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Haobam Milan Singh
Student Scholar M.Sc.,
Department of Agriculture
(Agronomy), Faculty of
Agriculture and Veterinary
Sciences Mewar University
Gangrar, Chittorgarh, Rajasthan,
India

Bhagwan Suman
Assistant Professor (Agronomy),
Faculty of Agriculture and
Veterinary Sciences, Mewar
University Gangrar, Chittorgarh,
Rajasthan, India

Pramod Mehta
Assistant Professor (Mathematics),
Faculty of Agriculture and
Veterinary Sciences, Mewar
University Gangrar, Chittorgarh,
Rajasthan, India

Rajendra
Assistant Professor (Soil Science),
Faculty of Agriculture and
Veterinary Sciences, Mewar
University Gangrar, Chittorgarh,
Rajasthan, India

Champa Lal Regar
Assistant professor (Horticulture),
Faculty of Agriculture and
Veterinary Sciences, Mewar
University Gangrar, Chittorgarh,
Rajasthan, India

Corresponding Author:
Haobam Milan Singh
Student Scholar M.Sc.,
Department of Agriculture,
(Agronomy), Faculty of
Agriculture and Veterinary
Sciences Mewar University
Gangrar, Chittorgarh, Rajasthan,
India

Effect of organic and inorganic nutrient sources on production of growth and yield in Mustard (*Brassica juncea* L.) in sub-humid southern plain and Aravali Hill Zone of Rajasthan

Haobam Milan Singh, Bhagwan Suman, Pramod Mehta, Rajendra and Champa Lal Regar

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Abstract

The present investigation entitled “Effect of Organic and Inorganic Nutrient Sources on Production of Growth and Yield in Mustard (*Brassica juncea* L.) in Sub-Humid Southern Plain and Aravali Hill Zone of Rajasthan” was conducted during the Rabi season of 2024-25 at the Agronomy Research Farm, Department of Agriculture, Faculty of Agriculture and Veterinary Sciences, Mewar University. The experiment was carried out under semi-humid conditions of Southern Rajasthan to evaluate the effect of integrated use of organic and inorganic nutrient sources on growth, yield attributes, yield, and economics of mustard crop. The mustard variety RH-761 was used for the study. The experiment was laid out in Randomized Block Design (RBD) with three replications and nine treatment combinations comprising different levels of Recommended Dose of Fertilizers (RDF), farmyard manure (FYM), and vermicompost. The treatments included control, 50%, 75%, and 100% RDF combined with FYM or vermicompost individually and in combination. Recommended fertilizer dose of 40:60:60 kg NPK ha⁻¹ was applied according to treatment specifications. The results revealed that integrated nutrient management significantly influenced all growth, yield, and economic parameters of mustard. Among all treatments, T₉ (100% RDF + FYM + Vermicompost) proved superior and recorded the maximum plant height of 29.8 cm at 30 DAS, 70.3 cm at 60 DAS, and 122.1 cm at harvest. The same treatment also recorded the highest dry matter accumulation of 8.95 g plant⁻¹ at 30 DAS, 16.42 g plant⁻¹ at 60 DAS, and 33.76 g plant⁻¹ at harvest. Consequently, the highest seed yield (21.44 q ha⁻¹), stover yield (45.33 q ha⁻¹), biological yield (60.85 q ha⁻¹), and harvest index (33.70%) were also obtained under the same treatment. Economic analysis indicated that integrated use of RDF, FYM, and vermicompost considerably enhanced profitability of mustard cultivation. Treatment T₉ recorded the maximum gross return, net return and benefit-cost ratio of 2.91, which was significantly superior over all other treatments. The control treatment T₁ consistently recorded the lowest values for all growth, yield, and economic parameters.

Keywords: Mustard, agronomy, integrated nutrient management, RDF, sustainable agriculture

Introduction

Indian mustard (*Brassica juncea* L.) is one of the most important rabi oilseed crops cultivated in India. It belongs to the family Brassicaceae and is commonly known as Sarson or Rai. Mustard is widely grown for its edible oil, vegetable purpose, condiments, and medicinal uses. The seeds contain about 35-40 percent oil rich in essential fatty acids, making it an important source of nutrition and cooking oil. Mustard oil is used for cooking, frying, pickles, medicines, soaps, lubricants, and hair oils, while the oil cake is used as cattle feed and organic manure due to its high protein and nutrient content. India ranks third in the world in rapeseed-mustard production after Canada and China. Rajasthan is the leading mustard-producing state in the country and contributes nearly 45 percent of total mustard production. Despite its importance, the productivity of mustard is still lower than the world average due to several factors, among which nutrient deficiency is one of the major constraints. Sulphur is considered the fourth major essential plant nutrient after nitrogen, phosphorus, and potassium. It plays a vital role in chlorophyll formation, protein synthesis, enzyme activation, and oil formation in mustard.

Sulphur is also an important constituent of amino acids such as cysteine, cystine, and methionine. Since mustard is an oilseed crop, its sulphur requirement is comparatively higher than many other crops. Adequate sulphur nutrition improves growth, seed yield, oil content, and quality of mustard. In recent years, sulphur deficiency has become widespread in Indian soils because of intensive cropping, use of sulphur-free fertilizers, and reduced application of organic manures. Continuous depletion of sulphur from soil has adversely affected crop productivity and quality. Therefore, balanced sulphur fertilization is essential for sustainable mustard production. Rajasthan is rich in sulphur-bearing minerals such as gypsum and pyrite. Gypsum is commonly used as a source of sulphur and calcium and also helps in improving soil properties. Proper management and utilization of sulphur resources can enhance mustard productivity and soil fertility under semi-arid conditions of Rajasthan. Therefore, studying the effect of sulphur on growth, yield, and quality of mustard is important for improving sustainable agricultural production.

Materials and Methods

The current investigation was carried out in *Rabi-2024* at Agronomy Research Farm of Mewar University, Gangrar, Chittorgarh, Rajasthan.

Experimental material

The experimental material for the present study consisted of Mustard (*Brassica juncea* L.) variety RH-761, a widely cultivated high-yielding variety suitable for the agro-climatic conditions of Rajasthan. The experiment was conducted during the *Rabi* season of 2024-25 at the Agronomy Research Farm of Mewar University, Gangrar, Chittorgarh, Rajasthan.

Table 1: Treatment Details

Sr. No.	Treatment	Symbol
1	Control	T ₁
2	50% RDF + FYM	T ₂
3	75% RDF+ FYM	T ₃
4	100% RDF+ FYM	T ₄
5	50% RDF + Vermicompost	T ₅
6	75% RDF + Vermicompost	T ₆
7	100% RDF + Vermicompost	T ₇
8	75% RDF+ FYM+ Vermicompost	T ₈
9	100% RDF + FYM + Vermicompost	T ₉

Experimental Details

The experiment was laid out in Randomized Block Design with Nine treatments and three replications. The random allocation of treatments was done using statistical table prepared by Fisher and Yates.

Table 2: Experimental Details

Sr. No.	Particular	Details
1	Name of crop	Mustard (<i>Brassica Juncea</i> . L.)
2	Variety	RH-761
3	Experimental design	Randomized Block Design (RBD)
4	Replication	3
5	Number of treatments	9
6	Total number of plots	27
7	Seed rate	5 kg/ha
8	Spacing	30cm x 10cm
9	Gross plot size	200m.sq.
10	Net plot size	145.8m.sq.
11	Nutrient application	40:60:60 kg/ha

Results and Discussion

The experimental results revealed that integrated application of organic and inorganic nutrient sources significantly influenced the growth, yield, and economic performance of mustard under semi-humid conditions of Southern Rajasthan. Among all treatments, T₉ (100% RDF + FYM + Vermicompost) recorded

the highest values for almost all parameters studied. In contrast, the control treatment (T₁) recorded the lowest values for growth, yield, and economic parameters. Overall, the integrated use of 100% RDF along with FYM and vermicompost proved most effective for enhancing mustard productivity and profitability under the agro-climatic conditions of Southern Rajasthan.

Table 3: Effect of Organic and Inorganic Nutrient Sources on Mustard production

Treatment Code	Treatment Combination	Plant Height at Harvest (cm)	Dry Matter Accumulation at Harvest (g plant ⁻¹)	Leaf Area Index	Number of Siliquae Plant ⁻¹	Number of Seeds Siliqua ⁻¹	Seed Yield (q ha ⁻¹)	Stover Yield (q ha ⁻¹)	Biological Yield (q ha ⁻¹)	Harvest Index (%)	B:C Ratio
T ₁	Control	91.4	15.89	1.31	155.3	10.2	10.82	26.48	35.41	25.46	2.11
T ₂	50% RDF + FYM	104.8	22.77	1.76	178.0	11.8	14.36	32.14	41.85	28.41	2.41
T ₃	75% RDF + FYM	110.5	25.64	1.93	192.6	12.9	16.41	36.05	46.64	29.63	2.54
T ₄	100% RDF + FYM	115.3	28.94	2.12	205.7	13.8	18.54	39.86	50.10	30.44	2.65
T ₅	50% RDF + Vermicompost	107.9	24.38	1.84	184.2	12.2	15.28	33.82	47.44	29.95	2.60
T ₆	75% RDF + Vermicompost	113.2	27.93	2.06	198.4	13.4	17.92	38.17	52.68	30.88	2.72
T ₇	100% RDF + Vermicompost	117.4	30.17	2.24	219.1	14.8	19.88	42.11	55.41	31.91	2.83
T ₈	75% RDF + FYM + Vermicompost	118.6	31.48	2.18	225.8	15.6	20.67	43.56	57.84	32.56	2.87
T ₉	100% RDF + FYM + Vermicompost	122.1	33.76	2.39	234.3	16.4	21.44	45.33	60.85	33.70	2.91
S.Em±		1.42	0.59	0.05	4.82	0.31	0.42	0.74	0.89	0.42	0.04
CD at 5%		4.15	1.76	0.15	14.2	0.92	1.24	2.17	2.61	1.23	0.13

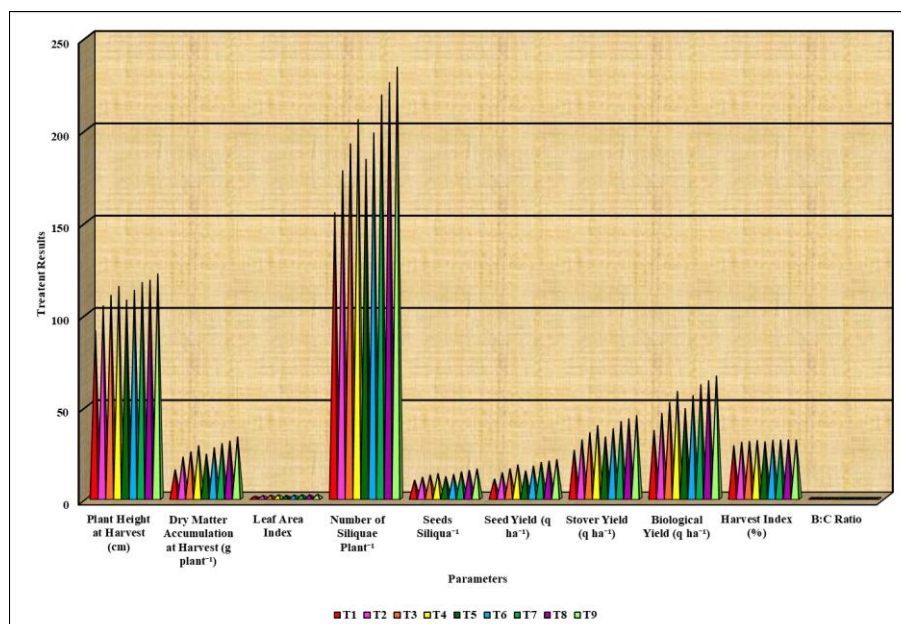


Fig 1: To study the Bio-efficacy of bio-pesticides against major insects of greengram

The data presented in the table clearly indicate that different combinations of organic and inorganic nutrient sources exerted a significant influence on the growth, yield attributes, yield, and economics of mustard crop under the semi-humid conditions of Southern Rajasthan. Among all the treatments, integrated application of RDF along with FYM and vermicompost proved superior over individual or partial nutrient applications. Treatment T₉ (100% RDF + FYM + Vermicompost) consistently recorded the highest values for all growth, yield, and economic parameters, demonstrating the beneficial effect of balanced nutrient management through combined use of organic and inorganic sources. The growth parameters showed a remarkable improvement with integrated nutrient application. Plant height increased progressively with higher levels of RDF combined with organic manures. The tallest plants were observed under T₉ (122.1 cm), followed by T₈ (118.6 cm) and T₇ (117.4 cm), whereas the control treatment recorded the minimum plant height (91.4 cm). The increase in plant height under integrated nutrient treatments may be attributed to improved nutrient availability, enhanced cell elongation, and increased metabolic activities resulting from the combined effect of inorganic fertilizers and organic amendments. Similar trends were observed in dry matter accumulation where T₉ recorded the highest dry matter accumulation (33.76 g plant⁻¹), followed by T₈ (31.48 g plant⁻¹) and T₇ (30.17 g plant⁻¹). The higher dry matter production under integrated nutrient treatments may be due to improved photosynthetic efficiency and better nutrient uptake throughout the crop growth period. Leaf Area Index (LAI) and chlorophyll content also improved significantly with integrated nutrient management practices. Treatment T₉ recorded the maximum LAI (2.39) and chlorophyll content (3.12 mg g⁻¹ fresh weight), indicating vigorous vegetative growth and enhanced photosynthetic activity. The incorporation of FYM and vermicompost likely improved soil physical conditions, microbial activity, and nutrient availability, thereby promoting chlorophyll synthesis and leaf expansion. The control treatment exhibited the lowest LAI (1.31) and chlorophyll content (2.14 mg g⁻¹), indicating nutrient deficiency and poor physiological activity in the absence of supplementary nutrient sources. The number of branches per plant was also significantly influenced by different treatments. Maximum branching (9.8 branches

plant⁻¹) was observed under T₉, while minimum branching (6.2 branches plant⁻¹) was recorded under the control. Increased branching under integrated nutrient treatments may be due to adequate nutrient supply and improved vegetative growth, which encouraged better development of lateral shoots and reproductive structures. Yield attributes such as number of siliqua per plant, seeds per siliqua, and test weight were markedly improved with integrated nutrient application. Treatment T₉ recorded the maximum number of siliqua per plant (234.3), seeds per siliqua (16.4), and test weight (4.91 g), which were significantly higher than all other treatments. The improvement in reproductive parameters may be attributed to enhanced flowering, better pollination, and improved nutrient translocation from source to sink due to balanced nutrient availability. In contrast, the control treatment recorded the lowest values for these parameters, indicating poor reproductive growth under nutrient-deficient conditions. The yield data further confirmed the superiority of integrated nutrient management practices. Maximum seed yield (21.44 q ha⁻¹), stover yield (45.33 q ha⁻¹), and biological yield (60.85 q ha⁻¹) were obtained under T₉ treatment, followed by T₈ and T₇. Higher yields under integrated nutrient treatments may be attributed to improved growth attributes, efficient nutrient utilization, enhanced photosynthetic activity, and better partitioning of assimilates towards economic yield. The harvest index was also slightly higher under integrated nutrient treatments, indicating efficient conversion of total biomass into seed yield. On the other hand, the control treatment recorded the lowest seed yield (10.82 q ha⁻¹), stover yield (26.48 q ha⁻¹), and biological yield (35.41 q ha⁻¹), highlighting the importance of adequate nutrient management for mustard production. Economic analysis revealed that integrated application of RDF with FYM and vermicompost was economically profitable. Treatment T₉ recorded the maximum gross return, net return, and benefit-cost ratio (2.91), proving its economic superiority over all other treatments.

Although the cost of cultivation was comparatively higher under integrated nutrient treatments due to the inclusion of organic manures, the substantial increase in seed and stover yield resulted in significantly higher net returns and profitability. Treatments T₈ and T₇ also recorded higher economic returns

compared to other treatments, while the control treatment showed the lowest gross return, net return, and B:C ratio (2.11). Overall, the results clearly demonstrate that integrated nutrient management involving 100% RDF along with FYM and vermicompost significantly improved growth, yield attributes, productivity, and profitability of mustard under the agro-climatic conditions of Southern Rajasthan. The combined application of organic and inorganic nutrient sources ensured balanced nutrient supply, improved soil health, enhanced nutrient use efficiency, and sustained crop productivity. Therefore, treatment T₉ can be recommended as the most suitable nutrient management practice for achieving higher mustard yield and economic returns in the semi-humid Southern Plain and Aravali Hill Zone of Rajasthan.

Conclusion

The investigation clearly demonstrated that integrated application of organic and inorganic nutrient sources significantly improved the growth, yield, and economic performance of mustard under the semi-humid conditions of Southern Rajasthan. Among all the treatments, T₉ (100% RDF + FYM + Vermicompost) proved superior in all aspects of crop performance. Treatment T₉ recorded the maximum plant height, dry matter accumulation, leaf area index, chlorophyll content, and number of branches per plant, indicating enhanced vegetative growth and better nutrient utilization. Yield attributes such as number of siliquae per plant, seeds per silique, and test weight were also highest under T₉ treatment. Consequently, the maximum seed yield, stover yield, biological yield, and harvest index were achieved with T₉, reflecting efficient conversion of nutrients into economic produce. The superior performance of T₉ may be attributed to balanced and continuous nutrient supply from both organic and inorganic sources, improved soil fertility, enhanced microbial activity, and better nutrient availability throughout crop growth. Economic analysis further confirmed the superiority of T₉ by recording the highest gross return, net return, and benefit-cost ratio among all treatments. In contrast, the control treatment recorded the lowest values for all growth, yield, and economic parameters, emphasizing the importance of integrated nutrient management in mustard cultivation. Overall, the combined application of 100% RDF along with FYM and vermicompost emerged as the most effective and profitable nutrient management practice for mustard production in the Southern Plain and Aravali Hill Zone of Rajasthan.

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