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: T₁- Control (100% RDF -80:40:40 kg NPK ha⁻¹), T₂ (25% RDN through Vermicompost + 75% RDF), T₃ (25% RDN through Farm Yard Manure + 75% RDF), T₄ (25% RDN through Sheep manure + 75% RDF), T₅ (25% RDN through Neem cake + 75% RDF), T₆ (50% RDN through Vermicompost + 50% RDF), T₇ (50% RDN through FYM + 50% RDF), T₈ (50% RDN through Sheep manure + 50% RDF), T₉ (50% RDN through Neem cake + 50% RDF). The results indicated that application of 25% RDN through farm yard manure + 75% RDF (T₃) 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 T₂ (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 (T₃) as the cost of cultivation of T₃ was lesser compared to other treatments.

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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
sources of nutrients (Table 1). The application of 25% RDN through FYM + 75% RDF (T3) had resulted in significantly highest oil content (35.93%), which was statistically at par with 25% RDN through vermicompost + 75% RDF (T2) (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 (T2) (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 (T2) produced gross returns of ₹ 75874 ha⁻¹. The lowest gross returns were recorded with control (100% RDF) (T1) (53521 ₹ ha⁻¹).

The higher net returns were realized with application of 25% RDN through FYM + 75% RDF (T3) (77574 ₹ ha⁻¹) over the remaining combinations of organic and inorganic treatments. The next best treatment was 25% RDN through vermicompost + 75% RDF (T2) with the net returns of 71156 ₹ ha⁻¹. The lowest net returns were observed with control (100% RDF) (T1) (49596 ₹ ha⁻¹). There was 52.78% higher net returns obtained with 25% RDF through FYM + 75% RDF (T3) over control.

Significantly highest B:C ratio of 3.09 was recorded with application of 25% RDN through FYM + 75% RDF (T3) compared to other treatments. The least B:C ratio of 2.43 recorded with application of 50% RDN through neem cake + 50% RDF (T9). 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 | No. of siliqua plant | Length of siliqua (cm) | No. of seeds siliqua | Test weight (g) |
|------------|-----------------------|----------------------|------------------------|----------------------|----------------|
| T1 Control (100% RDF - 80:40:40 kg NPK ha⁻¹) | 7 | 121 | 4.5 | 11 | 3.5 |
| T2 - 25% RDN through Vermicompost + 75% RDF | 10 | 133 | 5.0 | 14 | 3.9 |
| T3 - 25% RDN through Farm Yard Manure + 75% RDF | 11 | 138 | 5.1 | 14 | 3.9 |
| T4 - 25% RDN through Sheep manure + 75% RDF | 9 | 125 | 4.8 | 12 | 3.8 |
| T5 - 25% RDN through Neem cake + 75% RDF | 8 | 123 | 4.7 | 12 | 3.7 |
| T6 - 50% RDN through Vermicompost + 50% RDF | 9 | 124 | 4.7 | 12 | 3.7 |
| T7 - 50% RDN through FYM + 50% RDF | 10 | 126 | 4.8 | 13 | 3.6 |
| T8 - 50% RDN through Sheep manure + 50% RDF | 8 | 123 | 4.6 | 12 | 3.6 |
| T9 - 50% RDN through Neem cake + 50% RDF | 7 | 122 | 4.6 | 11 | 3.5 |
| SE± | 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 (%) |
|------------|----------------------|------------------------|----------------|
| T1 Control (100% RDF - 80:40:40 kg NPK ha⁻¹) | 1102 | 3926 | 33.23 |
| T2 - 25% RDN through Vermicompost + 75% RDF | 1581 | 4718 | 35.20 |
| T3 - 25% RDN through FYM + 75% RDF | 1684 | 4789 | 35.93 |
| T4 - 25% RDN through Sheep manure + 75% RDF | 1429 | 4527 | 34.77 |
| T5 - 25% RDN through Neem cake + 75% RDF | 1328 | 4372 | 33.96 |
| T6 - 50% RDN through Vermicompost + 50% RDF | 1374 | 4493 | 34.19 |
| T7 - 50% RDN through FYM + 50% RDF | 1459 | 4615 | 34.69 |
| T8 - 50% RDN through Sheep manure + 50% RDF | 1264 | 4245 | 33.68 |
| T9 - 50% RDN through Neem cake + 50% RDF | 1211 | 4026 | 33.47 |
| SE± | 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 |
|------------|------------------------------|------------------------|----------------------|-----------|
| T₁         | 22067                        | 53521                  | 49596                | 2.43      |
| T₂         | 27234                        | 75874                  | 71156                | 2.79      |
| T₃         | 26034                        | 80564                  | 75774                | 3.09      |
| T₄         | 25134                        | 68817                  | 64290                | 2.74      |
| T₅         | 34034                        | 64119                  | 59747                | 1.98      |
| T₆         | 33445                        | 66312                  | 61820                | 1.63      |
| T₇         | 31045                        | 70275                  | 65654                | 2.26      |
| T₈         | 29245                        | 61120                  | 56876                | 2.09      |
| T₉         | 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<sub>3</sub>) 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<sub>2</sub>). As the cost of cultivation for T<sub>2</sub> is higher than T<sub>3</sub>. The B:C ratio was high under T<sub>3</sub> (25% RDN through FYM + 75% RDF).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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