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Effect of organic nutrient management on mustard (*Brassica juncea* L.) growth and yield in semi-arid region

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Abstract
A field experiment entitled "Effect of nutrient management through organic sources on growth and yield of mustard" carried out during the *rabi* season 2021–2022, at the Organic Agriculture Research Farm, Karguaji, Institute of Agricultural Sciences, Bundelkhand University, Jhansi, Uttar Pradesh. The field experiment was laid out in three replications with nine treatment combination in randomized block design. Treatments were: T_0, with 100% RDF (60: 40: 30); T_1, with 100% nutrients from farm yard manure; T_2, with 100% nutrients from vermicompost T_3 with 50% nutrients from farm yard manure and 50% nutrients from vermicompost; T_4, with 25% nutrients from farm yard and 75% nutrients from vermicompost; T_5, with 75% nutrients from farm yard and 25% nutrients from vermicompost; T_6, with 25% farm yard manure + 75% vermicompost and 25% extra through poultry manure; T_7, 75% farm yard manure + 25% vermicompost with 25% extra poultry manure; T_8, 33.33% through farm yard manure, + 33.33% through vermicompost and 33.33% through poultry manure were evaluated. Among the treatments, T_8, 33.33% through farm yard manure, + 33.33% through vermicompost and 33.33% through poultry manure recorded higher growth and yield attributing characters with the seed and stalk yield of mustard.

Keywords: FYM, poultry manure, vermicompost and mustard

Introduction
Mustard (*Brassica juncea* L.), a member of the Cruciferae family, is one of the most significant oilseed crops. One of the first crop plants that man domesticated was the brassica; it may have been grown as early as 5000 BC. Black mustard (*Brassica nigra*) and white mustard (*Brassica hirta*), as well as brown mustard (Juncea), are the two types of Brassica that are grown the most frequently in India. India holds a significant role in terms of both area and output. After the United States, China, and Brazil, India is the fourth-largest producer of oil seeds in the world. It produces around 10% of the world's oilseeds, 6-7% of its vegetable oil, and nearly 7% of its protein meal. The 4th advance estimated area and production of rapeseed-mustard in India was cultivated in about 6.78 million hectares, with a production of about 9.12 million tonnes with average productivity of 1345 kg/ha (Anon, 2020) [1]. Rapeseed-mustard was cultivated in about 0.76 million hectares with a production of 0.96 million tonnes with a productivity of 1260 kg/ha in Uttar Pradesh and occupied second position in country (Anon, 2020) [1]. The average yield of rapeseed-mustard in Bundelkhand region is quite low in comparison to national productivity. Yellow revolution led by mainly rapeseed and mustard.
The yields of mustard and other oilseed crops are uncertain. Oil seed production usually has a high level of annual production volatility since it grows primarily under unbalanced nutritional conditions. Inadequate crop management and a lack of inputs make the issue even more difficult. Given the high energy content of oilseed crops, there is a clear need for important nutrients. Efficiency and factor productivity must be raised for sustainable oilseed production while addressing the issues of falling quantity response and rising eco-awareness. Nitrogen is the most important nutrient since it regulates the mustard crop's growth, increases yield, and increases protein content. It is commonly known that when nitrogen is present, potash and phosphorus may be utilised effectively. It encourages flowering, siliquae formation, and growth.
Mustard and other oilseed crops have modest yields. Due to predominate growing under an unbalanced nutrient condition, oil seed production frequently suffers from a significant degree

of volatility in annual production. Poor crop management and a lack of inputs further complicate the problem. Oilseeds are crops that are heavy in energy, so there is obviously a very high demand for major nutrients. For sustainable oilseed production, efficiency and factor productivity must be increased while dealing with the challenges of declining quantity response and rising eco-awareness. The most crucial nutrient is nitrogen, which controls the growth of the mustard crop and raises yield and protein content. It is well known that potash and phosphorus are effectively used when nitrogen is present. It encourages blooming, siliquae setting, and increases yield and siliquae size. Sulphur plays a crucial role in determining the rapeseed-mustard plant's seed output, oil content, quality, and resistance to a range of biotic and abiotic stresses. In addition to promoting the development of chlorophyll and oil synthesis, it has a critical function in the production of seed protein, amino acids, various enzymes, and glucosinolate (Rathore *et al*., 2019) [12]. Sulphur improves mustard seed production by 12 to 48% when it is irrigated and by 17 to 124% when it is rainfed. Because zinc is involved in numerous enzymatic processes, growth procedures, hormone generation, protein synthesis, and the translocation of photosynthates to seeds, which increases seed yield, zinc has a positive impact on mustard yield. The presence of boron is necessary for the transfer of sugar and carbohydrates, pollination and seed reproduction, cell division, and the balance of sugar and starch.

Fertilizers are significant sources of one or more nutrients for plants, but combining macro- and micronutrient fertilizers can meet the need. In contrast, organic manure would give plants the N, P, K, S, Fe, B, and Zn they need to meet their nutrient requirements and improve soil quality, but they need to be applied in large quantities. Crops wouldn't need to use micronutrients if enough organic manure was applied alongside inorganic fertilizers. In order to meet the rising demand for mustard on a global scale while limiting the negative environmental effects connected with chemical fertilizers, sustainable and environmentally friendly agriculture practices are becoming more popular. The effects of three organic fertilizers likes Farm Yard Manure (FYM), Poultry Manure, and Vermicompost those material capacity to increase crop output, improve soil fertility, and lessen reliance on synthetic agrochemicals, the use of organic fertilizers has attracted growing interest. Well-known sources of organic nutrients that provide a balanced mix of macro and micronutrients are farm yard manure, poultry manure and vermicompost. Manure are utilized agriculture wastes, including plant based and animal-based material and bio fertilizers, etc. These manures support nutrient balance, close the current substantial gap between nutrient removal and supply, increase response effectiveness, and maximize crop output and desired quality.

Materials and Methods

The experiment was carried out at Organic Agricultural Research Farm, Karguanji, Department of Agronomy, Institute of Agricultural Science, Bundelkhand University, Jhansi during the rabi season 2021-22. Geographically it is located at 25°26’57.4” N latitude and 78°36’58.6” longitude and with an altitude of 227 meters above mean sea level in Jhansi district of Uttar Pradesh. This region all under Agro Climatic Zone VIII (Central Plateau and hill region). The experiment was laid in Randomized Block Design with 9 treatments combinations that were T_0, with 100% RDF (60: 40: 30); T_1, with 100% nutrients from farm yard manure (53.4 q/ha FYM); T_2, with 100% nutrients from vermicompost (26.7 q/ha VC); T_3 with 50% nutrients from farm yard manure and 50% nutrients from vermicompost; T_4, with 25% nutrients from farm yard and 75% nutrients from vermicompost; T_5, with 75% nutrients from farm yard and 25% nutrients from vermicompost; T_6, with 25% farm yard manure + 75% vermicompost and 25% extra through poultry manure (8.9 q/ha); T_7, 75% farm yard manure + 25% vermicompost with 25% extra poultry manure; T_8, 33.33% through farm yard manure, + 33.33% through vermicompost and 33.33% through poultry manure were evaluated. The different treatments were allocated randomly in each replication. The analysis of critical mustard growth and yield parameters. The raw data obtained during the experimental observations were subjected to statistical analysis as per method of “analysis of variance”.

Results and Discussion

The data relating to growth and yield attributes of mustard based on application of nutrient through organic source was recorded and represented in (table 1), which clearly shows that nutrient management through organic sources significantly influenced the growth and yield attributes of mustard.

The maximum plant height (cm) (67.70, 176.33 and 180.67) at 30, 60 and 90 DAS of mustard was recorded in the treatment T_8: 33% FYM + 33% V.C.+ 33% poultry manure%) Whereas the minimum plant height (cm) (30.67, 131.23 and 137.43) was found in T_0: Control. Thaneshwar *et al*. (2017) [18] reported comparable outcomes as well.

The maximum number of branches (27.77 and 29.33) at 60 and 90 DAS of mustard was recorded in the treatment T_8: 33% FYM + 33% V.C.+ 33% poultry manure%) Whereas the minimum plant height (cm) (6.77, and 9.50) was found in T_0: Control. The findings of Rundal *et al*. (2013) [11] are partially supported of this study.

The maximum fresh weight of the plant (g) (15.43, 51.11 and 250.55) at 30, 60 and 90 DAS of mustard was recorded in the treatment T_8: 33% FYM + 33% V.C.+ 33% poultry manure%) Whereas the minimum fresh weight of the plant (g) (7.90, 14.44 and 81.66) was found in T_0: Control. These results are conformity with the findings of Choudhary *et al*., (2023) [4].

The maximum dry weight of the plant (g) (0.26, 5.11 and 50.11) at 30, 60 and 90 DAS of mustard was recorded in the treatment T_8: 33% FYM + 33% V.C.+ 33% poultry manure%) Whereas the minimum dry weight of the plant (g) (0.10, 1.44 and 16.33) was found in T_0: Control. These results are conformity with the findings of Chakra *et al*. (2023) [4].

The maximum number of siliquas per plant (235.77) was found in the treatment T_8: 33% FYM + 33% V.C.+ 33% poultry manure%) Whereas the minimum (89.57) was found in T_0: Control. Kumar *et al*., (2018) [2] also found similar result.

The maximum seed and straw yield (2.17 and 8.11 t/ha) was found in the treatment T_8: 33% FYM + 33% V.C.+ 33% poultry manure%) Whereas the minimum seed and straw yield (1.04 and 5.09 t/ha) was found in T_0: Control. This might had resulted to increase seed and straw yield by Ram *et al*., (2013) [9].

Table 1: Effect of Nutrient Management through organic source on growth and yield of Mustard (*Brassica juncea L.*))

Treatments	Plant height (cm)			Number of branches/plants		Fresh weight of plant (gm)			Dry weight of plant (gm)			No. of siliqua/plant	Seed yield (t/ha)	Straw yield (t/ha)
	30 DAS	60 DAS	90 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS			
Control (60:40:30)	30.67	131.23	137.43	6.77	9.50	7.90	14.44	81.66	0.10	1.44	16.33	89.57	1.04	5.09
100% through farm yard manure	38.67	138.10	145.00	8.23	10.87	9.86	20.00	87.78	0.12	2.00	17.55	126.67	1.09	5.61
100% through vermicompost	43.03	143.10	151.20	9.43	12.77	10.03	25.53	94.44	0.12	2.55	18.89	140.77	1.12	5.95
50% FYM + 50% Vermicompost 5	48.00	148.67	154.80	11.00	14.10	10.60	31.11	105.55	0.14	3.11	21.11	152.57	1.12	6.33
25% FYM + 75% Vermicompost	51.10	154.43	158.33	12.47	15.37	11.16	36.66	118.33	0.16	3.67	23.67	161.10	1.23	6.81
75% FYM + 25% Vermicompost	54.67	157.57	161.43	14.43	16.87	11.90	37.77	125	0.18	3.78	25.00	172.57	1.49	6.98
25% FYM + 75% vermicompost plus 25% extra poultry manure	57.87	161.90	166.33	17.33	18.53	13.16	38.88	166.66	0.20	3.89	33.33	193.333	1.73	7.51
75% FYM + 25% vermicompost plus 25% extra poultry manure	61.20	166.00	170.87	19.23	20.70	13.83	43.33	216.11	0.23	4.34	43.22	204.9	2.03	7.97
33% FYM + 33% V.C.+ 33% poultry manure	67.70	176.33	180.67	27.77	29.33	15.43	51.11	250.55	0.26	5.11	50.11	235.77	2.17	8.11
S.Em±	2.59	2.57	1.70	1.98	2.60	0.432	5.20	15.45	0.01	0.52	3.09	8.06	0.084	0.22
CD P=0.05	7.83	7.77	5.13	5.98	7.87	1.30	15.72	46.71	0.03	1.57	9.34	24.38	0.26	0.64

Conclusion

In the semi-arid region of Bundelkhand, the mixture of farm yard manure, poultry manure and vermicompost are the excellent substitute of inorganic nutrient for the nutrient management in mustard crop. For assuring better growth and yield of organic mustard, a combination of organic sources 33% FYM + 33% V.C.+ 33% poultry manure% was showed to be the most effective.

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