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"Effect of Integrated Nutrient Management in Indian Mustard *(Brassica juncea L.)*"

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Abstract

A field trial was carried out as an During the Rabi season of 2020–2021, was conducted at Rama University's agricultural farm in Kanpur in 2023 to address the specified objective. The experiment utilized sand loam soil with a pH of 7.4, electrical conductivity (EC) of 0.25 dSm^{-1}, organic carbon content of 0.61 percent, and available nutrients at levels of 216.0, 18.66, and 195.66 kg ha^{-1} for nitrogen (N), phosphorus (P), and potassium (K), respectively. The main focus of the study was "Integrated Nutrient Management in Mustard (Brassica juncea L.)." The experimental design employed a Randomized Block Design (RBD) with nine treatments distributed across four replications, including a control group. The results indicated that the combination of RDF (120:40:20), Poultry manure (5 tons ha^{-1}), FYM (5 tons FYM ha^{-1}) significantly enhanced growth, oil, and other yield parameters. Specifically, the data for treatment (T4-75% RDF + 5t FYM ha^{-1}) exhibited the highest values for various parameters, including plant height (180.5 cm), number of primary & secondary branches (7.25 & 11.16), dry matter accumulation (340.79 g/plant), and oil content (38.90%).

Keywords*:* mustard, poultry manure, FYM, growth, and yield.

Introduction

Oilseed crops, particularly Rapeseed and Mustard, hold a significant position in our agricultural system, boasting substantial acreage next to food grains. The primary challenge in the global production of oilseed crops, particularly Rapeseed and Mustard, lies in their energy-rich nature but cultivation under conditions of energy scarcity (Swaminathan, 1980). India stands as the fourth-largest oilseed-producing economy globally, following the USA, China, and Brazil, with Mustard and Rapeseed contributing approximately 10% to the world's oilseed production. In India, Rapeseed and Mustard

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(Brassica juncea L.) hold a prominent position, ranking second after groundnut in terms of both average area (6.23 million ha^{-1}) and production (9.26 million metric tonnes), contributing 12.79% to the world's output in the year 2018-2019, with an average yield of 1161 kg/ha^{-1} (Agricultural Statistics at a Glance, 2020). Mustard contains around 35–40% oil, and these oilseed crops are commonly grown in rainfed environments with limited inputs and inadequate management, leading to reduced productivity levels (Lal et al., 2015). Continuous farming with chemical fertilizers alone is insufficient to maintain optimal crop output, necessitating the use of both chemical fertilizers and organic manure to enhance soil health and fertility (Prasad et al., 2017). Integrated Nutrient Management (INM) practices play a crucial role in restoring soil fertility and sustaining optimal crop output over time (Pal and Pathak, 2016).

Efforts to increase Rapeseed and Mustard production at both the national and state levels must be intensified due to the growing demand for these oilseed crops for human consumption and industrial uses. Bridging the gap between production and consumption and reducing reliance on imports require increased productivity per unit of time and space. Identifying production constraints, particularly related to nutrient management, is essential for exploiting the yield potential of these crops. Improper use of fertilizers and excessive dependence on chemical fertilizers have been identified as critical constraints affecting Rapeseed and Mustard production and the sustainability of agricultural practices, leading to environmental pollution (Vinod et al., 2019). The recent fertilizer crisis and the resulting price hikes, along with the withdrawal of subsidies, have renewed interest in inorganic recycling. Sustainable agriculture systems will need to address the management of soil organic matter, and the rational use of organic and inorganic inputs is crucial to maintain soil fertility and productivity of Rapeseed and Mustard (Kumar et al., 2018). Integrated nutrient management approaches emphasize maintaining or adjusting soil fertility and plant nutrient supply at optimum levels for sustained crop productivity by optimizing benefits from various nutrient sources in an integrated manner. Numerous studies have highlighted the adverse effects of relying solely on chemical fertilizers, including impacts on soil physico-chemical properties and the environment, along with higher costs. The judicious use of both organic and inorganic nutrient sources is advocated for sustained maintenance of soil fertility and productivity.

Material and methods

A field trial was conducted during the Rabi season of 2020–2021 at Rama University's agricultural farm in Kanpur to assess the effects of different fertilization treatments on

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wheat. The sandy loam soil at the experimental site had a pH of 7.4 and exhibited low organic carbon content with a slightly alkaline reaction. The available Phosphorus and Potash levels were both moderate. The experimental design employed a randomized block with nine treatments and four replications. The treatments included T1-RDF (N.P.K) (120:40:20) kg/ha^{-1}, T2-FYM@10 tons ha^{-1}, T3-Poultry manure (PM) @5 tons ha^{-1}, T4-75% RDF + 5 tons FYM ha^{-1}, T5-75% RDF + 2.5 tons FYM ha^{-1}, T6-50% RDF + 5 tons FYM ha^{-1}, T7-50% RDF + 2.5 tons FYM ha^{-1}, T8-25% RDF + 5 tons FYM ha^{-1}, and T9-25% RDF + 2.5 tons FYM ha^{-1}. Mustard seeds (Pusa mustard-26) were planted on November 11, 2020, with a row spacing of 45 cm.

Observations were made on various parameters, including the growth and development of the ear and grain characteristics, yield, harvest index of wheat, and population at different stages. Tables in this chapter present the experimental results for mother shoots, shoot density at the maximum tillering stage, ear density at harvest, production of various fertilization populations at different stages, and the economics of various Integrated Nutrient Management (INM) fertilization treatments. Bar diagrams are used to visually represent key findings when necessary. The appendices contain the analysis of variance results.

Results and Discussion

As the growth progressed, a noticeable increase in plant height was observed, as depicted in Table 1. Statistically, treatment T4 (75% RDF + 5 tons FYM ha^{-1}) exhibited the highest plant height (180.5 cm), followed by treatment T1-RDF (N.P.K) (120:40:20) kg/ha^{-1} and T5 (75% RDF + 2.5 tons FYM ha^{-1}). The attainment of the maximum plant height with 75% RDF + 5 tons FYM ha^{-1} suggests that this combination is optimal for achieving greater plant height compared to other fertility treatments. The improvement in plant height could be attributed to the increased availability of nutrients, leading to enhanced cell division and expansion. This finding aligns closely with reports by Patel et al. (1996) and Yadav et al. (2018) [6 &13].

The highest number of primary and secondary branches, recorded as 11.16 and 7.25, respectively, was observed with treatment T4 (75% RDF + 5 tons FYM ha^{-1}). A similar trend in primary and secondary branches was observed at harvest, with T4 again showing the maximum number. The lowest number of primary and secondary branches was recorded with T3-Poultry manure (PM) @5 tons ha^{-1}, with values of 4.66 and 8.88. Each treatment showed a percentage increase in the number of primary and secondary

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branches. The number of branches at all growth stages was significantly influenced by RDF and FYM, in agreement with Gurjar and Chauhan (1997).

The dry matter weight of the plant increased with the crop's growth, as indicated in Table 1. Treatment T4 (75% RDF + 5 tons FYM ha^{-1}) exhibited notable and maximum dry matter accumulation (352.23 g/plant). However, treatment T1-RDF (N.P.K) (120:40:20) kg/ha^{-1} showed results statistically comparable to T4 (75% RDF + 5 tons FYM ha^{-1}). Numerous studies have reported significantly higher dry matter accumulation with the application of 75% RDF + 5 tons FYM, suggesting an enhancement in dry matter production with higher fertility levels and organic manures, as reported by Mondal et al. (1996) and Patel et al. (1996).

Regarding oil content in mustard, different treatments, whether organic or inorganic, did not significantly differ. However, treatment T4 (75% RDF + 5 tons FYM ha^{-1}) recorded the maximum oil content (38.9%), while increasing fertilizer levels from 25% to the full recommended dose decreased oil content. The minimum oil content was observed in treatment T3-Poultry manure (PM) @5 tons ha^{-1} (36.10%). Similar findings were reported by Roy et al. (1981), Tomer et al. (1997), and Sadhu et al. (1997), indicating that different treatments did not bring about significant differences in oil content in mustard seeds.

Conclusion

In conclusion, it can be asserted that treatment T4 (75% RDF + 5 tons FYM ha^{-1}) emerges as the optimal fertilizer treatment, exhibiting superior outcomes in terms of growth, oil content, yield, nutrient uptake, and fertilizer productivity. This determination is grounded in the aforementioned results. The application of 75% RDF in conjunction with FYM at 5 tons ha^{-1} (T4) or Poultry Manure at 2.5 tons ha^{-1} (T5) and the Full Recommended Dose of Fertilizers (T1) proves sufficient to achieve higher seed yield and net return in Mustard. It is essential to note that these conclusions are drawn from a single season, and further research may be necessary to enhance confidence in these findings. The study suggests that incorporating FYM at 5 tons ha^{-1} or poultry manure at 2.5 tons ha^{-1} alongside 75% of the recommended dose of fertilizer would be advantageous for the sustained maintenance of soil fertility and the productivity of Mustard.

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Table: 4.1 Influence of INM on growth of mustard.

Treatments	Plant height (cm)	Primary branches	Secondary branches	Dry matter accumulation per plant(g)	Oil content (%)
(T_1)RDF	178.4	7.09	10.98	345.12	38.37
(T_2)FYM @ 10 tonnes ha^{-1}	164.0	4.93	9.21	307.13	36.54
(T_3)PM @5 tonnes ha^{-1}	163.5	4.66	8.88	295.42	36.10
(T_4)75% RDF + 5t FYM ha^{-1}	180.5	7.25	11.16	352.23	38.90
(T_5)75% RDF + 2.5t Poultry Manure ha^{-1}	174.3	7.01	10.28	340.79	37.10
(T_6)50% RDF + 5t FYM ha^{-1}	169.4	6.66	9.66	323.77	36.96
(T_7)50% RDF + 2.5t Poultry Manure ha^{-1}	170.3	7.00	9.84	330.47	37.70
(T_8)25% RDF + 5t FYM ha^{-1}	164.6	4.72	9.07	298.13	36.40
(T_9)25% RDF + 2.5t Poultry Manure ha^{-1}	165.3	5.67	9.41	312.43	36.87
SEm$\pm$	0.435	0.06	0.07	1.58	0.029
CD(P=0.05)	0.870	0.13	0.14	3.144	0.059

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