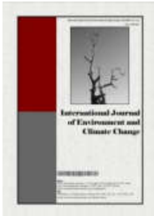

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Effect of Integrated Nutrient Management on Productivity and Economics of Indian Mustard (*Brassica juncea* L)

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Authors' contributions

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

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ABSTRACT

An experiment was carried out at College farm, College of Agriculture, Rajendranagar, Hyderabad, Telangana, in sandy loam soils during *rabi* 2020 to study the effect of integrated nutrient management on productivity and economics of Indian mustard (*Brassica juncea* L.). The treatments comprised were: T_1- Control (100% RDF -80:40:40 kg NPK ha^{-1}), T_2 (25% RDN through Vermicompost + 75% RDF), T_3 (25% RDN through Farm Yard Manure + 75% RDF), T_4 (25% RDN through Sheep manure + 75% RDF), T_5 (25% RDN through Neem cake + 75% RDF),T_6 (50% RDN through Vermicompost + 50% RDF), T_7 (50% RDN through FYM + 50% RDF), T_8 (50% RDN through Sheep manure + 50% RDF), T_9 (50% RDN through Neem cake + 50% RDF). The results indicated that application of 25% RDN through farm yard manure + 75% RDF (T_3) recorded significantly higher yield attributes *viz.,* number of branches plant^{-1}, number of siliqua plant^{-1}, length of siliqua, number of seed siliqua $^{-1}$ which was at par with T_2 (25% RDN through Vermicompost + 75% RDF). Higher values of gross returns, net returns and benefit cost (B:C) ratio were obtained with application of 25% RDN through FYM + 75% RDF (T_3) as the cost of cultivation of T_3 was lesser compared to other treatments.

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Keywords: Mustard; integrated nutrient management; yield attributes; oil content; economics.

1. INTRODUCTION

Oilseeds are second largest agricultural commodity after cereals in India. Mustard crop is second most important edible oilseed crop in India after groundnut and accounts for nearly one-third of the oil produced in country [1]. It is grown in Rajasthan, UP, Haryana, Madhya Pradesh and Gujarat states [2]. In India it covers an area of 61.24 lakh hectares with production of 92.56 lakh tonnes and productivity of 1511 kg ha^{-1}. In Telangana state mustard is cultivated in an area of 4000 ha with a production of 0.776 Mt and productivity of 1940 kg ha^{-1} [3]. Mustard seed contains 30-33% oil, 17-25% proteins, 8-10% fibres, 10-12% extractable substances [4]. The cake obtained after extraction of oil is used as cattle feed and manure. The oil cake contains 25-30% crude protein, 5% nitrogen, 1.8-2.0% phosphorous and 1.0-1.2% potassium [5]. It is a major *rabi* crop which is taken up between October-November and February-March.

Imbalanced nutrition is one of the important constraints towards higher mustard productivity, oil content and other quality parameters [6]. In the present agriculture scenario use of chemical fertilizer is increasing to boost up crop production. Simultaneously, cost of chemical fertilizer is increased constantly and indiscriminate use of inorganic fertilizer is injurious to soil health and soil productivity [7]. Hence, in order to improve crop productivity, soil health and lessen the negative environmental impact integrated nutrient management (INM) is a viable agronomic option. The key component of the INM is to decrease the enormous use of chemical fertilizers and accelerating a balance between fertilizer inputs and crop nutrient requirement, optimizing the level of yield, maximizing the profitability, and subsequently reducing the environmental pollution [8]. Yield potential of the crop can be maximized by balanced and efficient use of organic and inorganic sources of nutrients [9].

Organic manures like sheep manure and vermicompost are a good source of organic matter and play a vital role in improving soil fertility and contains higher nitrogen and phosphorus. Farm yard manure not only provides most of the essential nutrients but also improves soil structure through binding effect on soil aggregates [10]. Balanced nutrient management through the use of organic manures like FYM, vermicompost, neem cake, sheep manure in conjunction with inorganic fertilizers facilitate profitable and sustainable crop production besides improving physico-chemical properties of soil for crop production.

2. MATERIALS AND METHODS

The present experiment was conducted at College farm, College of Agriculture, Rajendranagar, Hyderabad, Telangana during *rabi* 2020 which is geographically situated at 17°19’ N latitude and 78°23’ E longitude at an altitude of 542.6 m above mean sea level. Experimental location falls under Southern Telangana Agro Climatic Zone of Telangana. The soil was sandy loam in texture, slightly alkaline in soil reaction with available nitrogen (223 kg ha^{-1}), phosphorus (30 kg ha^{-1}) and potassium (429 kg ha^{-1}). The total rainfall received during the crop growth period was 19.4 mm in 4 rainy days. There were no drought weeks during crop growth period. To study the response of mustard to integrated nutrient management practices, randomized block design was used with nine treatments replicated thrice.

The experimental field was laid out in 27 unit plots, each plot measuring 19.2 m^2 (4.8 m x 4.0 m). There were twelve rows of mustard crop in each plot and forty plants in each row. One row of crop from both sides of length and also both sides of breadth were left as guard rows. The net plot consisted of ten rows with thirty-eight plants per row (4.0 m x 3.6 m). Seeds of mustard variety DRMR IJ 31(Giriraj) were sown @ 5 kg/ha (250000 plants/ha), on 8th November 2020 with the spacing of 40 cm between the rows and 10 cm between the plants. The required quantities of 25% RDN (20 kg ha^{-1}) and 50% RDN (40 kg ha^{-1}) through farm yard manure, vermicompost, neem cake and sheep manure were applied in respective plots as per the treatments and incorporated into soil 15 days before sowing of the crop.

The remaining dose of nitrogen as urea, entire dose of phosphorous @ 40 kg ha^{-1} in the form of single super phosphate (SSP) and potassium @ 40 kg ha^{-1} as muriate of potash (MOP) were applied as basal dose at the time of sowing. All the fertilizers including the top dressed urea was applied by placement method at 5 cm away from the seed/plant rows at a depth of 5 cm. The periodical plant protection measures for mustard crop were followed to save the crop from pests and diseases. The mustard crop was harvested manually. Different growth and yield components were recorded periodically.

The data obtained from various parameters under study were analysed by the method of analysis of variance (ANOVA) as described by Gomez and Gomez [11]. The level of significance used in the "F" test was given at 5%.

ANOVA Table

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F ratio
Treatments	k - 1	(Sum of the squares of the individual treatments / no of replications)- Correction factor	Treatment sum of squares/ Degrees of freedom	Treatment mean sum of squares / Error mean sum of squares
Replications	r - 1	(Sum of the squares of the individual replications / no of treatments)- Correction factor	Replication sum of squares/ Degrees of freedom	Replication mean sum of squares / Error mean sum of squares
Error	(k - 1) *(r - 1)	Total sum of squares- treatment sum of squares- replication sum of squares	Error sum of squares/ Degrees of freedom	-
Total	(k* r) - 1	-	-	-

r = No.of replications, k = No.of treatments.

The prices of the inputs prevailed in local market during experimentation were considered for working out the cost of cultivation of mustard. The gross returns were calculated using the yield of mustard and the market price of the produce at the time of marketing. The net returns per hectare were calculated by deducting the cost of cultivation per hectare from the gross returns per hectare.

Net monetary return = Gross monetary return - Total cost of cultivation

Benefit cost ratio was worked out for each treatment by using the formula given by Subba Reddy and Raghuram [12].

Benefit cost ratio = Gross returns (₹ ha^{-1}) / Cost of cultivation (₹ ha^{-1})

3. RESULTS AND DISCUSSION

3.1 Yield Attributes

Yield attributes *viz.,* number of branches $plant^{-1}$, number of siliqua $plant^{-1}$, length of siliqua and number of seed $siliqua^{-1}$ were significantly influenced by integrated nutrient management treatments (Table.1). Among the various integrated nutrient management treatments application of 25% RDN through FYM + 75% RDF (T_3) produced significantly higher number of branches $plant^{-1}$ (11), number of siliqua $plant^{-1}$ (138), length of siliqua (5.1 cm), number of seed siliqua $^{-1}$ (14) which was superior to rest of treatments and was statistically at par with 25% RDN through vermicompost + 75% RDF (T_2).The test weight was found to be non-significant among different treatments. Integrated application of organic and inorganic combinations of nutrients increased N and provided congenial nutritional environment to the crop plants which increased metabolic process in plants resulted in greater meristematic activities leading to increased branching which provided area to produce maximum number of siliqua, seeds and test weight. These findings were in confirmation with Ajnar et al. [13], Boddepalli et al. [14], Singh et al. [15] and Ranjan et al. [16].

3.2 Seed Yield

Seed yield was significantly influenced by combined application of organic and inorganic sources of nutrients (Table.1). The highest seed yield (1684 kg ha^{-1}) was observed with the application of 25% RDN through farm yard manure + 75% RDF (T_3), which was at par with the application of 25% RDN through vermicompost + 75% RDF (T_2) (1581 kg ha^{-1}). The lowest seed yield (1102 kg ha^{-1}) was observed with control (100% RDF -80:40:40 kg

N, P_2O_5, K_2O kg ha^{-1}). There was increase of 52.8 % in the seed yield observed with application of 25% RDN through farm yard manure + 75% RDF (T_3) as compared to control (T_1).

Seed yield is directly related with the yield attributes. All the yield attributes were higher with application of 25% RDN through FYM + 75% RDF (T_3) and 25% RDN through vermicompost + 75% RDF (T_2) which might be due to availability of essential nutrients and growth hormones that led to enhanced nitrogen metabolism and protein synthesis into the plant tissues. The elevated yield due to integrated application of synthetic fertilizer and organic manures could be attributed to more exploitation of crop genetic potential for vegetative and reproductive growth and sustained nutrient supply. These findings are in close agreement with those reported by Dhaked et al. [17], Singh et al. [15], Bijarnia et al. [18] and Thakur et al. [19].

3.3 Stover Yield

Stover yield was significantly influenced by combined application of organic and inorganic sources of nutrients (Table 1). The highest stover yield (4789 kg ha^{-1}) was observed with the application of 25% RDN through farm yard manure + 75% RDF (T_3), which was at par with the application of 25% RDN through vermicompost + 75% RDF (T_2) (4718 kg ha^{-1}). The lowest stover yield (3926 kg ha^{-1}) was observed with control (100% RDF -80:40:40 kg N, P_2O_5, K_2O kg ha^{-1}). The straw yield increased by 21.98 % with application of 25% RDN through FYM + 75% RDF (T_3) over control which might be due to combined application of organic manures and chemical fertilizers resulted in better consumption of applied nutrients through enhanced micro environmental conditions and the activities of soil microorganisms involved in nutrient transformation and fixation.

The easy availability of nitrogen due to mineralization of organics influences the shoot and root growth favouring absorption of other nutrients that accelerated physiological process of plant metabolism and growth thereby leading to higher stover yields. These results are in accordance with the findings of Yadav et al. [20], Khambalkar et al. [21], Pati and mahapatra [22] and Singh et al. [23].

3.4 Oil Content

Oil content was significantly influenced by combined application of organic and inorganic sources of nutrients (Table 1). The application of 25% RDN through FYM + 75% RDF (T_3) had resulted in significantly highest oil content (35.93%), which was statistically at par with 25% RDN through vermicompost + 75% RDF (T_2) (35.20%) and was significantly superior to rest of organic and inorganic treatments. The increase in oil content with application of FYM, vermicompost and chemical fertilizers might be due to enhanced availability of sulphur which involved in conversion of primary fatty acid metabolites to the end products of fatty acid. Similar reports were also made by Mhetre et al. [24], Saha et al. [25], Singh et al. [26] and Tripathi et al. [27].

3.5 Economics

Perusal of data on economics of mustard showed that it was influenced by integrated nutrient management practices (Table.2). Application of 25% RDN through FYM + 75% RDF (T_3) (80564 ₹ ha^{-1}) resulted significantly highest gross returns among all the combinations of organic and inorganic treatments. The next best treatment was 25% RDN through vermicompost + 75% RDF (T_2) produced gross returns of ₹ 75874 ha^{-1}. The lowest gross returns were recorded with control (100% RDF) (T_1) (53521 ₹ ha^{-1}).

The higher net returns were realized with application of 25% RDN through FYM + 75% RDF (T_3) (75774 ₹ ha^{-1}) over the remaining combinations of organic and inorganic treatments. The next best treatment was 25% RDN through vermicompost + 75% RDF (T_2) with the net returns of 71156 ₹ ha^{-1}. The lowest net returns were observed with control (100% RDF) (T_1) (49596 ₹ ha^{-1}). There was 52.78% higher net returns obtained with 25% RDN through FYM + 75% RDF (T_3) over control.

Significantly highest B:C ratio of 3.09 was recorded with application of 25% RDN through FYM + 75% RDF (T_3) compared to other treatments. The least B:C ratio of 2.43 recorded with application of 50% RDN through neem cake + 50% RDF (T_9). Higher gross returns, net returns and benefit-cost ratio were obtained by the way of lesser cost of cultivation and also due to lower cost of organic manures *viz.,* FYM compared to inorganic fertilizers and good market price of mustard. These findings were in confirmation with Maurya et al. [28], Ranjan et al. [16], Saha et al. [25] and Kumawat et al. [29].

Table 1. Yield attributes of mustard as influenced by integrated nutrient management

Treatments	No.of branches plant^{-1}	No.of siliqua plant^{-1}	Length of siliqua (cm)	No.of seeds siliqua^{-1}	Test weight (g)
T_1–Control (100% RDF -80:40:40 kg NPK ha^{-1})	7	121	4.5	11	3.5
T_2 - 25% RDN through Vermicompost + 75% RDF	10	133	5.0	14	3.9
T_3 – 25% RDN through Farm Yard Manure + 75% RDF	11	138	5.1	14	3.9
T_4 - 25% RDN through Sheep manure + 75% RDF	9	125	4.8	12	3.8
T_5- 25% RDN through Neem cake + 75% RDF	8	123	4.7	12	3.7
T_6- 50% RDN through Vermicompost + 50% RDF	9	124	4.7	12	3.7
T_7- 50% RDN through FYM + 50% RDF	10	126	4.8	13	3.8
T_8- 50% RDN through Sheep manure + 50% RDF	8	123	4.6	12	3.6
T_9- 50% RDN through Neem cake + 50% RDF	7	122	4.6	11	3.5
SEm±	0.12	3.44	0.07	0.16	0.06
CD (P=0.05)	0.4	10	0.2	0.5	NS

Table 2. Yield and Oil content of mustard as influenced by integrated nutrient management

Treatments	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Oil content (%)
T_1–Control (100% RDF -80:40:40 kg NPK ha^{-1})	1102	3926	33.23
T_2 - 25% RDN through Vermicompost + 75% RDF	1581	4718	35.20
T_3 – 25% RDN through Farm Yard Manure + 75% RDF	1684	4789	35.93
T_4 - 25% RDN through Sheep manure + 75% RDF	1429	4527	34.77
T_5- 25% RDN through Neem cake + 75% RDF	1328	4372	33.96
T_6- 50% RDN through Vermicompost + 50% RDF	1374	4493	34.19
T_7- 50% RDN through FYM + 50% RDF	1459	4615	34.69
T_8- 50% RDN through Sheep manure + 50% RDF	1264	4245	33.68
T_9- 50% RDN through Neem cake + 50% RDF	1211	4026	33.47
SEm±	37.02	56.90	0.41
CD (P=0.05)	111	171	1.24

Table 3. Economics of mustard as influenced by integrated nutrient management

Treatments	Cost of cultivation (₹ ha^{-1})	Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	B:C Ratio
T_1	22067	53521	49596	2.43
T_2	27234	75874	71156	2.79
T_3	26034	80564	75774	3.09
T_4	25134	68817	64290	2.74
T_5	34034	64119	59747	1.98
T_6	33445	66312	61820	1.63
T_7	31045	70275	65654	2.26
T_8	29245	61120	56876	2.09
T_9	47045	58515	54489	1.24
SEm±	-	774.95	731.11	0.03
CD (P =0.05)	-	2322	2191	0.1

Market rates of mustard seed @ ₹.4600/- per quintal; mustard stover @ 100/- per quintal

4. CONCLUSION

The yield attributes, seed, stover yields, oil content and economics of the mustard crop are significantly influenced by integrated application of organic and inorganic sources of nutrients. Application of 25% RDN through FYM + 75% RDF (T_3) gave the best results in terms of yield, oil content and economics which was at par with application of 25% RDN through vermicompost + 75% RDF (T_2). As the cost of cultivation for T_2 is higher than T_3. The B:C ratio was high under T_3 (25% RDN through FYM + 75% RDF).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Anupdas Devi T, Dey U, Layek J, Ramkrushna GI, Krishnappa R, Babu S. No- till rapeseed- mustard, production technology in rice fallow. *Lal bahadur shastri young scientist award project.* ICAR Research complex for NEH region, Umiam, Meghalaya;2018.
2. Anonymous. Role of potash for crops. IFFCO News Bulletin, Gurgaon. 2017;1-4.
3. Indiastat. 2018-19. Agricultural production. http://www.indiastat.com.
4. Mishra JP, Singh RK, Yadav D, Das A, Sahoo S. Effect of tillage and irrigation frequency on growth of Indian mustard. International Journal of Chemical Studies. 2019;7(1):2127-2130.
5. Reddy SR, Ramu YR. Agronomy of field crops. Kalyani Publishers;2016.
6. Lal B, Rana KS, Gautam P, Rana DS, Shivay YS, Meena BP, Meena RK, Singh P. Ethiopian Mustard–Chickpea Intercropping System is a Viable Option for Yield Advantage in Dryland Condition of North India-Part II. Proceedings of the National Academy of Sciences, India Section B: Biological Sciences. 2015;1-10.
7. Eyhorn F, Ramakrishnan M, Mader P. The variability of cotton based organic farming systems in India. International Journal of Agricultural Sustainability. 2007;5:S25-38.
8. Selim MM. Introduction to the Integrated Nutrient Management Strategies and Their Contribution to Yield and Soil Properties. International Journal of Agronomy. 2020;1–14.
9. Meena BP, Kumar A, Dhar S, Paul S, Arvind Kumar. Productivity, nutrient uptake and quality of popcorn and potato in relation to organic nutrient management practices. Annals of agricultural Research. 2016;37(1): 72-79.
10. Zamil Shawkat, Sheikh Quadir, Forhad Quazi, Wahid Al, Adnan. Effect of different animal manures on yield, quality and nutrient uptake by mustard. BRAC University Journal. 2004;1(2): 59-66.
11. Gomez KA, Gomez AA. Statistical procedure for agriculture research. John Wiley and Sons Publishe₹, New York. 1984;357-423.
12. Subba Reddy S, Raghu Ram. Agricultural economics. Oxford and IBH Publishing Cooperative Private Limited., New Delhi;1996.
13. Ajnar, P and Namdeo, S. Effect of integrated nutrient management on Indian mustard yield attributes and yield. Journal of Pharmacognosy and Phytochemistry. 2021;10(2):545-548.
14. Boddepalli VK, David AA, Thomas T, Rao S. Effect of Integrated Nutrient Management on Growth, Yield of Indian mustard (*Brassica Juncea* L.) Cv. Sangam. International Journal of Chemical Studies. 2019;7(3):2970-2974.
15. Singh H, Singh RP, Meena BP, Lal B, Dotaniya ML, Shirale AO, Kumar K. Effect of integrated nutrient management (INM) modules on late sown Indian mustard [*Brassica juncea* (L.) Cernj. Cosson] and soil properties. Journal of Cereals and Oilseeds. 2018;9(4):37-44.
16. Ranjan R, Dimree S, Pathak RK, Awasthi UD, Verma AK. Productivity, water use efficiency and economics of Indian mustard (*Brassica juncea* L.) as influenced by integrated nutrient management. International Journal of Current Microbiology and Applied Sciences. 2018;7(11):2027-2034.
17. Dhaked GS, Tomer V, Panotra N. Effect of Indian mustard to various organic and inorganic sources of nutrient on yield, available soil p balance and p recycling through residues;2020.
18. Bijarnia AL, Yadav RS, Rathore PS, Singh SP, Jat RS. Study of integrated nutrient management and weed control measures on mustard (Brassica juncea L.) and its residual effect on fodder pearl millet (Pennisetum glaucum L) in North Western

Rajasthan. International Journal of Chemical Studies. 2017;5(3):314-318.
19. Thakur R, Sawarker SD, Vaishya UK, Singh M. Impact of continuous use of inorganic fertilizers and organic manure on soil properties and productivity under soybean-wheat intensive cropping of vertisols. Indian Journal of Soil Science. 2011;59(1):74-81.
20. Yadav KM, Chaudhry S, Kumar H, Singh R, Yadav R. Effect of integrated nutrient management on growth and yield in mustard [*Brassica juncea* (L.) Czern & Cosson]. *International Journal of Chemical Studies*. 2018;6(2):3571-3573.
21. Khambalkar PA, Singh N, Verma SK, Yadav SS. Influence of integrated nutrient management on soil fertility and properties of sandy clay loam and relationship with productivity of pearl millet (Pennisetum glaucum) – mustard (*Brassica juncea*) cropping sequence. International Journal of Chemical Studies. 2017;5(5):1237-1243.
22. Pati P, Mahapatra PK. yield performance and nutrient uptake of Indian mustard (*Brassica juncea* L.) as influenced by integrated nutrient management. Journal Crop and Weed. 2015;11(2):58-61.
23. Singh Sandeep, Singh Vinay, Chandel Singh, Bandana. Effect of integrated nutrient management on Indian mustard and soil fertility. Annals of Agriculture Research. 2013;34 (3):231-235.
24. Mhetre AG, Vaidya KP, Dademal AA, Kapse VD. Effect of integrated nutrient management on yield and quality of mustard (*Brassica juncea* L.) on Alfisols of Konkan (MS). The Pharma Innovation Journal. 2019;8(8):147-149.
25. Saha PK, Malik GC, Bhattacharyya P, Banerjee M. Integrated nutrient management on growth and productivity of rapeseed-mustard cultiva₹. International Journal of Bio-resource and Stress Management. 2015;6(2):192-197.
26. Singh SP, Pal MS. Effect of integrated nutrient management on productivity, quality, nutrient uptake and economics of mustard (*Brassica juncea*). Indian Journal of Agronomy. 2011;56(4):381-387.
27. Tripathi MK, Chaturvedi S, Shukla DK, Mahapatra BS. Yield performance and quality in Indian mustard (*Brassica juncea*) as affected by integrated nutrient management. Indian Journal of Agronomy. 2010;55(2):138-142.
28. Maurya S, Pandey M, Padhak R, Verma AK, Ranjan R, Pal A, Gangwar V. Integrated nutrient management of mustard (*Brassica Juncea* L.) alluvial soil of Uttar Pradesh. International Journal of Chemical Studies. 2020;8(1):1386-1389.
29. Kumawat A, Pareek BL, Yadav RS, Rathore PS. Effect of integrated nutrient management on growth, yield, quality and nutrient uptake of Indian mustard (*Brassica juncea*) in arid zone of Rajasthan. Indian Journal of Agronomy. 2014;59(1):119-123.

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