The Pharma Innovation Journal 2021; 10(12): 1584-1587

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(12): 1284-1287

www.thepharmajournal.com
Received: 13-09-2021
Accepted: 30-10-2021

Niranjan R Chavan
M.Sc. Scholar, Department of Agronomy, College of Agriculture, Latur, VNMKV, Parbhani, Maharashtra, India

AK Ghotmukale
Junior Agronomist, Oilseeds Research Station, Latur, Maharashtra, India

Pratiksha J Karpe
M.Sc. Scholar, Department of Agronomy, College of Agriculture, Latur, VNMKV, Parbhani, Maharashtra, India

Corresponding Author:
Niranjan R Chavan
M.Sc. Scholar, Department of Agronomy, College of Agriculture, Latur, VNMKV, Parbhani, Maharashtra, India

Growth and yield attributes and yield of mustard (*Brassica juncea* L.) as influenced by different nutrient sources

Niranjan R Chavan, AK Ghotmukale and Pratiksha J Karpe

Abstract
A field experiment to study the influence of different nutrient sources on growth and yield attributes and yield of mustard (*Brassica juncea* L.) was conducted during *rabi* 2020-2021 at Experimental Farm, Agronomy, Oilseeds Research Station, Latur. The objectives of the present study was to study the effect of different nutrient sources on growth and yield of mustard. The soil was clayey in texture, low in available nitrogen, very low in available phosphorus, very high in available potassium and alkaline in reaction. The experiment was laid out in Randomized Block Design with 8 treatments each with three replications. The treatments were T_1 – Control, T_2 - RDF + FYM @ 5 t ha^{-1}, T_3 - RDF + Vermicompost @ 2.5 t ha^{-1}, T_4 - RDF + Poultry manure @ 5 t ha^{-1}, T_5- RDF + Elemental sulphur @ 20 kg ha^{-1}, T_6 - RDF + $ZnSO_4$ @ 20 kg ha^{-1}, T_7- RDF + $FeSO_4$ @ 20 kg ha^{-1} and T_8 - RDF + Gypsum @ 500 kg ha^{-1}. The gross and net plot size was 5.4 m x 4.5 m and 4.5 m x 3.9 m, respectively. Sowing was done on 12th November, 2020. The recommended dose of fertilizer was applied as per treatments through Urea, DAP and MOP. The crop was harvested on 23rd February, 2021. The results of the experiment indicated that combined application of RDF + Vermicompost @ 2.5 t ha^{-1} (T_3) observed significantly maximum growth parameters *viz*., plant height, number of branches, number of leaves, leaf area and dry matter and yield and yield attributes *viz*., number of silique $plant^{-1}$, length of silique (cm), number of seeds $silique^{-1}$, seed yield $plant^{-1}$ (g), straw yield $plant^{-1}$ (g), test weight (g), seed yield (kg ha^{-1}), straw yield (kg ha^{-1}) and biological yield (kg ha^{-1}), but statistically remained at par with RDF + FYM @ 5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8).

Keywords: Mustard, nutrient sources, RDF, Vermicompost, FYM, Gypsum

Introduction
Indian mustard (*Brassica juncea* L.) is one of the major oilseed crop and has been cultivated in India since ancient times. India is the third largest Rapeseed-Mustard seed producer in the world (Chauhan *et al*., 2002) [4]. Mustard is an important *rabi* oilseed crop of India. Indian mustard, locally known as "Khardal" belongs to *Cruciferae* family and genus *Brassica*. Mustard has two center of origin i.e. (1) Middle - East and India, where oldest forms are found and (2) China. Mustard is cool season crop and follows C_3 pathway. It requires temperature between 06^0 – 26 ^{0}C. It is generally grown in rainfed condition. It requires well drained soil and is moderately tolerant to acidic soil. Water requirement of mustard is low (240-400 mm) which is sufficient for rainfed cropping system. Oil content in mustard varies from 37% to 49% with 14-15% carbohydrate, 25-30% protein, 10-12% fibre, 1-1.5% minerals and vitamins, 2-3% glucosinolate. Mustard oil contains about 40-60% of ericic acid, 4.5 to 13% linolenic acid and 25-30% of oleic acid. Linoleic acid has a higher nutritive value. Indian mustard accounts over 70% of area and production of *Brassica juncea* followed by *Brassica rapa.* Mustard is the second most important edible oilseed crop after groundnut, which accounts nearly 30% of the total oilseed produced in India. India is one of the largest Rapeseed - Mustard growing country in the world occupying the first rank in area and third in production next to China and Canada.

Area, production and productivity of Rapeseed - Mustard in the world is 36.59 (Mha), 72.37(MT) and 1980 kg ha^{-1}, respectively during 2018-19. Globally, India account for 19.8% and 9.8% of the total acreage and production. During the last eight years, there has been a considerable increase in productivity from 1840 kg ha^{-1} in 2010-11 to 1980 kg ha^{-1} in 2018-19 and production has also increased from 61.64 MT in 2010-11 to 72.42 MT in 2018-19. (Anonymous, 2018) [1].

In India, mustard is cultivated on large scale in Rajasthan, MP, Haryana, Panjab, Assam, Bihar, Gujarat, WB, etc. Rajasthan ranks first in both area (40.74%) and production (44.97%).

Addition of FYM directly adds organic carbon and helps to stimulate the growth and activity of microorganisms. Higher production of biomass also increases the organic carbon content of soil (Babulkar *et al.*, 2000) [2]. The application of vermicompost adds plant nutrient and growth regulators. It increases soil water retention, microbial population, soil aeration, porosity, mineralization and consequently more release of available nutrients. Vermicompost application improves physical, chemical and biological properties of soil (Nagavallemma *et al.*, 2004) [10]. The application of poultry manure stimulates the soil microbial growth and activity, subsequent mineralization of plant nutrients and increases soil fertility and quality. Poultry manure is a good source of organic matter and plays a vital role in soil fertility. Sulphur is essential for synthesis of amino acids, protein and oil and activates enzymes system in plant. Application of sulphur in combination with balanced amounts of other nutrients significantly increases oil content and protein content of *Brassica* spp. (Pasricha and Aulakh, 1991) [11]. Zinc has vital role in growth, development and quality of crop. Zinc plays important role in biosynthesis of protein and amino acids in plants. Iron has an important role in synthesis of chlorophyll and proteins. It regulates respiration, photosynthesis, reduction of nitrates and sulphates. Gypsum is available in India and is a cheaper source of S which is used for oilseed crop.

Since adequate information is lacking on the choice of different sources of sulphur and micronutrient fertilizers for mustard, this investigation was undertaken to find out the suitability of various levels and sources of micronutrient for mustard. Keeping these points in view, the present investigation was carried out.

Materials and Methods

A field experiment to study the influence of different nutrient sources on growth and yield attributes and yield of mustard (*Brassica juncea* L.) was conducted during *rabi* 2020-2021 at Experimental Farm, Agronomy, Oilseeds Research Station, Latur. The soil of experimental plot was clayey in texture, low in available nitrogen (231.00 kg ha^{-1}), very low in available phosphorous (8.55 kg ha^{-1}) and very high in available potassium (580.89 kg ha^{-1}). The soil was moderately alkaline in reaction having pH 7.02. This soil was favourable for normal growth of the crop. The environmental conditions were moderately suited for growth and development of mustard. The experiment comprised of eight treatments and laid out in Randomized Block Design (RBD). The treatments consisted of effect of different nutrient sources on growth and yield of mustard. The treatments were T_1 – Control, T_2 - RDF + FYM @ 5 t ha^{-1}, T_3 - RDF + Vermicompost @ 2.5 t ha^{-1}, T_4 - RDF + Poultry manure @ 5t ha^{-1}, T_5- RDF + Elemental sulphur @ 20kg ha^{-1}, T_6 - RDF + $ZnSO_4$ @ 20kg ha^{-1}, T_7- RDF + $FeSO_4$ @ 20kg ha^{-1} and T_8 - RDF + Gypsum @ 500kg ha^{-1}. Each experimental unit was replicated thrice. Experimental unit had the plot size of 5.4 m x 4.5 m and 4.5 m x 3.9 m as the gross and net plot, respectively. Sowing was done by dibbling method at spacing of 45 cm x 15 cm. Sowing was done on 12th November, 2020. As per treatments, half dose of nitrogenous fertilizers and full dose of phosphatic were applied. The next half dose of nitrogen fertilizer was applied in bands as top dressing one month after sowing. The sources of nitrogen and phosphorus were urea and DAP, respectively. Elemental sulphur through bensulf, $ZnSO_4$, $FeSO_4$ and gypsum were also applied as per treatments. The recommended cultural practices and plant protection measures were undertaken as per recommendation. The crop was harvested on 23rd February, 2021.

Results and Discussion

Growth attributes

Data regarding effect of various treatments on growth attributes such as plant height (cm), number of branches $plant^{-1}$ and dry matter $plant^{-1}$ (g) is presented in Table 1.

Table 1: Mean plant height (cm), number of branches and dry matter $plant^{-1}$ (g) of mustard as influenced by different treatments at harvest

Treatments	Plant height (cm)	Number of branches	Dry matter $plant^{-1}$ (g)
T_1 – Control	114.88	10.30	62.90
T_2 - RDF + FYM @ 5 t/ha	148.84	13.87	76.02
T_3 - RDF + Vermicompost @ 2.5 t/ha	157.97	14.07	79.40
T_4 - RDF + Poultry manure @ 5t/ha	129.14	12.20	69.55
T_5 - RDF + Elemental sulphur @ 20 kg/ha	124.73	10.80	66.90
T_6 - RDF + $ZnSO_4$ @ 20 kg/ha	135.02	12.33	71.14
T_7 - RDF + $FeSO_4$ @ 20 kg/ha	127.83	11.67	68.47
T_8 - RDF + Gypsum @ 500 kg/ha	144.66	13.83	74.67
SE ±	6.53	0.55	3.33
CD at 5%	19.82	1.66	10.11
General mean	135.38	12.41	71.13

Plant height (cm)

The mean plant height at 30, 45, 60, 75, 90 DAS and at harvest were 17.95, 102.44, 124.21, 134.60, 135.38 and 135.38 cm, respectively. The plant height increased very fast during 31-45 DAS and slowed down during 75-90 DAS and remained constant up to harvest. The maximum plant height 19.62, 115.23, 142.20, 156.77 and 157.97 cm were recorded at 30, 45, 60, 75 and 90 DAS, respectively with RDF + Vermicompost @ 2.5 t ha^{-1} (T_3) which was followed by RDF + FYM @ 5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8) and it was found significantly superior over rest of the treatments at 45, 60, 75 and 90 DAS. The lowest plant height was observed with control (T_1).

Increase in plant height with application of RDF and vermicompost i.e. organic and inorganic sources might be due to higher nutrient supply, rigid conversion of carbohydrates into protein which in turn elaborated into protoplasm. These results corroborate with the findings of Kumar *et al.*, (2018) [8] and Haque and Ali (2020) [6].

Number of branches plant^{-1}

The mean number of branches were 5.31, 8.98, 11.59, 12.41 and 12.41 at 45, 60, 75, 90 DAS and at harvest, respectively. Different treatments significantly affected on number of branches plant^{-1}. Maximum increase in number of branches was observed during 30-45 DAS. Thereafter, number of branches increased slowly but in decreasing rate up to 90 DAS and remained constant up to harvest. Application of RDF + Vermicompost @ 2.5 t ha^{-1} (T_3) recorded significantly maximum number of branches and it was found at par with application of RDF + FYM @ 5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8) and found significantly superior over rest of the treatments. The significantly lower number of branches plant^{-1} were observed with treatment control (T_1) at various growth stages of crop.

The increase in growth under these treatments might be attributed due to the combined effect of organic and inorganic fertilizers with which the crop was ultimately favoured with better environment for proper growth and development. Results were in conformity with the findings of Sharma *et al.*, (2017) [12] and Singh *et al.*, (2018) [13].

Dry matter plant^{-1} (g)

The dry matter accumulation was increased as growth of plant increased. Faster rate of increase in dry matter production was observed at 76-90 DAS. The highest dry matter plant^{-1} were recorded with application of RDF + Vermicompost @ 2.5 t ha^{-1} (T_3) and found statistically at par with RDF + FYM @ 5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8) and significantly superior over rest of the treatments. The lowest dry matter accumulations observed due to control treatment (T_1).

Photosynthetic activity and its photo morphogenesis resulted into the total dry matter production plant^{-1} (g). Due to maximum nutrient availability, the increased plant height, functional leaves and leaf area resulted into more dry matter production under nutrient management treatments. The result of the present investigation are in accordance with the findings of Beenish *et al.*, (2018) [3] and Kumar *et al*, (2018) [8].

Yield attributes and yield

Yield attributes

Data presented in Table 2 indicates the yield contributing character *viz.*, number of silique plant^{-1}, length of silique (cm), number of seeds silique^{-1}, seed yield plant^{-1} (g), straw yield plant^{-1} (g) and test weight (g) of mustard.

Application of RDF + Vermicompost @ 2.5 t ha^{-1} (T_3) produced highest number of silique plant^{-1} (438.93), length of silique (4.73 cm) and number of seeds silique^{-1} (17.93) and it was statistically at par with RDF + FYM @ 5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8). The treatment of control (T_1) recorded the significantly lowest number of silique plant^{-1} (332.13), length of silique (3.70 cm) and number of seeds silique^{-1} (14.37). The result of the present investigation are in accordance with the findings of Kumar *et al.*, (2016) [9], Sharma *et al.*, (2017) [12] and Haque and Ali (2020) [6].

Application of RDF + Vermicompost @ 2.5 t ha^{-1} (T_3) produced highest seed yield plant^{-1} (25.40 g) and straw yield plant^{-1} (51.80 g) and it was statistically at par with RDF + FYM @ 5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8). The treatment control (T_1) recorded the significantly lowest seed yield plant^{-1} (18.93 g) and straw yield plant^{-1} (38.87 g). The result of the present investigation are in accordance with the findings of Kumar *et al.*, (2016) [9], Sharma *et al.*, (2017) [12] and Haque and Ali (2020) [6].

Highest test weight (5.25 g) was observed with the application of RDF + Vermicompost @ 2.5 t ha^{-1} (T_3) which was followed by RDF + FYM @ 5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8). Significantly lowest test weight of 4.18 g was recorded by the treatment control (T_1). The effect of various treatments on mean test weight was not evident significant. However the highest test weight (5.25 g) was recorded with the application of RDF + Vermicompost @ 2.5 t ha^{-1} (T_3). Similar trends were also observed by Kumar *et al.*, (2016) [9].

Table 2: Number of silique plant^{-1}, length of silique (cm), number of seeds silique^{-1}, seed yield plant^{-1} (g), straw yield plant^{-1} (g) and test weight (g) of mustard as influenced by various treatments

Treatments	Number of silique plant^{-1}	Length of silique (cm)	Number of seeds silique^{-1}	Seed yield plant^{-1} (g)	Straw yield plant^{-1} (g)	Test weight (g)
T_1 – Control	332.13	3.70	14.37	18.93	38.87	4.18
T_2 - RDF + FYM @5 t/ha	394.13	4.33	17.20	24.33	49.67	5.16
T_3 - RDF + Vermicompost @ 2.5 t/ha	438.93	4.73	17.93	25.40	51.80	5.25
T_4 - RDF + Poultry manure @ 5 t/ha	360.07	4.10	15.33	21.60	44.20	4.55
T_5 - RDF + Elemental sulphur @ 20 kg/ha	352.93	3.77	14.83	19.47	39.93	4.38
T_6 - RDF + $ZnSO_4$ @ 20 kg/ha	369.07	4.13	15.43	21.73	44.47	4.86
T_7 - RDF + $FeSO_4$ @ 20 kg/ha	359.73	3.97	15.03	20.87	42.73	4.49
T_8 - RDF + Gypsum @ 500 kg/ha	390.93	4.20	17.07	23.93	48.87	5.07
SE ±	16.41	1.93	0.67	1.07	2.18	0.24
CD at 5%	49.76	0.58	2.04	3.25	6.61	NS
General mean	374.74	4.12	15.90	22.03	45.19	4.74

Yield

Data presented in Table 3 indicates the seed yield (kg ha^{-1}), straw yield (kg ha^{-1}), biological yield (kg ha^{-1}) and harvest index (%) of mustard.

Application of RDF + Vermicompost @ 2.5 t ha^{-1} (T_3) produced highest seed yield (2051 kg ha^{-1}) and it was statistically at par with RDF + FYM @ 5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8). The treatment control (T_1) recorded the lowest seed yield (1174 kg ha^{-1}). The treatments gave immediate supply of nutrients to crop from inorganic sources at early stage and slow, continuous supply of nutrients from organic sources throughout crop growth period. This resulted into sufficient biomass production and improvement in yield parameters resulting in maximum seed yield. Positive response of crop in terms of RDF and vermicompost were also reported by Kansotia *et al.*, (2013) [7], Singh *et al.*, (2014) [14], Kumar *et al.*, (2016) [9], Gour *et al.*, (2017) [5] and Singh *et al.*, (2018) [13].

Application of RDF + Vermicompost @ 2.5 t ha^{-1} (T_3) produced highest straw yield (5778 kg ha^{-1}) and it was found statistically at par with RDF + FYM @ 5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8). The treatment control (T_1) recorded the lowest straw yield (3966 kg ha^{-1}).

Application of RDF + Vermicompost @ 2.5 t ha^{-1} (T_3) produced highest biological yield (7829 kg ha^{-1}) and it was found statistically at par with RDF + FYM @ 5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8). The treatment T_1 (control) recorded the lowest biological yield (5140 kg ha^{-1}). Higher seed yield and straw yield resulted into higher biological yield.

The application of RDF + Vermicompost 2.5 t ha^{-1} (T_3) recorded maximum harvest index (26.20%) whereas lowest harvest index (22.84%) was recorded with treatment T_1. It may be due to higher economic yield in proportionate to biological yield. These collaborate with the findings of Kumar *et al.*, (2016) [9].

Table 3: Seed yield (kg ha^{-1}), straw yield (kg ha^{-1}), biological yield (kg ha^{-1}) and harvest index (%) of mustard as influenced by various treatments

Treatments	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest Index (%)
T_1 – Control	1174	3966	5140	22.84
T_2 - RDF + FYM @ 5 t/ha	1846	5225	7071	26.11
T_3 - RDF + Vermicompost @ 2.5 t/ha	2051	5778	7829	26.20
T_4 - RDF + Poultry manure @ 5 t/ha	1493	4672	6165	24.22
T_5 - RDF + Elemental sulphur @ 20 kg/ha	1464	4615	6079	24.08
T_6 - RDF + $ZnSO_4$ @ 20 kg/ha	1590	4974	6564	24.22
T_7 - RDF + $FeSO_4$ @ 20 kg/ha	1481	4621	6102	24.27
T_8 - RDF + Gypsum @ 500 kg/ha	1812	5168	6980	25.96
SE ±	92	224	285	-
CD at 5%	280	680	864	-
General mean	1614	4877	6491	24.87

Conclusion

The application of RDF + Vermicompost @ 2.5 t ha^{-1} (T_3) recorded significantly higher growth, yield and yield attributes which was found at par with RDF + FYM @ 5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8) and found significantly superior over rest of the treatments. Significantly highest (seed yield- 2051 kg ha^{-1}) was recorded with the application of RDF + Vermicompost @ 2.5 t ha^{-1} (T_3) which was found at par with RDF + FYM @ 5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8) and significantly superior over rest of the treatments.

Acknowledgements

The authors are thankful to Agronomy Section, College of Agriculture, Latur, Maharashtra, India for providing necessary facilities to undertake the field experiment.

References

1. Anonymous, Directorate of Rapeseed-Mustard Research, 2018. Retrieved from - https://www.drmr.res.in/. Accessed on January 01, 2021.
2. Babhulkar PS, Wandile RM, Badole WP, Balpande SS. Residual effect of long term application of FYM and fertilization on soil properties (vertisols) and yield of soybean. Journal of the Indian Society of Soil Science 2000;48:89-92.
3. Beenish O, Ahmad L, Hussain A, Lal EP. Organic manure and biofertlizers: effect on the growth and yield of Indian mustard (*Brassica juncea* L.) varieties. Current Journal of Applied Science & Technology. 2018;30(04):1-7.
4. Chauhan JS, Tyagi MK, Kumar PR, Tyagi P, Singh M, Kumar S. Breeding for oil and seed meal quality in rapeseed-mustard in India-A Review. Agricultural Review 2002;23(02):71-92.
5. Gour MK, Choudhary R, Jat BL. Influence of vermicompost and different nutrients on performance of Indian mustard [*Brassica juncea* (L.) Czern and Coss] in Typic Haplustepts. Journal of Biological Sciences 2017;12(02):165-184.
6. Haque MA, Ali MM. Integrated effects of vermicompost with chemical fertilizers on the yield of mustard. Progressive Agriculture 2020;31(02):81-88.
7. Kansotia B, Meenaand RS, Meena VS. Effect of vermicompost and inorganic fertilizers on Indian mustard (*Brassica juncea* L.). Asian Journal of Soil Science 2013;8(01):136-139.
8. Kumar S, Yadav KG, Goyal G, Kumar R, Kumar A. Effect of organic and inorganic sources of nutrients on growth and yield attributing characters of mustard crop (*Brassica juncea* L.). International Journal of Chemical Studies 2018;6(02):2306-2309.
9. Kumar V, Kandpal BK, Dwivedi A, Kumar SV, Kumar V, Sharma DK. Effect of nitrogen and zinc fertilizer rates on growth, yield and quality of Indian Mustard (*Brassica juncea* L.). International Journal of Agricultural Sciences. 2016;8(06):1031-1035.
10. Nagavallemma KP, Wani SP, Lacroix S, Padmaja VV, Vineela C, Baburao M, *et al.* Vermicomposting recycling wastes into valuable organic fertilizer. Global Theme on Agroecosystems Report no. 8. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics, 2004, pp. 20.
11. Pasricha NS, Aulakh MS. Twenty years of sulphur research and oilseed production in Punjab. Sulphur Agric. 1991;15:13-23.
12. Sharma JK, Jat G, Meena RH, Purohit HS, Choudhary RS. Effect of vermicompost and nutrients application on soil properties, yield, uptake and quality of Indian mustard (*Brassica juncea*). Annals of Plant & Soil Research 2017;19(01):17-22.
13. Singh S, Singh M. Influence of nitrogen and sulphur application on growth, yield attributes, yield and quality of mustard (*Brassica juncea* L.) in Bundelkhand region. International Journal of Fauna & Biological Studies. 2018;5(02):83-85.
14. Singh V, Chaudhary S, Verma VK, Srivastava AK, Aslam M, Thaneshwar. Studies on integrated nutrient management in mustard [*Brassica juncea* (L.) Czern & Coss]. International Journal of Agricultural Sciences 2014;10(02):667-670.