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Effect of organic and inorganic source of nutrition on growth and yield of Indian Mustard (*Brassica juncea* L.)

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Abstract
A Field experiment was conducted at Rama University, situated in central region of Utter Pradesh in district Mandhana from kanpur during *Rabi* season of 2022- 2023.The experiments was consist of 8 treatment with three replication in RBD design, which are T_1 RDF (80:60:40 N:P:K), T_2RDF 75%, T_3 RDF 100% + FYM 10 t ha^{-1}, T_4 RDF 100% + *Azotobacter +PSB*, T_5RDF 75% + FYM 25 t ha^{-1}+ *Azotobacter +PSB*, T_6RDF 100% +10 FYM t ha^{-1} + *Azotobacter +PSB*, T_7RDF 100% + FYM 5 t ha^{-1}+ *Azotobacter +PSB*, T_8RDF 100% + FYM 25 t ha^{-1} + *Azotobacter+ PSB*. The result of present study also exhibited that the treatments T_5(RDF 75% + FYM 20tha^{-1}+ Azotobacter + PSB) has shown significant result in term of the maximum plant height at 45, 60 and 90 DAS, total number of branches, yield attributes *viz*- No. of siliqua plant of mustard plant, siliqua length of musterd plant, No. of Seed per siliqua of mustard plant, Weight of siliqua plant of mustard plant, Weight of seed plant of mustard plant, test weight and oil seed yield, followed by T_7 RDF 100% + FYM 5t ha^{-1} + *Azotobacter + PSB*, The highest cost of cultivation was observed in treatments T_5 (Rs. 48212ha^{-1}) Followed by treatments T_8 (Rs 46305 ha^{-1}). The maximum gross and net return were recorded form treatment T_8 (112975ha^{-1}) and treatments T_7 (109267ha^{-1}), The maximum benefit cost ratio was computed in treatments T_1 (2.08:1).

Keywords: Organic, inorganic, growth, yield, nutrition, mustard

Introduction
The country's total oilseed coverage area is 27.40 million ha, and its total oilseed production was 36.57 million tonnes— an increase of 3.35 million tonnes over the production realised in 2020–21. The country's total oilseed productivity is 1284 kg/hac. In India, mustard and rapeseed account for 24% of the land and 27% of the production. In the nation, mustard and rapeseed produce an average yield of 1499 kg/ha. 2020–21 DAC&FW ANNUAL REPORT. Even though most of the country grows mustard and rapeseed, production of those crops peaked between 2018 and 21 in Rajasthan (44.97%), Haryana (12.44%), Madhya Pradesh (11.32%), and Uttar Pradesh (10.60%). The average productivity in Uttar Pradesh was 1141kg/ha. in 2018-19. Mustard is the most important oilseed crop in world after soybean oilseed crop and palm oil. It belongs to cruciferae family. In different parts of the country, mustard is referred to by different names, such as sarson, rai or raya, toria or lahi. Sarson and Toria (Lahi) are frequently referred to as repeseed, whereas rai or laha is referred to as mustard. The oil concentration ranges between 37 and 49%. The oil is used as a condiment for making pickles, to flavour curries, to cook vegetables, hair oil, soaps and for other purposes (lubricant oil and tanning oil). In northern India, mustard oil is used for frying and cooking that is intended for human consumption. The edible oil cake comprise minerals like P, S, K, Co, Zn, M) is also utilised as manure and cattle feed. Young plant leaves (after 30days of sowing) are used as green vegetables because they provide enough sulphur and minerals for the human healthy diet and cattle feed it is also transport fat soluble vitamins (vitamin A, D, E and K) they are high in vitamin C. Green steam and leaves are also a good source of nutrients and can be used as cattle fodder and green manures. Mustard oil is a leather softening agent used in the tanning business. Protein, sugar, minerals, and even vitamins can all be found in oil. Oilseeds generally have receivable composition and quality, but their use domestically and for export is constrained by specific restrictions and hazardous elements. Mustard is a good source of several vitamins and outher includes 37–49% oil, 25–32% proteins, 7% ash, and 0.6% each of calcium, phosphorus, magnesium, and manganese. It is a desirable culinary oils.

The most crucial effective nutrient is nitrogen, which controls the growth of the mustard crop and raises minerals, output and protein content. It is well known that *potassium* and *phosphorus solubilizing* nutrient are effectively used when nitrogen is present. It encourages blooming, siliqua setting, and increases siliqua size, shape and production. Since our nation imports the majority of its fertilisers, wise use of nutrients is crucial. Under the current circumstances, the emphasis on managing the nutrients in mustard needs to be adjusted by incorporating alternative options. There are various restrictions on the utilisation of completely organic or inorganic nutrient sources (Kandpal, 2001). The goal of integrated plant nutrient management is to maximise the benefits from all potential sources of plant nutrients while maintaining or adjusting soil fertility and plant nutrient supply to an ideal level for maintaining targeted crop production. Even though they were administered to mustard in an integrated fashion, other sources of plant nutrients such as organic manures, fertilisers, and bio-fertilizers were used. There are many types of organic manure accessible locally these days. Their chemical breakdown and breakdown is variable. The farm yard manure (FYM) has a pH of 7.50, a total NPK of 0.94, 0.56, and 0.72%, which improves the chemical and biological conditions of the soil health by increasing cation exchange capacity (CEC) and supplying various vitamins, hormones, and organic acids that are crucial for soil aggregation and the growth of beneficial micro-organisms that are involved in a variety of bio-chemical processes and the release of nutrients. It is a universal truth that the addition of organic residues to bio-fertilizers, a part of integrated nutrient management, is regarded as a cost-effective, environmentally friendly, and renewable source of non-bulky, low-cost plant nutrients that can be used to supplement the world's unsustainable agriculture system's reliance on chemical fertilisers. In the current environment of extremely expensive chemical fertiliser costs, their work takes on an unique relevance. As opposed to bio-inoculants as *Azospirillum phosphoru solubilizing micro-organisms PSM VAM and Raizobium Cynobacteria*, which are crop-specific. Utilizing all of the primary components of plant nutrient sources effectively and wisely was a part of integrated nutrient management (INM). For sustaining soil fertility, health, soil water absorption capacity and production, chemical fertilisers are used in concert with animal manure, compost, green leaf manures, legumes in cropping systems, bio-fertilizers, crop residues, recyclable trash, and other locally accessible nutrient sources. The major goal of integrated nutrient management (INM) is to provide crops with a balanced supply of nutrients while maintaining and improving the health of the soil's fertility for long-term high productivity.

Materials and Methods

The present investigation entitled, "Effect of organic and inorganic source of nutrition on growth and yield of Indian Mustard (*Brassica juncea* L.)" was carried out during Rabi season of 2020-2021. The details of climatic and edaphic conditions, experimental material used, technique employed and the criteria for evaluation of treatments during the course of investigation have been described in this chapter.

Experimental site: The site is situated in central region of Uttar Pradesh in rural district Mandhana from Kanpur. The soil is alluvial with slightly sodic in nature due to lower terrain region.

Geographical condition: The city Kanpur Nagar is situated in the alluvial tract of Gangetic plains in Central part of U.P. between $25^{0}56$ to $28^{0}58^{'}$ North latitude and $79^{0}31^{'}$ to $80^{0}0$ East longitudes and at an elevation of 125.9 meter from mean sea level.

Climatic and weather conditions: This zone has semiarid climatic conditions having alluvial fertile soil. The normal rainfall of the area is about 935 mm per annum. Most of the rains are received from the mid june to the end of September. The winter months are cooler with occasional rain and frost during the last week of December to mid-January. The temperature in the month of May and June go up to 44-47^{0}C

Result and Discussion

The results of the experiment entitled "Effect of organic and inorganic source of nutrition on growth and yield of Indian Mustard (*Brassica juncea* L.)" has discussed in this lesion. The observations have been observed with respect to plant growth, root parameters, yield and yield contributing characters and economics has been accessible in following headings. The results obtained have been logically interpreted with causes and its effect association in this chapter.

Growth and development studies on crop: The result of experiment depicted that the application of fertilizers on soil test recommendation (NPK) along with FYM and seed inoculation with Azotobacter. PSB most effective enhanced growth parameter plant height the result gave clear data that use of vermin compost and seed treatment with Azotobacter in combination with inorganic fertilizers (RDF) has a significant effect on plant height. There was significant superior plant height registered from plot which was treated T_8 over soil test recommendations and of fertiliezers and control fallowed by T_7, however, minimum plant height at 45 DAS was recorded in T_2 in which were 75% RDF used and also produced higher plant height. This could be due to the supply of adequate amount of Nitrogen and other nutrients help to produce taller plant height these have opportunity to accumulate more photosynthates that would be more helpful to produce significant increase in various growth and yield attributes these result are accordance with the finding of and Selvi *et al*., (2004) [20], Jadhav *et al*., (2009) [5], Tripathi *et al*., (2011) [12] the beneficial effect of organic and inorganic source of on mustard crop also reported by many other scientist.

Yield: The data about the yield attributes showed that applications of all the nutrient accordance with soil test recommendations (NPK) with FYM and seed inoculation by Azotobacter and PSB most effective enhanced yield parameter the result gave clear data that use of FYM and seed treatment with Azotobacter in combination with inorganic fertilizers (RDF) has a significant effect the highest yield was observed when combination of various organic and inorganic nutrient was applied. There was best yield realized from plot which was treated with treatment T_8 over soil test recommendations and of fertilizer and control fallowed by treatment T_7, however, minimum yield at was observed in treatment T_2 in which were 75% RDF used. This indicates, that mustard response is better towards INM this make

favorable soil condition. Applicaion FYM with inorganic fertilizer improve soil physio-chemical property and provide favorable environment for stimulated uptake of plant nutrient and almost continuous supply of N, P, K, and micronutrient essential in adequate quantity throughout the growth period of crop Specially at critical period of crop growth Selvi *et al*., (2004) [20] the use of growth stimulant and seed inoculants bio fertilizers (Azotobacters) help in fixing free atmospheric nitrogen in soil and PSB and made root enable to utilize more nitrogen and phosphorus availability of N,P improve yield and quality have significantly improve seed yield beside this it improve mustard seed it have positive influence of protein metabolism and promoting growth the result are also justified by Nagdive *et al*. (2007) [18].

Data presented in table-4.5. revealed that the application of all the nutrient accordance with soil test recommendation (NPK), with Vermin compost and seed inoculation by Azotobacter most effective enhanced stover yield the result gave clear data that use of vermin compost and seed treatment with Azotobacter in combination with inorganic fertilizers (RDF) has a significant effect the highest yield was observed when combination of various organic and inorganic nutrient was applied. There was best yield realized from plot which was treated with treatment T_8, over soil test recommendations and of fertilizer and control fallowed by treatment T_7, However, minimum yield was observed in treatment T_2 in which were 75% RDF used. These finding was accordance with Mishra and Giri *et al*., (2004) [17].

Net return: Experimental data showed that the application of fertilizers on soil test recommendation (NPK) along with vermin compost and seed inoculation with Azotobacter give highest net return. The result give clear data that use of vermin compost and seed treatment with Azotobacter in combination with inorganic fertilizers (RDF) has a significant effect on net return. There was significant superior plant height registered from plot which was treated with treatment T8 over soil test recommendations and of fertilizer and control fallowed by treatment T7, however, minimum yield at was recorded in treatment T2 in which were 75% RDF used. These finding is also justified by this work also supported by many other scientest *viz*. Rao (2003) [19], Singh and Meena (2004) [21], Singh *et al*. (2005) [22].

Plant height at different growth stage of Mustard influenced by various organic & inorganic source of nutrient

S.N.	Treatments	Plant height (cm)		
		45DAS	60DAS	90DAS
T_1	RDF (80:60:40 N:P:K)	87.54	123.11	105.13
T_2	RDF 75%	85.16	118.14	105.46
T_3	RDF 100% + FYM 10 t ha^{-1}	89.41	126.76	111.72
T_4	RDF 100% + *Azotobacter +PSB*	92.30	127.56	114.16
T_5	RDF 75% + FYM 25 t ha^{-1}+ *Azotobacter +PSB*	93.38	132.86	116.36
T_6	RDF 100% + FYM10 t ha^{-1} + *Azotobacter +PSB*	94.49	136.70	136.29
T_7	RDF 100% + FYM 5 t ha^{-1}+ *Azotobacter +PSB*	95.41	144.40	142.16
T_8	RDF 100% + FYM 25 t ha^{-1} + *Azotobacter+ PSB*	96.98	145.23	140.25
	SE(m)	0.576	0.788	0.983
	C.D.(P=0.05)	1.76	2.41	3.00

Total number of branches

S.N.	Treatments	Total Number of Branches/Plant at Flowering	Total Number of Branches/ Plant at Maturity
T_1	RDF100%(80:60:40 N:P:K)	18.35	7.16
T_2	RDF 75%	19.11	8.98
T_3	RDF 100%+FYM 10 t ha-1	18.42	9.92
T_4	RDF100%+*Azotobacter+PSB*	20.40	7.42
T_5	RDF75%+FYM 20 t ha-1+*Azotobacter+PSB*	20.58	8.01
T_6	RDF100%+FYM 10t ha-1+*Azotobacter +PSB*	24.50	8.51
T_7	RDF100%FYM 5t ha-1+*Azotobacter+PSB*	21.18	9.85
T_8	RDF100%+FYM 25t ha-1+*Azotobacter+PSB*	22.08	6.56
	SE(m)	0.41	0.22
	C.D.(P=0.05)	1.26	0.69

Treatments	No. of siliqua $plant^{-1}$	Siliqua length (cm)	No. of seed per siliqua	Weight of siliqua $plant^{-1}$ (g)	Weight of seed $plant^{-1}$ (g)	Test weight (g)
T_1-RDF100%(80:60:40 N:P:K) ($kgha^{-1}$)	225.65	3.56	9.87	77.16	7.20	4.25
T_2-RDF75%(60:45:30) ($kgha^{-1}$)	224.42	3.85	10.02	75.18	8.60	3.75
T_3RDF100%+FYM 10tha^{-1}	228.32	3.32	10.16	78.41	9.52	3.98
T_4RDF100%+ *Azotobacter+PSB*	240.01	3.41	10.50	90.57	11.02	3.70
T_5RDF75%+FYM20tha^{1}+*Azotobacter+PSB*	246.05	3.36	11.76	87.52	10.56	3.11
T_6RDF100%+FYM10tha^{1}+*Azotobacter+PSB*	247.35	3.45	09.86	96.71	12.65	4.98
T_7RDF100%+FYM5tha^{1}+*Azotobacter+PSB*	250.50	3.22	09.98	99.60	11.98	5.06
T_8RDF100%+FYM25tha^{1}+*Azotobacter+PSB*	256.09	4.01	09.76	100.65	12.51	4.54
SE(M)	0.532	0.054	0.109	0.558	0.381	0.070
CD	1.62	0.16	0.33	1.71	1.16	0.21

Summery and Conclusion

The present investigation entitled "Effect of organic and inorganic source of nutrients on growth and yield of Indian mustard (*Brassica juncea* L.)" was carried out during Rabi season of 2022-23 at Agricultural Research Farm of faculty of Agricultural Sciences and Allied Industries, Rama University, Mandhana, Kanpur Nagar (U.P.). The experimental site is situated in main campus of the university, about 21 km. away from Kanpur Nagar district head quarter. The present experiment was laid out in randomized block design, the experiment consist of 8 treatments with three replications in mustard crop. The soil of the experimental field was sandy loam in texture, with soil pH 7.2 and EC 0.37 dsm^{-1} and soil having low organic matter, nitrogen and phosphorus; and medium potassium. The crop was sown on 4rd November 2022 using seed rate 5 kg ha^{-1}. One irrigation was applied as per need. The silent feature of finding have been summarized below.

Effect of organic and inorganic sources on growth of mustard: The maximum plant height at 60 and 90 DAS were recorded in treatment T_8 were application of 100% RDF+ FYM 25 t ha^{-1}+ *Azotobacter +PSB* that was at par with treatment T_7 were applied 100% RDF+ FYM 5 t ha^{-1} + *Azotobacter+ PSB.* However, minimum plant height at 45 DAS was recorded in treatment T_2 which were 75% RDF. The maximum total no. of branches at flowering and maturity stages were recorded in treatment T_8 were application of 100% RDF+ FYM 25 t ha^{-1}+ *Azotobacter +PSB*, that was at par with treatment T_7 were applied 100% RDF+ FYM 5 t ha^{-1}+ *Azotobacter+ PSB.*

Effect of organic and inorganic sources on yield attributes of mustard: The maximum no. of siliqua $plant^{-1}$, siliqua length(cm), no. of seeds $siliqua^{-1}$, weight of siliqua $plant^{-1}$(g), weight of seed $plant^{-1}$ (g) test weight(g) were recorded in treatment T_8 (application of 100% RDF+ FYM 25 t ha^{-1} +Azotobacter +PSB) that was at par with treatment T_7 were applied 100% RDF+ FYM 5 t ha^{-1}+ *Azotobacter + PSB.*

Effect of organic and inorganic sources on yield of mustard The maximum grain and straw yields were recorded from treatment T_8 (application of 100% RDF +FYM 25 t ha^{-1} + *Azotobacter+PSB*) which were at par with treatment T_7 were applied 100% RDF+ FYM 5 t ha^{-1} +*Azotobacter +PSB.*

Effect of organic and inorganic sources on economics of mustard: The highest cost of cultivation was observed in treatments T_5 (Rs. 48212 ha^{-1}) followed by treatments T_8 (Rs. 46305 ha^{-1}). However, minimum cost of cultivation was recorded in treatment T_2 (Rs. 25500 ha^{-1}) which were 75% RDF. The maximum gross and net return were recorded treatments T_8 (Rs. 112975 ha^{-1}) and treatments T_7 (Rs. 109267 ha^{-1}), respectively. However, minimum gross and net return were recorded in treatment T_2 (Rs. 77627 ha^{-1}) in which were RDF 75% used. The maximum benefit cost ratio was computed in treatments T_1 (2.08:1). However, minimum B:C ratio was recorded in treatment T_5 (0.99:1).

Conclusion

On the basis of the result obtaining in the present study the following conclusions are being made: Application of treatment T_8 which comprised with 100% RDF+ FYM 25 t ha^{-1} + *Azotobacter +PSB* exhibited best result in respect of growth, yield and net return of mustard crop followed by treatment T_7 (applied 100% RDF +FYM 5 t ha^{-1}+ *Azotobacter + PSB*).

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