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Integrated Nutrient Management in Mustard (Brassica Juncea L.)

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Abstract

Background - The Oilseed crops generally are one of the most important crops in the world. Their role in human diet and industrial application cannot be underestimated. Among the seven edible oilseeds cultivated in India, rapeseed-mustard contributes 28.6% in the total oilseeds production and ranks second after groundnut sharing 27.8% in the data, mustard seed production is estimated at 109.5 lakh tonnes in 2021-22. Integrated nutrient management approach underlines the basic concept of maintenance or adjustment of soil fertility and of plant nutrient supply at an optimum level for sustaining the desired crop productivity through optimization of the benefits from all possible sources of plant nutrients in and integrated manner. Keeping in view of above production constraints, the combination of organic resources as farm yard manure and poultry manure coupled with the chemical fertilizers has been felt as the need of the hour in order to increase and sustain the oilseed production in the North-West region of Uttar Pradesh and Uttarakhand state.

Methodology and Result - The combined application of 75% RDF with compost (5 or 2.5 t/ha) significantly improved mustard seed yield and net returns. This combination performed similarly to the full recommended dose of fertilizers. About 25% of chemical fertilizers can be saved using this integrated approach.

Conclusion - It offers both economic and environmental benefits. Using compost with reduced RDF supports long-term soil fertility and crop productivity. This practice is especially suitable for the tropical conditions of western U.P. and Uttarakhand plains.

Keywords: Mustard, Nutrient Management, Oilseed, Soil fertility

Introduction

The Oilseed crops generally are one of the most important crops in the world. Their role in human diet and industrial application cannot be underestimated. India is the 4th largest oilseeds producer in the world. It has 20.8% of the total area under cultivation globally, accounting for 10% of global production. Among the seven edible oilseeds cultivated in India, rapeseed-mustard contributes 28.6% in the total oilseeds production and ranks second after groundnut sharing 27.8% in the data, mustard seed production is estimated at 109.5 lakh tonnes in 2021-22. The area under coverage has been pegged at 87.44 lakh hectares while the average yield is seen at 1,270 kg per hectare.

In North-West plane zone of Uttar Pradesh and Uttarakhand. Rapseed and Mustard cultivated on an area of about 639 Lakh hectare with annual production of 726 thousand tonnes with having and average yield of 1136 kg/ ha[1] in year (2011-12).

In common decades, a major issue in designing sustainable agriculture system will be the management of soil organic matter and the Rational use of organic and inorganic inputs will check the plant nutrient depletion to maintain the soil fertility and the productivity of Rapseed and Mustard. Integrated nutrient management approach underlines the basic concept of maintenance or adjustment of soil fertility and of plant nutrient supply at an optimum level for sustaining the desired crop productivity through optimization of the benefits from all possible sources of plant nutrients in and integrated manner.

Several studies have established the ill effects of continuous use of chemical fertilizers alone on the soil-physico-chemical properties and environment besides their higher cost. After that the Judicious use of both organic and inorganic sources of can alone to lead sustained maintenance of soil fertility and productivity.

Keeping in view of above production constraints, the combination of organic resources as farm yard manure and poultry manure coupled with the chemical fertilizers has been felt as the need of the hour in order to increase and sustain the oilseed production in the North- West region of Uttar Pradesh and Uttarakhand state.

1. Aim of the Study

To investigate the effect of INM on growth, yield and quality of Mustard.

2. Objective of Study

- To study the effect of INM on growth, yield and quality of Mustard.
- To find out the best combination of organic manure and inorganic fertilizers.
- To work out of the economics of different treatments.

3. Methodology

3.1 Experimental Site

The experimental field of Raja Mahendra Pratap (Post Graduate) College, Gurukul Narsan, is situated in the alluvial belt of the Ganga River, encompassing regions of western Uttar Pradesh and Haridwar district, Uttarakhand. The site lies within a sub-tropical and semi-arid climatic zone, geographically positioned at 29.7024°N latitude and 77.8486°E longitude, with an elevation of 261 meters above mean sea level. The topography of the field is even and uniformly fertile, with well-leveled soil and consistent textural properties. The farm is equipped with tubewell irrigation and proper drainage facilities to ensure regular water supply and prevent waterlogging.

3.2 Climate and Weather Conditions

The Haridwar district experiences a sub-tropical, semi-arid climate with distinct seasonal variations. The monsoon typically begins in late June and persists until early October. Occasional cyclonic rains occur between December and February. The region has an average annual temperature of 23.7°C and an average annual rainfall of 1170 mm.

3.2.1 Weather During the Crop Growth Period

During the Rabi season (2022–2023), weather conditions remained generally favorable for crop growth. Maximum and minimum temperatures during early growth stages decreased steadily, aiding vegetative growth. A gradual rise in temperature toward the end of March facilitated the reproductive phase. Total rainfall during the crop period was 90 mm. Relative humidity was lower during the early stages, potentially reducing the risk of white rust and blight. Wind velocity remained low and non-detrimental.

3.3 Soil Characteristics

Surface soil samples (0–15 cm) were collected from ten random spots using a post-hole digger. Samples were air-dried, sieved (2 mm), and analyzed at the Soil Science Department, KVK Dhanauri, Roorkee. The soil was classified as sandy loam with the following properties:

Mechanical Composition:

- Sand: 60.30%
- Silt: 20.03%
- Clay: 18.94%
- Texture: Sandy loam

Chemical Properties:

- Organic Carbon: 0.60%
- Total Nitrogen: 0.055%
- Available Phosphorus: 19.50 kg/ha
- Available Potassium: 195.6 kg/ha
- pH: 7.5
- Electrical Conductivity: 0.26 S/m

3.4 Crop Rotation (2020–2023)

Year	Kharif	Rabi	Zaid
2020–2021	Sorghum	Wheat	Green gram
2021–2022	Sorghum	Wheat	Maize
2022–2023	Sorghum	Mustard (experiment)	

3.5 Experimental Design

The experiment followed a randomized block design (RBD) with four replications and nine treatment combinations, totaling 36 plots.

Treatments:

- T1 to T9 involved various combinations of RDF (120:40:20 NPK kg/ha), compost (10 t/ha), and vermicompost (5 t/ha), with combinations of 25%, 50%, and 75% RDF.

Layout Details:

- Gross plot size: 4.5 m × 5.0 m = 22.5 m²
- Net plot size: 4.0 m × 4.5 m = 18.0 m²
- Spacing: 45 cm × 45 cm
- Total experimental area: 1246 m²

Crop variety:

Mustard variety ‘Pro-agro 5210’, suitable for western Uttar Pradesh and Uttarakhand plains, was used. The variety has a maturity period of 135 days, high yield potential (13–15 q/acre), and resistance to white rust.

3.6 Cultural Practices

Operation	Date
Tillage and Layout	3–4 Nov 2022
Compost/Vermicompost Application	4 Nov 2022
Sowing and Fertilizer Application	5 Nov 2022
Thinning (1st/2nd)	30 Nov, 27 Dec 2022

Irrigation (1st/2nd)	1 Dec 2022, 10 Jan 2023
Weeding and Hoeing	25 Dec 2022
Harvesting	17 Mar 2023
Threshing and Seed Cleaning	28 Mar 2023

3.7 Growth and Yield Parameters

Growth Observations: Recorded from five tagged plants at 30, 60, 90 days, and harvest.

- Plant Height (cm)
- Primary and Secondary Branches per Plant
- Dry Matter Accumulation (g)

Yield Attributes:

- Number and length of siliquae
- Number of seeds per siliqua
- 1000-seed weight (g)

Yield Metrics:

- Biological Yield (q/ha)
- Seed Yield (q/ha)
- Straw Yield (q/ha)
- Harvest Index (%) = (Seed Yield / Biological Yield) × 100

3.8 Quality Parameter

Oil Content (%): Estimated using the Soxhlet extraction method (Chopra and Kanwar, 1976).

3.9 Economic Analysis

- Cost of Cultivation: Based on prevailing market rates for inputs and labor.
- Gross Return: Based on market rate of yield.
- Net Return: Gross return minus cost of cultivation.
- Benefit-Cost Ratio (B:C) = Net Return / Cost of Cultivation

3.10 Statistical Analysis

The data were analyzed using ANOVA (factorial RBD) at a 5% significance level. Significant differences were further examined using the Critical Difference (CD) method as described by Cochran and Cox (1957). Significant interactions were interpreted using two-way mean tables to identify optimal treatment combinations.

4. Result

The combined application of 75% RDF with compost (5 or 2.5 t/ha) significantly improved mustard seed yield and net returns. This combination performed similarly to the full recommended dose of fertilizers. About 25% of chemical fertilizers can be saved using this integrated approach. It offers both economic and environmental benefits. Using compost with reduced RDF supports long-term soil fertility and crop productivity. This practice is especially suitable for the tropical conditions of western U.P. and Uttarakhand plains.

5. Discussion

5.1 Growth Parameters:

Application of 75% RDF+ 5 tones compost/ha Significantly influenced growth characters. Viz. Plant hei

ght number of Primary and Secondary Branches per plant through it was Found at par with recommended dose of Fertilizers and 50% RDF + 5 tones compost/ha. Application of 50% RDF+ 5 tones compost/ha Produced significantly taller plants at all the crop stages except at 30-day stage. The enhancement in plant height may be attributed to the increase availability of Nutrients to the plants. Which in turn might have increased availability of Nutrients to the plants, which in turn might have increased cell division and their expansion Finding Patel I care in close agreement with those reported byet al (1996).

Similarly, application of 75% RDF+5 tones compost/ha resulted in significantly a greater number of primary and secondary branches per plant at all the crop growth stages with regarding to primary and secondary branches. The improvement in branches per plant may be attributed to profuse vegetative growth which may have resulted in enhanced translocation of photosynthetic from source to sink with the use of balanced fertilization. Coupled with organic manures. These results are in line with the findings of Gurjar and Chauhan (1997).

Different treatments of organic and inorganic had a marked influence to a greater number of Primary and Secondary branches and increased plant height moreover integrated use of inorganic and organic might have increased the photosynthetic surface area resulting in greater net photosynthesis better growth in plants. These results are in accordance with dose of Lal and Dravid (1993) , Mondal et al (1996) and Patel et al (1996). On dry Matter accumulation per plant at all the crop growthstages. Significantly higher dry matter wax accumulated with the application of 75% RDF+5 tones compost/ha which was statistically par at with the treatment receiving RDF 100%. The increase in dry matter due to the application of 75% RDF+5 tones compost/ha over compost alone Enhanced dry matter production by plants under higher Fertility levels coupled with organic manures may be attributed

5.2 Yield Attributes: -

Various treatments had favour ably affected all the yield attributes except length of siliquae and 1000-seed weight Application of 75% RDF + 5 tones compost/ha Significantly increased no. of silique per plant, Length of siliquae per plant, and number of seeds per siliquae over the rest of treatments. However, it remained at par with recommended dose of fertilizers vermicompost @5 tones/ha and 50% RDF+ 2.5 compost/ha. The improvement in yield attributes may be due to the balance use of chemical Fertilizers at optimum level coupled with organize manures which might have improved vegetative growth and it turn resulted in enhanced production of photosynthetic and their adequate translocation from source to sink. Similar, results have been reported by Mondal et. al. (1997).

5.3 Seed and Straw yield: -

Application of 75% RDF in combination with 5 tones compost/ha produced significantly higher seed yield in comparison to rest of the treatments. This treatment was also at par with RDF and 50% of RDF along with 5 tones compost/ha the increase in seed yield was 80% with the application of 75% RDF+5 tones compost/ha over compost alone. This might be due to better plant growth and development as resulted from increased number of Primary and Secondary branches per plant. Higher dry Matter Accumulation per plant and better yield attributed. These results are in close conformity withthose of Mondal et al (1996).

The effect of different treatments on Straw yield was almost same to that of grain yield. The increase in Straw yield might be due to more plant height, Primary and Secondary branches per plants. These findings are in line with those reported by Dhurandher et.al (1999).

5.4 Quality Parameter: -

Different treatments of organic and inorganic did not bring about a significant difference, with regard to oil content in Mustard seed (Table 4.6) Roy et. al. (1981), Tomer et. al. (1997) and Sadhuet al. (1997) have reported similar findings.

5.6 Economics: -

Maximum return of Rs. 2.38 per rupee invested was achieved with the application of RDF Higher gross returns were obtained with the application of 75% RDF+ 5 tones compost, However, the net returns were lower as compared with recommended dose of fertilizers this possible reason for this higher cost of inorganic fertilizers.

6. Future Scope of Study

On the basis of Economic Analysis of experimental findings, it is recommended that 75 % RDF along with 5 tonnes compost/ ha-1 should be apply for better seed yield of Mustard (Brassica Juncea L.)

7. Conclusion

Application of 75% RDF along with compost@ 5 tones/ ha (T4) or compost @ 2.5 tones/ ha (T5) and Full Recommended dose of Fertilizers along (T1) is sufficient to obtain the higher seed yield and net return higher seed yield and net return in Mustard. Inorganic Fertilizers to the extent of about 25% can be saved if compost @ 5 tones/ ha-1 or compost @ 2.5 tones/ ha^{1} is applied along with 75% Recommended dose of Fertilizers in Mustard. Instead of applying inorganic Fertilizers or organic Manure alone, application of compost @ 5 tones ha^{1} or compost@2.5 tones/ ha^{1} along with 75% of Recommended dose of Fertilizer would be beneficial for sustained Maintenance of soil Fertility and productivity of Mustard under tropical agro-climatic condition of western region of U.P. & Uttarakhand plain districts.

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