



## Agronomic evaluation of different Indian mustard (*Brassica juncea* L.) varieties under organic management system in Bundelkhand

Deepmala Jain\* and B Gangwar

Institute of Agricultural Sciences, Bundelkhand University, Jhansi 284128, Uttar Pradesh, India

\*Corresponding author: jaind8588@gmail.com

(Received: 15 June 2021; Revised: 25 December 2021; Accepted: 27 December 2021)

### Abstract

An experiment was conducted to study the comparative performance of different Indian mustard (*Brassica juncea* L.) varieties under organic management system during the *Rabi* season of the year 2019-20. Nine Indian mustard varieties viz., RH-0749, Super Gold, Pusa Bold, KMH-721, Varuna, Bayer-5222, JM-3, Giriraj and RVM-2 were compared for growth, yield attributes and yield. Significant variations in growth parameters like plant height, root length, fresh shoot and root weight, dry shoot and root weight, number of leaves, number of branches and CGR were observed among the different varieties. Yield attributes like siliqua per plant, test weight, seed per plant of different varieties were also differed significantly. Variety 'Varuna' performed exceedingly well in terms of growth and yield characteristics among all the varieties and fetched the highest seed yield (27.5 q/ha) and stover yield (40.34 q/ha). Thus, variety 'Varuna' could be a better choice for organic farming system to enhance the mustard productivity and profitability in the Bundelkhand region.

**Keywords:** Growth and yield parameters, Indian mustard, organic farming, varieties

### Introduction

Oilseeds have important place in Indian agriculture next to cereals. India is one of the largest rapeseed-mustard growing country in the world, occupying the second position in area and fourth position in production after Canada, European Union and China. The estimated area, production and productivity of rapeseed-mustard in the world was 36.59 mha, 72.37 mt and 1980 kg/ha, respectively, during 2018-19. Indian mustard account for about 75-80% of the 6.23 mha of rapeseed and mustard area with the production 8.32 mt and productivity of 1397 kg/ha in the country. (Anonymous, 2019). Rapeseed-mustard is one of the most important groups of oilseed crop of India. It is a winter (*Rabi*) season crop and being cultivated both under irrigated (79.2%) and rainfed (20.8%) conditions. Indian mustard cultivation predominantly is carried out widely in 13 states of India, wherein Madhya Pradesh ranks third (11.73 %) and Uttar Pradesh (11.36%) on fourth place with area 0.68 mha, production 0.95 mt and productivity 1392 kg/ha (Anonymous, 2018). In present scenario, India has surplus of cereal production but is lagging behind in supplying the edible oil demand. This gap can be filled by growing mustard varieties as the oil recovery from rapeseed-mustard is about 42%. Also, rapeseed-mustard crop are well known for its potential and importance, as this is the only crop that is able to meet the challenge of demand and supply gap of edible oil in India (Kumar, 2014). Since, there is a vast

variability in the climatic and edaphic conditions in the mustard growing areas of India, the selection of suitable varieties is important factor to ensure higher economic yield. Bundelkhand is categorised under rainfed area and prone to drought conditions. In a research study by Dawadi *et al.* (2019), on the basis of drought tolerance and germination rate parameters found that amongst all the oilseed crops *Brassica juncea* was the most drought tolerant followed by *carinata* and *pennycress* whereas *canola* and *rapa* were considered as intermediate and other species (soybean, peanut, *alba*, camelina and crambe) were drought susceptible. Organic farming seems to be more appropriate in Bundelkhand region. A number of studies showed that under drought conditions, crops in organic agriculture systems produce significantly higher yield than conventional agriculture. Therefore, strengthening of organic farming in Bundelkhand is reported to be very helpful in improving profitability of farmer and thereby increase in their income (Tripathi, 2020). Organic manures apart from containing NPK also contains small amount of trace elements especially boron, copper, iron, sulphur, zinc, and fair quantity of growth promoting substances. The scientific studies on evaluation of mustard varieties for organic farming in Bundelkhand are very limited. Therefore, the present investigation was under taken to identify the most suitable variety for organic farming in Bundelkhand region.

## Materials and Methods

A field experiment was conducted at Organic Research Farm, Karguaji, Institute of Agricultural Sciences, Bundelkhand University, Jhansi, Uttar Pradesh during the *Rabi* season of 2019-20 to study the comparative performance of different Indian mustard (*Brassica juncea* L.) varieties under organic management system. The experiment was conducted involving 9 varieties (treatments) *viz.*, RH-0749, Super Gold, Pusa Bold, KMH-721, Varuna, Bayer-5222, JM-3, Giriraj (DRMRIJ 31) and RVM-2 of Indian mustard crop in randomized block design with 3 replications. Each variety was grown in a 3 m × 1.8 m (5.4 m<sup>2</sup>) plot having border size of 30 cm and irrigation channel of 40 cm. To get fine seedbed for sowing, soil was first deep ploughed with a soil turning plough followed by two cross ploughing and planking after each ploughing. Vermicompost and farm yard manure (50:50 ratio) were used as organic sources to supply nutrients to the crop. Farm yard manure was applied at the time of land preparation and vermicompost was applied in a moist soil in a row 2 to 3 cm below from the seeds at the time of sowing. Mustard seeds at the rate of 4.5 kg/ha were sown 15 cm apart on 05<sup>th</sup> November 2019 in lines at the distance of 45 cm. One pre-sowing irrigation was given to ensure proper germination and two irrigations one at rosette stage (30 DAS) and second at siliqua formation (55 DAS) were given with tube well for proper crop establishment and higher yield. Inter culture operations like thinning, gap filling, etc. were done as per the requirement. No major pest was observed on the crop, only one spray of cow urine was undertaken at 45 DAS to protect the crop from frost. The crop was harvested on 03<sup>rd</sup> March 2020 at complete maturity as judged by visual observation. One border row from both the sides of plots and one plant from each side were harvested first. Thereafter, crop of each net plot was harvested separately and brought to threshing floor after proper tagging. The produce of net plot weighed individually and recorded before threshing. Threshing was done by wooden sticks and seed weight was recorded for net plot after winnowing the produce. To obtain stover yield, the seed weight was subtracted from total biomass recorded from each plot.

Data was recorded at 30, 60 and 90 DAS on growth parameters like plant height, root length, fresh shoot and root weight and dry shoot and root weight on randomly selected three plants from each plot. The whole sampled plants were collected and their fresh weights of shoot and root were recorded at each sampling stage. The root portion was cut from sampled plants carefully and then gently washed with water and the root lengths of three plants were measured in cm from the soil level to its tip.

To determine the dry weight of shoot and root, these samples were chopped into small pieces and put for sun drying for two days and then in the oven at a temperature of 70±1°C till the constant weight attained. The average value was calculated and noted as dry matter in g/plant. The other growth parameters like number of leaves per plant and number of branches per plant were recorded. The crop growth rate (CGR) in different varieties was recorded using the formula  $CGR = (W_2 - W_1) / (t_2 - t_1)$ ; Where,  $W_1$  and  $W_2$  are plant dry weight (total dry matter in gram per unit area) at time  $t_1$  and  $t_2$ , respectively. The yield and yield attributes like no. of siliqua per plant, seed, stover and husk weight per plant, test weight and yield (biological, seed and stover) along with harvest index were recorded at maturity stage. The recorded data was statistically analysed by using OP-STAT software (1998) and the C.D. values were calculated at 5% level of probability.

## Results and Discussion

### Growth parameters

The maximum plant height was recorded in variety Varuna *i.e.*, 19.5 cm, 133.8 cm and 217.7 cm at 30, 60 and 90 DAS respectively, while the minimum was recorded in RH-0749 (12.6 cm) at 30 DAS and in RVM-2 *i.e.*, 112.0 cm and 190.1 cm at 60 and 90 DAS respectively (Table 1). The maximum fresh weight of shoot was found in variety Varuna, (16.4 g, 84.1 g and 487.4 g), while minimum in RVM-2, (12.4 g, 65.6 g and 320.0 g) at 30, 60 and 90 DAS respectively. Similar trends have been reported by Chaplot *et al.* (2012). The maximum dry weight of shoot per plant was recorded in variety Pusa Bold (4.1 g) and the minimum in KMH-721 (1.9 g) at 30 DAS. Whereas, at 60 and 90 DAS it was found the maximum in variety Varuna (12.6 g and 67.1 g respectively) and the minimum in RVM-2 (7.6 g and 52.9 g, respectively). Similar trends have been reported by Khushu and Singh (2005). Number of primary branches per plant was the highest in variety Varuna (3.3, 5.6 and 8.7) and the lowest in RVM-2, (2.2, 3.8 and 6.6) at 30, 60 and 90 DAS respectively. Similar trends were reported by Kandpal (2001). The highest number of secondary branches were recorded in variety Varuna, (9.6 and 25.9) while lowest in RVM-2, (7.6 and 17.7) at 60 and 90 DAS respectively Table 1. Similar findings were reported by Deol *et al.* (2008).

The highest number of leaves per plant was observed in Varuna and the lowest in RVM-2 (Table 2). Similar results were supported by Bhat *et al.* (2006). The maximum root length was found in variety Varuna, *i.e.*, 7.61 cm, 15.74 cm and 87.61 cm at 30, 60 and 90 DAS, while the minimum was found in RH-0749 (5.15 cm) at 30 DAS and in RVM-2

Table 1: Growth parameters of different Indian mustard varieties at 30, 60 and 90 days after sowing

| Treatment  | Plant height(cm) |       |       | Shoot weight (g/plant) |      |       |      |      |      | No. of branches/plant |      |      |           |      |    |
|------------|------------------|-------|-------|------------------------|------|-------|------|------|------|-----------------------|------|------|-----------|------|----|
|            |                  |       |       | Fresh                  |      |       | Dry  |      |      | Primary               |      |      | Secondary |      |    |
|            | 30               | 60    | 90    | 30                     | 60   | 90    | 30   | 60   | 90   | 30                    | 60   | 90   | 30        | 60   | 90 |
| RH-0749    | 12.7             | 121.0 | 205.5 | 15.2                   | 74.6 | 405.4 | 2.1  | 7.7  | 60.5 | 2.9                   | 4.4  | 7.8  | 8.9       | 20.4 |    |
| Super Gold | 17.6             | 123.7 | 208.3 | 15.4                   | 76.9 | 432.5 | 3.7  | 9.1  | 62.5 | 2.9                   | 4.6  | 8.03 | 9.02      | 21.6 |    |
| Pusa Bold  | 19.3             | 130.2 | 212.3 | 16.0                   | 82.0 | 471.9 | 4.1  | 10.6 | 65.5 | 3.2                   | 5.1  | 8.6  | 9.5       | 23.3 |    |
| KMH-721    | 14.7             | 114.7 | 193.3 | 13.8                   | 68.9 | 349.6 | 1.9  | 8.1  | 54.1 | 2.5                   | 3.9  | 6.9  | 8.3       | 18.1 |    |
| Varuna     | 19.5             | 133.8 | 217.7 | 16.4                   | 84.1 | 487.4 | 3.3  | 12.6 | 67.1 | 3.3                   | 5.6  | 8.7  | 9.6       | 25.9 |    |
| Bayer-5222 | 13.3             | 115.9 | 195.4 | 14.3                   | 70.7 | 360.6 | 2.0  | 8.2  | 56.7 | 2.7                   | 4.1  | 7.4  | 8.5       | 18.6 |    |
| JM-3       | 16.6             | 117.3 | 198.5 | 14.8                   | 71.9 | 372.9 | 2.1  | 8.6  | 58.4 | 2.8                   | 4.2  | 7.7  | 8.6       | 19.1 |    |
| Giriraj    | 16.3             | 126.9 | 211.7 | 15.6                   | 79.6 | 456.5 | 2.2  | 9.3  | 63.3 | 3.1                   | 4.8  | 8.2  | 9.2       | 22.9 |    |
| RVM-2      | 17.4             | 111.9 | 190.1 | 12.4                   | 65.6 | 320.0 | 2.0  | 7.6  | 52.9 | 2.2                   | 3.8  | 6.6  | 7.6       | 17.7 |    |
| SEm±       | 0.2              | 2.3   | 2.3   | 0.1                    | 1.1  | 6.3   | 0.03 | 0.12 | 1.25 | 0.05                  | 0.06 | 0.07 | 0.13      | 0.31 |    |
| CD(p=0.05) | 0.9              | 7.1   | 7.1   | 0.3                    | 3.2  | 19.0  | 0.09 | 0.36 | 3.35 | 0.14                  | 0.19 | 0.27 | 0.40      | 0.94 |    |

Table 2: Number of leaves, root length and root weight of different Indian mustard varieties at 30, 60 and 90 days after sowing

| Treatment  | No. of leaves/plant |      |       | Root length (cm) |      |      |      |      |       | Root weight (g/plant) |      |       |     |    |    |
|------------|---------------------|------|-------|------------------|------|------|------|------|-------|-----------------------|------|-------|-----|----|----|
|            |                     |      |       | Fresh            |      |      | Dry  |      |       | Fresh                 |      |       | Dry |    |    |
|            | 30                  | 60   | 90    | 30               | 60   | 90   | 30   | 60   | 90    | 30                    | 60   | 90    | 30  | 60 | 90 |
| RH-0749    | 8.3                 | 24.3 | 89.4  | 5.2              | 14.7 | 74.9 | 0.75 | 7.86 | 19.10 | 0.24                  | 2.24 | 6.82  |     |    |    |
| Super Gold | 8.4                 | 24.8 | 105.4 | 6.9              | 14.9 | 79.6 | 0.77 | 8.30 | 21.59 | 0.26                  | 2.32 | 11.5  |     |    |    |
| Pusa Bold  | 8.9                 | 25.2 | 132.5 | 7.5              | 15.6 | 85.3 | 0.81 | 9.19 | 23.28 | 0.31                  | 2.59 | 11.86 |     |    |    |
| KMH-721    | 7.7                 | 23.7 | 78.5  | 6.6              | 13.6 | 65.4 | 0.66 | 6.59 | 17.72 | 0.18                  | 1.83 | 6.14  |     |    |    |
| Varuna     | 9.1                 | 25.5 | 150.4 | 7.6              | 15.7 | 87.6 | 0.85 | 9.77 | 25.86 | 0.35                  | 2.73 | 11.88 |     |    |    |
| Bayer-5222 | 7.9                 | 23.9 | 97.4  | 6.7              | 13.9 | 67.4 | 0.69 | 6.84 | 18.35 | 0.19                  | 1.91 | 7.27  |     |    |    |
| JM-3       | 8.1                 | 24.1 | 100.4 | 6.1              | 14.0 | 70.3 | 0.73 | 7.61 | 18.90 | 0.21                  | 2.07 | 7.40  |     |    |    |
| Giriraj    | 8.7                 | 24.9 | 128.5 | 7.2              | 15.2 | 82.4 | 0.79 | 8.75 | 22.92 | 0.28                  | 2.44 | 9.34  |     |    |    |
| RVM-2      | 7.2                 | 22.2 | 70.4  | 5.5              | 11.8 | 61.4 | 0.58 | 5.96 | 16.45 | 0.16                  | 1.70 | 5.16  |     |    |    |
| SEm±       | 0.30                | 0.44 | 2.13  | 0.08             | 0.15 | 1.20 | 0.01 | 0.11 | 0.29  | 0.003                 | 0.04 | 0.13  |     |    |    |
| CD(p=0.05) | 0.91                | 1.33 | 6.43  | 0.24             | 0.46 | 3.16 | 0.02 | 0.34 | 0.89  | 0.01                  | 0.12 | 2.63  |     |    |    |

Table 3: Crop growth rate of different varieties of mustard at different period of growth

| Varieties  | Crop growth rate (g/m <sup>2</sup> /day) |           |           |
|------------|--|-----------|-----------|
|            | 0-30 DAS                                 | 30-60 DAS | 60-90 DAS |
| RH-749     | 1.74                                     | 5.61      | 42.55     |
| Super Gold | 2.97                                     | 5.53      | 46.07     |
| Pusa Bold  | 3.26                                     | 6.48      | 47.54     |
| KMH-721    | 1.57                                     | 5.76      | 37.33     |
| Varuna     | 2.67                                     | 8.65      | 47.19     |
| Bayer 5222 | 1.65                                     | 5.85      | 39.90     |
| JM-3       | 1.73                                     | 6.21      | 40.84     |
| Giriraj    | 1.81                                     | 6.88      | 45.09     |
| RVM-2      | 1.58                                     | 5.32      | 36.08     |
| SEm±       | 0.32                                     | 0.55      | 1.09      |
| CD(p=0.05) | 0.97                                     | 1.66      | 3.29      |

*i.e.*, 11.79 cm and 61.37 cm at 60 and 90 DAS respectively (Table 2). Significantly higher fresh weight of roots per plant was recorded in variety Varuna, (0.85 g, 9.77 g and 25.86 g), while it was recorded the minimum in RVM-2, (0.58 g, 5.96 g and 16.45 g) at 30, 60 and 90 DAS respectively (Table 2). Similar findings have also been reported by Aziz *et al.* (2011). Dry weight of roots per plant was recorded the maximum in Varuna, (0.35 g, 2.73 g and 11.88 g), while it was recorded the minimum in RVM-2 (0.16 g, 1.70 g and 5.16 g) at 30, 60 and 90 DAS respectively. Similar findings have been reported by Chaplot *et al.* (2012).

The highest crop growth rate (CGR) was recorded during 0-30 days in Pusa Bold, (3.26 g/m<sup>2</sup>/day) which was at par with Super Gold, (2.97 g/m<sup>2</sup>/day) and Varuna, (2.67 g/m<sup>2</sup>/

day) (Table 3). During 30-60 DAS, the highest CGR was recorded in Varuna (8.65 g/m<sup>2</sup>/day) followed by Giriraj (6.88g/m<sup>2</sup>/day) and Pusa Bold (6.48 g/m<sup>2</sup>/day). Whereas during 60-90 DAS, the highest CGR was recorded in Pusa Bold (47.54 g/m<sup>2</sup>/day) which was at par with Varuna (47.19 g/m<sup>2</sup>/day) and Super Gold (46.07 g/m<sup>2</sup>/day). The other varieties showed lower growth rate during different stages and finally reflected in yield and yield attributes

### Yield and yield attributes

Significantly maximum numbers of siliqua per plant at maturity were recorded in variety Varuna (300.3) whereas minimum was noted in RH-0749-2 (241.6) followed by RVM-2 (253.4) (Table 4). Similar findings have been reported by Kandpal (2001) and Deol *et al.* (2008). Data on seed weight per plant was found to be statistically significant. Variety 'Varuna' recorded the highest seed weight per plant (57.49 g), while the lowest was recorded in variety RVM-2 (36.34 g). Similar findings have been reported by Kumar *et al.* (2001). Data on dry weight per plant of mustard was found to be statistically significant wherein variety 'Varuna' was recorded highest (100.3 g/plant) while the lowest was recorded in variety RVM-2 (74.7 g/plant). The maximum husk weight was recorded in variety Varuna (26.9 g/plant) while minimum in RVM-2 (22.5 g/plant). The similar results were also reported by Shukla *et al.* (2001). The 1000-seed weight was found maximum in variety Varuna (5.22 g), while the minimum in RVM-2 (4.35 g) (Table 4). Among different varieties, the maximum biological yield was recorded in variety Varuna, (67.82 q/ha) and the minimum in RVM-2 (49.86 q/ha) (Table 4). The highest seed yield was obtained with Varuna (27.49 q/ha) while it was the lowest in RVM-2 (16.14 q/ha). Similarly, the maximum

Table 4: Yield and yield attributes of different mustard varieties at maturity under organic management system

| Treatment   | Siliquae /plant | Seed weight (g/plant) | Dry weight (g/plant) | Husk weight (g/plant) | 1000-seed weight (g) | Biological yield (q/ha) | Seed yield (q/ha) | Stover yield (q/ha) | Harvest index (%) |
|-------------|-----------------|-----------------------|----------------------|-----------------------|----------------------|-------------------------|-------------------|---------------------|-------------------|
| RH-0749     | 241.6           | 37.4                  | 82.5                 | 25.0                  | 4.79                 | 59.1                    | 21.6              | 37.5                | 36.5              |
| Super Gold  | 280.4           | 46.5                  | 85.9                 | 25.3                  | 4.95                 | 61.0                    | 23.1              | 38.0                | 38.8              |
| Pusa Bold   | 284.6           | 52.5                  | 93.6                 | 26.1                  | 5.16                 | 64.8                    | 25.7              | 39.1                | 39.6              |
| KMH-721     | 254.4           | 39.5                  | 78.4                 | 23.9                  | 4.48                 | 53.5                    | 17.7              | 35.8                | 33.1              |
| Varuna      | 300.3           | 57.5                  | 100.3                | 26.9                  | 5.22                 | 67.8                    | 27.5              | 40.3                | 40.5              |
| Bayer-5222  | 231.4           | 44.5                  | 82.2                 | 24.2                  | 4.57                 | 55.4                    | 19.1              | 36.2                | 34.6              |
| JM-3        | 267.6           | 47.4                  | 91.1                 | 24.7                  | 4.71                 | 57.3                    | 20.3              | 37.0                | 35.4              |
| Giriraj     | 290.3           | 52.3                  | 92.4                 | 25.7                  | 5.07                 | 63.1                    | 24.6              | 38.6                | 38.9              |
| RVM-2       | 253.4           | 36.3                  | 74.7                 | 22.5                  | 4.35                 | 49.9                    | 16.1              | 33.7                | 32.4              |
| SEm±        | 1.98            | 1.88                  | 2.85                 | 0.36                  | 0.06                 | 0.77                    | 0.30              | 5.72                | 0.72              |
| CD (p=0.05) | 6.0             | 5.68                  | 8.62                 | 1.10                  | 0.17                 | 2.32                    | 0.91              | 1.73                | 2.16              |

stover yield was found in variety Varuna (40.33 q/ha) and it was minimum in RVM-2 (33.72 q/ha). The maximum harvest index was also in variety Varuna (40.53 %) while minimum was found in variety RVM-2 (32.37 %).

### Conclusion

Based on present study, it can be concluded that variety 'Varuna' of Indian mustard could be the best choice for growing under organic farming system to achieve the higher productivity in Bundelkhand region.

### References

- Anonymous 2018. Agriculture statistics at a glance, Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India.
- Anonymous 2019. Brief about rapeseed-mustard production in the world. Directorate of rapeseed-mustard research, Bharatpur, Rajasthan, ICAR, India. pp-1-25.
- Aziz MA, Rahman AKMM, Ahmed M and Ahsan AFMS. 2011. Performance of mustard varieties in the hilly areas of Bangladesh. *J Expt Biosci* **2**: 7-10.
- Bhat SA, Khan FA and Khan ML. 2006. Effect of nitrogen and phosphorus on growth, nutrient, content, seed yield and quality of mustard. *Indian J Plant Physiol* **11**: 1150-1160.
- Chaplot PC, Vandeeep A and Kumar R. 2012. Effect of balanced fertilization and agro-chemical on growth, yield attributes and yield of mustard varieties. 3<sup>rd</sup> International Agronomy Con., Nov., 26-30, 1110-1111.
- Dawadi D, Seepaul R, George S, Groot J and Wright D. 2019. Drought tolerance classification of common oilseed species using seed germination assay. *J Oilseed Brassica* **10**: 97-105.
- Deol HS, Singh MS and Singh RP. 2008. Yield quality and economics of Indian mustard (*B. juncea*) as affected by nutrient management practices under late sown conditions. *Indian J Ecol* **35**: 31-34.
- Kandpal BK. 2001. Integrated nutrient management in relation to growth, yield and quality of *B. carinata* A. Braun and its residual effect on succeeding rice. *Ph. D. Thesis, G.B.P.U.A. & T., Pantnagar*.
- Khushu MK and Singh M. 2005. Thermal response of mustard under rainfed condition of Jammu. *Environ Ecol* **23**: 683-686.
- Kumar A. 2014. Challenge of edible oils: Can brassicas deliver. *J Oilseed Brassica* **5**: 83-86.
- Kumar S, Singh B and Rajput AL. 2001. Response of Indian mustard (*B. juncea*) to source and level of sulphur. *Indian J Agron* **46**: 528-532.
- Shukla DK, Singh RP and Shukla A. 2001. Response of yellow sarson varieties to different nitrogen levels in Tarai region of U.P. *Ann Agric Res* **22**: 586-588.
- Tripathi AK 2020. Strategies for doubling farmer's income by 2022 in Bundelkhand region of Madhya Pradesh. In: Advances in agriculture for doubling farmers income (Jain S and Verma N., Eds.). Empryreal Publishing House. pp 71-75.