Asian Research Journal of Agriculture

Volume 17, Issue 3, Page 17-21, 2024; Article no.ARJA.117255
ISSN: 2456-561X

Effect of Different Levels of Integrated Nutrient Management in Mustard (*Brassica juncea* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/arja/2024/v17i3468

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/117255

Original Research Article

Received: 10/04/2024
Accepted: 12/06/2024
Published: 02/07/2024

ABSTRACT

A field experiment was conducted during the Rabi session of 2020-21 in Jaunpur district which lies Indo-Gangetic plains of Central Uttar Pradesh to study the effect of integrated nutrient management in mustard (*Brassica juncea* L.). The trial was laid down in randomized block design (RBD) with three replications and twelve treatments *viz,* T_1 100% RDF, T_2 100% RDF + *Azotobacter,* T_3 100% RDF + *Azotobacter* + PSB, T_4 75% RDF + 25% N from FYM, T_5 75% RDF + 25% N from FYM + *Azotobacter,* T_6 75% RDF + 25% N from FYM + *Azotobacter* + PSB, T_7 50% RDF + 50% N from FYM, T_8 50% RDF + 50% N from FYM + *Azotobacter*, T_9 50% RDF + 50% N from FYM + *Azotobacter* + PSB, T_{10} 25% RDF + 75% N from FYM, T_{11} 25% RDF + 75% N from FYM + *Azotobacter,* T_{12} 25% RDF + 75% N from FYM + *Azotobacter* + PSB. Result of this study revealed

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Cite as: *Chaurasiya, Saurav, R.K. Singh, Sandeep Kumar, and Pramod Kumar Yadav. 2024. "Effect of Different Levels of Integrated Nutrient Management in Mustard (Brassica Juncea L.)". Asian Research Journal of Agriculture 17 (3):17-21. https://doi.org/10.9734/arja/2024/v17i3468.*

that there was significant effect on growth and yield parameters. Plant height, number of branches, number of siliques, length of silique, number of seed per siliqua, test weight, seed and stover yield in T_6 which was statistically at par with T_9, T_8, T_7, T_3. Maximum yield (1807 kg/ha) was recorded in T_6. It may be concluded that RDF with organic Manure (FYM) and Biofertilizer (*Azotobacter* + PSB) is possible to produce more yield in mustard crops cultivated without much soil productivity under Indo-Gangetic plains of central Uttar Pradesh.

Keywords: Integrated nutrient management; Indian mustard (Brassica juncea L.).

ABBREVIATION

RDF : Recommended Dose of Fertilizers
FYM : Farm Yard Manure
PSB : Phosphate Solubilizing Bacteria

1. INTRODUCTION

"Brassica juncea (L.) Czern & Coss., also known as Indian mustard, belongs to the plant family Brassicaceae (Cruciferae) or the mustard family. Indian mustard is the world's third most important source of edible oil after soybean and palm. Central Asia Himalayas are a primary center of diversification for *Brassica juncea*. Estimated production of rapeseed and mustard are 11.46 million tonnes in India during 2021-22 [1]. The oil content obtained from the different species and variety show variation in percentage of oil recovery. The oil content varies from 37-49%. The young plants are used as vegetables as they supply enough sulphur and minerals in the diet. The seed and oil are used as cooking and frying purposes throughout Northern India. It is also used for preparation of hair oils, medicines, soaps and manufacture of lubricants. Mustard oilseed cake is the vestige found after extraction of oil from mustard, which is used as organic fertilizer in herbaceous plants. Mustard cake is very useful for cattle feed" [2]. "The area and production of oilseeds is concentrated in the Central and Southern parts of India, largest oilseed-producing states in India include Andhra Pradesh, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal" [3]

"The productivity is quite lower than other developed countries mainly due to suboptimal application of fertilizers and cultivation on marginal lands. Further the quality of mustard oil and mustard oil cake is an important aspect affected by mineral nutrition. Mineral nutrient management is one important practice to improve crop production" [4]. "Proper integration of organic manures with chemical fertilizers shows great promise in not only sustaining the growth and productivity but also in meeting a part of the chemical requirement of crop" [5]. "The cost of production is increasing due to high prices of inorganic fertilizers. Therefore, the alternatives of chemical fertilizers are to be looked into just to reduce the cost of cultivation. Organic manures such as vermicompost and FYM are good source nutrients and organic matter, these sources enhance biodiversity and microbial property of soil" [6]. The organic manures being cheaper and eco-friendly, like FYM, compost and also biofertilizers are available and could be the alternatives of chemical fertilizers for improving both crop productivity and sustainability of the systems. Study regarding in effect of different levels of integrated nutrient management in mustard (*Brassica juncea* L.).

2. MATERIALS AND METHODS

The field experiment was conducted at Agronomic Experimental Farm of Sri Ganesh Rai PG College, Dobhi, Jaunpur during 25 October to 23 March of the year 2020-21 located in sub-humid subtropical climatic zone of Indo-Gangetic alluvium of Eastern Uttar Pradesh. The experiment was laid out into Randomized Block Design with three replications and consisted of twelve treatments *viz*.

T_1 100% RDF
T_2 100% RDF + *Azotobacter*
T_3 100% RDF + *Azotobacter* + PSB
T_4 75% RDF + 25% N from FYM
T_5 75% RDF + 25% N from FYM + *Azotobacter*
T_6 75% RDF + 25% N from FYM + *Azotobacter* + PSB
T_7 50% RDF + 50% N from FYM
T_8 50% RDF + 50% N from FYM + *Azotobacter*
T_9 50% RDF + 50% N from FYM + *Azotobacter* + PSB
T_{10} 25% RDF + 75% N from FYM
T_{11} 25% RDF + 75% N from FYM + *Azotobacter*
T_{12} 25% RDF + 75% N from FYM + *Azotobacter* + PSB

The crop was provided with spacing of 45 cm × 15 cm (line sowing) and plot size of 2.70 × 4.50

m. Standard culture practices followed uniformly in all experimental plots. The data regarding growth and yield parameters were analysed with statistical analysis and significance of treatments were tested with the help of 'F' test.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

Among the all treatment T_6 (75% RDF + 25% N from FYM + *Azotobacter* + PSB) record higher plant height (180.7 cm), maximum numbers of primary branches plant^{-1} (7.0) and secondary branches plant^{-1} (12.0) at the harvest stage followed by in T_9 (50% RDF + 50% N from FYM + *Azotobacter* + PSB) which was statistically at par with other treatment and lowest height and number of primary and secondary branches was observed in T_{12} (25% RDF + 75% N from FYM + *Azotobacter* + PSB). Higher plant height has been derived due to combined application of chemical fertilizers and organic manures which satisfied the immediate requirement of nutrients and also provided a favourable soil environment for better plant growth. The results were supported by the findings of Mandal and Sinha [7] and Tripathi et al. [4]. Maximum number of primary and secondary branches plant^{-1} could be due to adequate supply of readily available N and phosphorus solubilization availability due to *Azotobacter* and PSB inoculation respectively. It also might activate the enzymes to produce hormone (growth promoting substances) *viz*., auxin, gibberellin and cytokinin, which might stimulate the root morphology and affect the assimilation of nutrients. This has contributed towards vigorous growth of the plant. Moreover, the application of inorganic sources boosted the synthesis of carbohydrate and thereby enhanced the cell division and cell enlargement. Taller plants make more dry matter because of more opportunity for accumulation of photosynthates and production. The finding of present study in supported by observation of Kumar et al*.* [8].

3.2 Yield Parameters

Among the all treatment T_6 (75% RDF + 25% N from FYM + *Azotobacter* + PSB) recorded highest number of silique plant^{-1} (472.6), Length of silique^{-1} (5.4 cm), number of seeds silique^{-1} (16.6) at the time of harvesting and recorded maximum seed yield (1807 kg ha^{-1}), stover yield (3298 kg ha^{-1}) and test weight (4.9 g) after harvesting of crop followed by T_9 (50% RDF + 50% N from FYM + *Azotobacter* + PSB) which was statistically at par with other treatment. "The increase in number of siliquae per plant might be attributed to more secondary branches under T_6 which resulted in an increased process of tissue differentiation and induced reproductive meristematic activity, which in turn, enhanced the development of floral primordia, resulting in more flowers and siliquae. Furthermore, the mustard sink lies in siliqua and seeds. Application of FYM with chemical fertilizers improved the physio-chemical condition of the soil, provided favourable environment, stimulated the uptake of nutrients and almost continuous supply of N, P, K, S and micronutrient distributed over the entire crop and better availability in sufficient amounts of plant nutrients throughout the growth period and especially at critical period of crops growth which has resulted in batter plant vigour and superior yield parameters" [9]. "The integrated application of FYM, chemical fertilizers and biofertilizers might increase availability of plant nutrients which result in better nourishment of plants and the formation of bold seeds, ultimately increasing the test weight of seeds. Highest length of silique might be because of enhanced and availability of nutrients from integrated use of FYM, chemical fertilizers and biofertilizers, which finally resulted in rapid cell multiplication and cell elongation under sufficient nutrient supply". Tripathi et al*.,* [4]. The increase in the number of seeds per siliqua might be due to the beneficial effect of these treatments on cell division and tissue differentiation, which enhanced the reproductive growth of the plant. As yield is the resultant outcome of the effect of various growth and yield parameters, its expression was observed with their integrated influence. With the increment in supply of essential nutrients to mustard, their availability, acquisition, mobilization and influx into the plant tissues increased and thus improved growth and yield parameters. Similar result was also given by Thaneshwar (2017). The increase in stover yield was mainly due to increased growth characteristics like plant height and number of primary and secondary branches. The use of organic manure like FYM and biofertilizers in conjunction with chemical fertilizers had a profound effect on vegetative growth due to improved nutrients availability in the soil for a longer time with progressive decompositions of FYM. Similar results were also given by Singh et al. [10] and Tripathi et al. [4]. The increase in seed yield was mainly due to increased yield characteristics like length of siliqua^{-1}, number of siliqua plant^{-1} and number of seeds siliqua^{-1}

Table 1. Effect of different levels of integrated nutrient management on growth and yield parameters of Indian mustard

S.N.	Plant height (cm) At harvest	No. of branches in plant^{-1} Primary	Secondary	No. of siliquae plant^{-1}	Length of siliquae (cm)
T_1	150.0	3.6	7.6	354.0	4.6
T_2	153.7	5.0	8.6	381.6	4.7
T_3	173.0	6.3	11.0	438.0	5.0
T_4	152.7	4.6	9.0	355.3	4.3
T_5	152.2	4.3	8.0	433.0	4.5
T_6	180.7	7.0	12.0	472.6	5.4
T_7	164.8	5.6	9.6	373.0	4.4
T_8	178.9	6.0	11.3	437.3	4.9
T_9	180.0	6.3	11.6	450.6	5.0
T_{10}	156.5	4.3	8.3	390.6	4.4
T_{11}	143.9	3.6	7.0	392.0	4.5
T_{12}	145.5	4.0	6.3	393.6	4.6
C.D. at 5%	**21.01**	**1.30**	**1.48**	**37.91**	**0.60**

Table 2. Effect of different levels of integrated nutrient management on growth and yield parameters of Indian mustard

S.N.	Number of seeds siliqua^{-1}	Test weight (g)	Seed Yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index %
T_1	12.3	3.5	1311	2430	34.55
T_2	12.0	3.5	1356	2556	34.30
T_3	15.0	4.2	1664	3027	34.71
T_4	12.6	3.2	1448	2529	36.00
T_5	13.0	3.1	1475	2632	35.45
T_6	16.6	4.9	1807	3298	34.79
T_7	13.3	3.4	1601	3007	34.30
T_8	15.3	4.4	1613	2983	34.47
T_9	15.3	4.4	1777	3147	35.64
T_{10}	13.0	3.4	1356	2660	33.40
T_{11}	12.3	3.2	1408	2567	34.75
T_{12}	11.6	3.1	1419	2554	35.33
C.D. at 5%	**1.75**	**0.41**	**232.72**	**391.83**	**NS**

finally improved the yield. The use of organic manure like FYM and biofertilizers in conjunction with chemical fertilizers had a profound effect on vegetative growth due to improved nutrients availability in the soil for a longer time with progressive decompositions of FYM. Similar results were given by Tripathi et al. [4] and Thaneshwar (2017). The data contained at harvest index was influenced due to different integrated nutrient management treatments. It was obvious from the result that different treatments had failed to exert any significant influence on the harvest index of mustard. T_4 (75% RDF + 25% N from FYM) recorded the highest Harvest index 36.0 [11-13].

4. CONCLUSION

The result showed that different levels of integrated nutrient management was important for mustard production. The application of 75% recommended dose of fertilizers along with 25% Nitrogen from FYM in combination with *Azotobacter* and Phosphate solubilizing bacteria improve growth and yield characters resulted in increased yield in Mustard in Jaunpur district crop cultivated under Uttar Pradesh conditions.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

ACKNOWLEDGEMENT

Authors have deep regard for those who were directly or indirectly involved in this study. Special thanks is owed to Dr. A.K. Singh SMS

(Animal husbandry) Krishi Vigyan Kendra, Amhit for this guidance in directly this work.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/117255