub>1</sub>, F<sub>2</sub>, and F<sub>3</sub> was found to be 4.43, 4.62, 4.55, 4.55 cm, respectively. The highest values were observed in F<sub>1</sub> followed by F<sub>3</sub> than F<sub>2</sub> and lowest in F<sub>0</sub> treatment.

In analyzed data of number of siliquae under treatment of F<sub>0</sub>, F<sub>1</sub>, F<sub>2</sub> and F<sub>3</sub> was found to be 251, 274, 269 and 262, respectively. The highest values were observed in F<sub>1</sub> followed by F<sub>3</sub> than F<sub>2</sub> and lowest in F<sub>0</sub> treatment.

**Effect of moisture conservation practices:** In case of moisture conservation practices, the length of siliquae in M<sub>2</sub> (4.58 cm) was significantly higher as compared to M<sub>3</sub> (4.54 cm) and M<sub>1</sub> (4.50cm) treatment. The moisture conservation practices, the number of siliquae in M<sub>2</sub> (272) was significantly higher as compared to M<sub>3</sub> (259) and M<sub>1</sub> (261) treatment.

**1000-Seed weight:** The data on pertaining to per plant number of 1000-seed weight. The data were analyzed statistically and presented in table- 02

**Effect of bio-fertilizer:** It is clear the data that the test weight was found to be highest under F<sub>1</sub> (3.76 g) treatment followed by F<sub>3</sub> (3.33 g) than F<sub>2</sub> (3.20g) and lowest in F<sub>0</sub> (3.06g) treatment. The treatment F<sub>3</sub> gave significantly higher as compared to F<sub>0</sub> and F<sub>2</sub> but non-significant with F<sub>1</sub> treatment.

Treatments	Seed yield (q ha <sup>-1</sup> )	Stover yield (q ha <sup>-1</sup> )	Harvest index (%)
<b>Fertilizer doses</b>			
F <sub>0</sub>	11.38	39.12	3.15
F <sub>1</sub>	16.66	52.52	3.43
F <sub>2</sub>	12.78	43.70	3.41
F <sub>3</sub>	14.36	49.08	3.42
S.E. (d)	0.42	0.75	1.78
C.D. at 5%	0.88	1.55	1.76
<b>Moisture conservation practices</b>			
M <sub>1</sub>	13.18	43.37	3.29
M <sub>2</sub>	14.43	48.83	3.38
M <sub>3</sub>	13.78	46.11	3.34
S.E. (d)	0.36	0.65	1.80
C.D. at 5%	0.76	1.34	1.76

**Seed yield (q ha<sup>-1</sup>):** The results pertaining to seed yield of mustard. The data were analyzed statically and presented in table - 03

**Effect of bio- fertilizer:** The data on grain yield was increasing with increasing dose of fertilizer application. The highest grain yield was observed in F<sub>1</sub> (16.66 q ha<sup>-1</sup>) treatment followed by F<sub>3</sub> (14.36 q ha<sup>-1</sup>) than F<sub>2</sub> (12.78) and lowest grain yield was recorded under F<sub>0</sub> treatment (11.38 q ha<sup>-1</sup>).

**Effect of mulch:** Regarding moisture conservation practices the treatment of organic mulch @ 4t ha<sup>-1</sup> gave highest grain yield (14.43 q ha<sup>-1</sup>) followed by premergence weedicide (13.78 q ha<sup>-1</sup>) and lowest grain yield was recorded under control (13.18 q ha<sup>-1</sup>). The treatment under organic mulch was found significant.

**Stover yield (q ha<sup>-1</sup>):** 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 obtained under F<sub>1</sub> treatment (52.52q ha<sup>-1</sup>) followed by F<sub>3</sub> (49.08q ha<sup>-1</sup>), F<sub>2</sub> (43.70 q ha<sup>-1</sup>) and minimum was observed under F<sub>0</sub> (39.12q ha<sup>-1</sup>) treatment.

**Effect of mulch:** Application of moisture conservation practices enhanced considerably obtained in M<sub>2</sub> treatment the stover yield. Highest stover yield in organic mulch (48.83 q ha<sup>-1</sup>) treatment followed by preemergence weedicide (46.11 q ha<sup>-1</sup>) and dust mulch (43.37 q ha<sup>-1</sup>).

Treatments	Total cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio
<b>Fertilizer doses</b>				
F <sub>0</sub>	23300	37740	14440	1:1.61
F <sub>1</sub>	27000	56712	29712	1:2.10
F <sub>2</sub>	25300	43588	18288	1:1.72
F <sub>3</sub>	26100	49028	22928	1:1.87
S.E. (d)				
C.D. at 5%				
<b>Moisture conservation practices</b>				
M <sub>1</sub>	26500	46852	20352	1:1.76
M <sub>2</sub>	24200	49096	24896	1:2.02
M <sub>3</sub>	24420	47022	22602	1:1.92
S.E. (d)				
C.D. at 5%				

**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 (F<sub>3</sub>) plots Rs 27000 per ha followed by (F<sub>3</sub>) plots Rs 26100 per ha than (F<sub>2</sub>) Rs 25300 ha<sup>-1</sup>, while minimum was in of control plots which is Rs 23300 per ha.

**Effect of mulch:** The total cost of cultivation was maximum in (M<sub>1</sub>) Rs 26500 ha<sup>-1</sup> followed by dust mulch than (M<sub>3</sub>) Rs 24420 per ha and the lowest in (M<sub>2</sub>) 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<sup>-1</sup>, followed (F<sub>3</sub>) Rs 22928 ha<sup>-1</sup> than (F<sub>2</sub>) Rs 18288 ha<sup>-1</sup> and lowest under (F<sub>0</sub>) control plots Rs 14440 ha<sup>-1</sup>.

**Effect of mulch:** In case of moisture conservation practice the net return (Rs 24896 ha<sup>-1</sup>) was highest under M<sub>2</sub> treatment followed by M<sub>3</sub> treatment (Rs 22602 ha<sup>-1</sup>) and lowest of (Rs 20352 ha<sup>-1</sup>) under M<sub>1</sub> 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<sup>-1</sup> and 2.1 followed by the yield and B:C ratio of the application of biofertilizer + 75% (RDF) supplemented with organic mulch @ 4 t ha<sup>-1</sup> (14.43 q ha<sup>-1</sup> 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 condition.

### References

- Hegde DM, Sudhakara SN. Nutrient management strategies for oilseed crops under rainfed condition. Indian j. of Fertilizers. 2011; 7(4):30-46
- Verma CK, Yadav DD, Kushwaha KP. Effect of fertilizers and moisture conservation practices in mustard (*Brassica juncea* L.) under rainfed condition. Crop Research. 2011; 42(1):17-119.
- Awasthi UD, Singh RB, Dubey SD. Effect of sowing date and moisture –conservation practices on growth and yield of Indian mustard (*Brassica juncea*). Indian j. Agronomy. 2007; 52(2):151-153.
- Ghanbahadur MR, Lanjewar RKVS, Patil SM. Effect of sowing dates, irrigation levels and mulching on growth and yield of Indian mustard. Annals Plants Physico. 2005; 19(1):49-55.
- Katiyar SC. Effect of moisture conservation practices on mustard production under rainfed condition. *Bhartiya Krishi Anusandhan Patrika*. 2000; 17(2):81-86.
- Katiyar SC. Effect of moisture conservation practices on mustard production under rainfed condition. *Bhartiya Krishi Anusandhan Patrika*. 2002; 17(2-3):81-86.
- Chaudhary HP, Singh Y, Uttam SK. Effect of nutrient management and moisture conservation practices on growth and yield of rainfed mustard on eroded soils. Indian Agriculturist. 2008; 52(1-2):53-56.
- Regar PL, Rao SS, Jonsi NL. Effect of in –situ moisture conservation practices on productivity of rainfed Indian mustard (*Brassica juncea*) Indian journal of Agron.; 2007; 52(3):148-150.
- Singh T, Rana KS. Effect of moisture conservation and fertility on Indian mustard (*Brassica juncea* L.) Indian j. Agron., 2006; 51(4):267-270.
- Meena DS, Trtarwal JP, Baldev R. Effect of chemical and bio-fertilizers on productivity, profitability and quality of Indian mustard (*Brassica juncea*) in vertisols. Gujrat Agric. Uni. Res. J. 2013; 21(2): 1-7.
- Gangwal TV, Patel MV, Jadev NJ. Effect of phosphorus, sulphur and phosphate solubilising bacteria on yield, nutrient uptake and soil fertility after harvest of mustard. Indian j. of Fertilizer. 2011; 7(8):32-40.
- Pathak AK, Shailash. Effect of organic fertilizers, biofertilizers, antagonists and nutritional supplements on yield and disease incidence in Indian mustard in arid soil. Indian journal of Agricultural Science. 2010; 80(7):652-654.
- Chavan PG, Shinde VS, Kote GM, Solunke PS, Bhondve AA. Response of sources and levels of phosphorus with and without PSB inoculation on growth, yield and quality of soyabean. Research on Crops. 2008; 9(2):286-289.
- Munda S, Shivakumar BG, Gangaiah B, Rana DS, Manjaiah KM, Lakshman K *et al*. Response of soyabean (*Glycine max*) to phosphorus with or without biofertilizers. *Indian Journal of Agro*, 2013; 58(1):86-90.
- Premi OF, Kandpal BK, Kumar S, Shekhawat K, Bhogal NS, Rathore SS, Chauhan JS. Performance of Indian mustard (*Brassica juncea*) as influenced by PSB and phosphorus fertilization in semi-arid region. *Gaurav Society of Agriculture Research information Centre Research on Crops*. 2012; 13(3):944-951.
- Yadav PN, Uttam SK, Singh RP, Kaushal Kumar. Effect of fertilizer and moisture conservation practices on

productivity, economics and water use efficiency of  
rainfed indian mustard (*Brassica juncea*). Current  
Advances in Agricultural Science. 2011; 3(2):108-111.