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Krishnkant Tiwari
Department of Agronomy, Vikrant
University Gwalior, Madhya
Pradesh, India

Hirdesh Kumar
Assistant Professor, School of
Agriculture Science, Vikrant
University Gwalior, Madhya
Pradesh, India

Ashish Pathak
Students M.Sc. Agronomy, School of
Agriculture Science Vikrant
University Gwalior, Madhya
Pradesh, India

Ankit Bhadoriya
Students M.Sc. Agronomy, School of
Agriculture Science Vikrant
University Gwalior, Madhya
Pradesh, India

Sachin Kumar Singh
Dean of School of Agriculture
Science, Vikrant University, Gwalior,
Madhya Pradesh, India

Arun Sahu
Assistant Professor, School of
Agriculture Science, Vikrant
University, Gwalior, Madhya
Pradesh, India

Mandvi Srivastava
Assistant Professor, School of
Agriculture Science, Vikrant
University, Gwalior, Madhya
Pradesh, India

Jay prakash Thakur
Professor, School of Agriculture
Science, Vikrant University, Madhya
Pradesh, India

Naveen Kumar Singh
Dean of Natural & Applied Sciences,
Vikrant University, Gwalior, Madhya
Pradesh, India

Corresponding Author:
Krishnkant Tiwari
Department of Agronomy, Vikrant
University Gwalior, Madhya
Pradesh, India

Effect of integrated nutrient management on growth of mustard (*Brassica juncea* L.)

**Krishnkant Tiwari, Hirdesh Kumar, Ashish Pathak, Ankit Bhadoriya,
Sachin Kumar Singh, Arun Sahu, Mandvi Srivastava, Jay Prakash Thakur
and Naveen Kumar Singh**

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Abstract

The present investigation entitled “Effect of Integrated Nutrient Management on growth and yield of mustard (*Brassica juncea* L.)” was executed at Agriculture Research and development Centre, Sakatpura, Vikrant University, Gwalior (M.P.). Mustard (*Brassica juncea* L.) belongs to the family *cruciferae* popularly known as rai and is an important rabi season oilseed crop of north India. The major constraint attributing to low production of mustard are scare and untimely water supply and poor fertility status of soil. General practices of growing this crop that the field are kept fallow during rainy season to conserve moisture and farmers generally give one or two irrigations depending on the availability of water even to the crop grown on conserved moisture. Integrated Nutrient Management (INM) improving and building up soil fertility and increase the fertility use efficiency. Integration of chemical fertilizers with organic manures has been found quite promising not only in sustaining the soil health and productivity but also in stabilizing the crop production in comparison to the use of each component, separately. The experiment was laid out in the Randomized Block Design with three replications. Each replication was comprised of nine treatments i.e. T₁ - 100% RDF (Control), T₂ - 75% RDF + FYM, T₃ - 75% RDF + Vermicompost, T₄ - 75% RDF + *Azotobacter* + PSB, T₅ - 75% RDF + *Azotobacter* + KSB, T₆ - 75% RDF + PSB + KSB, T₇ - 75% RDF + *Azotobacter* + PSB + KSB, T₈ - 75% RDF + FYM + *Azotobacter* + PSB + KSB and T₉ - 75% RDF + Vermicompost + FYM + *Azotobacter* + PSB + KSB were applied in mustard cv. Pioneer. Result concluded that the various treatments of FYM, Vermicompost, and biofertilizers with different recommended doses of fertilizers were significantly influenced the growth and yield parameters of mustard. It was observed that the maximum growth and yield parameters were observed under treatment T₉ - 75% RDF + Vermicompost + FYM + *Azotobacter* + PSB + KSB and it was the best treatment as compared to rest of all. The maximum net returns (₹ 47680 /ha) was noted in treatment T₇ - 75% RDF + *Azotobacter* + PSB + KSB and the maximum benefit cost ratio (3.8) was recorded in treatment T₄ - 75% RDF + *Azotobacter* + PSB.

Keywords: Integrated nutrient management, mustard, FYM, vermicompost, biofertilizers

Introduction

Mustard (*Brassica juncea* L.) belongs to the family *cruciferae* popularly known as rai and is an important rabi season oilseed crop of north India. In India estimated area, production and productivity of rapeseed-mustard was 8.06 million hectares, 11.75 million tonnes and 1458 kg/ha, respectively, (Anonymous, 2024-25)^[1]. Indian mustard is predominantly cultivated in the states of Rajasthan, Madhya Pradesh, Haryana and Uttar Pradesh which contribute 75.21% area and 81.43% production (Sahoo *et al.*, 2018)^[21]. The seed and oil are used as condiment in the preparation of pickles and for flavouring curries and vegetables. The oil is utilized for human consumption throughout the northern India, in cooking and frying purposes. It is also used in the preparation of hair oils and medicines. It is used in the manufacture of greases. The major constraint attributing to low production of mustard are scare and untimely water supply and poor fertility status of soil. To maintain the soil health and sustaining the crop productivity, INM approach involving FYM, bio fertilizers and inorganic fertilizers needs to be standardized. Crop production largely depends on cultivation of high yielding cultivars and need based application of nutrients. FYM not only provides most of the essential plant nutrients but also improves soil structure through binding effect on soil aggregates, cation exchange capacity,

water holding capacity, fertilizers use efficiency, microbial activity and nutrient availability in soil. *Azotobacter* is a free-living bacteria. It has been reported to fix about 20 kg N/ha per year in a field of non-legume crop and also secretes some growth promoting substance (Singh *et al.*, 2018) ^[22].

Materials and Methods

The experiment was laid out in the Randomized Block Design with three replications. Each replication was comprised of nine treatments i.e. T₁ - 100% RDF (Control), T₂ - 75% RDF + FYM, T₃ - 75% RDF + Vermicompost, T₄ - 75% RDF + *Azotobacter* + PSB, T₅ - 75% RDF + *Azotobacter* + KSB, T₆ - 75% RDF + PSB + KSB, T₇ - 75% RDF + *Azotobacter* + PSB + KSB, T₈ - 75% RDF + FYM + *Azotobacter* + PSB + KSB and T₉ - 75% RDF + Vermicompost + FYM + *Azotobacter* + PSB + KSB were applied in mustard cv. Pioneer.

Results and Discussion

Growth parameters

Result reported that the treatment T₉ - 75% RDF + Vermicompost + FYM + *Azotobacter* + PSB + KSB was statistically superior treatment for enhancing the growth parameters in mustard and it gave the maximum growth parameters viz., plant height (cm), number of branches per plant and dry matter at 30, 60 and 90 DAS. However, the T₁ - 100% RDF (Control) was recorded the minimum growth parameters viz., plant height (cm), number of branches per plant and dry matter at 30, 60 and 90 DAS, respectively. This could be due to adequate supply of readily available nitrogen, phosphorus, potash and other nutrients produced taller and superior plants. It will be expected that plants grow taller with more number of leaves having bigger size and higher chlorophyll content (Rundala *et al.*, 2013) ^[20]. Taller plants produced more dry matter because of more opportunity for production and accumulation of photosynthates and improve plant growth (Indira *et al.*, 2023). The beneficial effect of chemical fertilizers with FYM and seed treatment on growth parameters was also observed by several researchers in mustard. Similar findings have been earlier reported by Singh and Pal (2011) ^[23], Kumar *et al.* (2013) ^[14], Meena *et al.* (2013) ^[16], Parihar

et al. (2013) ^[18], Yadav *et al.* (2018) ^[27], Bisht *et al.* (2018) ^[3], Dubey and Shukla (2020) ^[6], Karbak *et al.*, (2023) ^[10], Kumar *et al.*, (2024) ^[12] and Awasthi *et al.* (2024) ^[2].

Yield parameters

Result shows that the treatments of FYM, Vermicompost, and biofertilizers with different recommended doses of fertilizers were significantly influenced the yield parameters of mustard. The maximum yield parameters viz., number of silique/plant, number of seeds/ silique, length of silique /plant, seed yield and biological yield were found in treatment T₉ - 75% RDF + Vermicompost + FYM + *Azotobacter* + PSB + KSB and the minimum yield parameters viz., number of silique /plant, number of seeds/ silique, length of silique /plant, seed yield and biological yield were observed under treatment T₁ - 100% RDF (Control). The result revealed that minimum harvest index (%) was observed under treatment T₉ - 75% RDF + Vermicompost + FYM + *Azotobacter* + PSB + KSB, whereas the maximum harvest index (%) was recorded under treatment T₁ - 100% RDF (Control). Mustard responds well to integrated nutrient management which might be owing to the favourable soil condition (Tripathi and Singh, 2021) ^[25]. Application of FYM, vermicompost with chemical fertilizers improved the physio-chemical condition of the soil, provided favourable environment, stimulated the uptake of nutrients and almost continuous supply of N, P, K, S and micro nutrient distributed over the entire crop and better availability in sufficient amounts of plant nutrients throughout the growth period and especially at critical period of crops growth which has resulted in better plant vigour and superior yield attributes (Dubey and Shukla, 2020) ^[6]. The use of growth stimulating seed inoculants (*Azotobacter*) help in greater uptake of plant nutrients from applied chemical fertilizers by increasing the root growth beside improving the availability of nutrient particularly N and enhanced the seed yield (Singh *et al.*, 2024) ^[24]. These results are supported by the findings of Gora *et al.* (2022) ^[7], Gupta and Kumar (2022) ^[9], Biswas *et al.* (2023) ^[4], Chand *et al.* (2023) ^[5], Goyal *et al.* (2023) ^[8], Kaur and Verma (2023) ^[11], Tripathy *et al.* (2024) ^[26], Kumar *et al.* (2025) ^[13], Marahatta *et al.* (2025) ^[15], Pardhi *et al.* (2025) ^[17] and Pratiwi *et al.* (2025) ^[19].

Table 1: Effect of Integrated Nutrient Management on growth parameters of mustard

Treatment details	Plant height (cm)			Number of branches per plant			Dry matter		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T ₁ - 100% RDF (Control)	45.17	128.04	144.01	6.00	12.02	16.03	11.51	29.00	56.03
T ₂ - 75% RDF + FYM	46.81	135.24	155.24	6.22	13.91	18.00	12.08	30.42	63.56
T ₃ - 75% RDF + Vermicompost	47.21	139.46	159.46	6.28	14.59	18.77	12.20	30.81	66.89
T ₄ - 75% RDF + <i>Azotobacter</i> + PSB	46.54	134.92	152.41	6.17	13.42	17.93	12.03	30.35	62.65
T ₅ - 75% RDF + <i>Azotobacter</i> + KSB	46.02	133.16	151.56	6.16	13.22	17.58	11.91	30.04	61.87
T ₆ - 75% RDF + PSB + KSB	45.97	130.69	147.69	6.09	12.38	16.96	11.74	29.55	59.46
T ₇ - 75% RDF + <i>Azotobacter</i> + PSB + KSB	47.07	136.67	157.23	6.25	14.04	18.28	12.14	30.63	64.68
T ₈ - 75% RDF + FYM + <i>Azotobacter</i> + PSB + KSB	47.72	140.38	160.17	6.31	14.76	18.89	12.26	30.91	67.54
T ₉ - 75% RDF + Vermicompost + FYM + <i>Azotobacter</i> + PSB + KSB	48.06	141.03	162.05	6.33	15.01	19.02	12.30	31.04	68.00
SEm ±	0.382	1.015	0.878	0.050	0.328	0.358	0.061	0.307	0.585
CD 5%	1.146	3.044	2.632	0.151	0.984	1.072	0.183	0.920	1.753

Table 2: Effect of Integrated Nutrient Management on yield parameters of mustard

Treatment details	Number of siliqua /plant	Number of seeds/ siliqua	Length of siliqua /plant (cm)	Seed yield (q/ha)	Biological yield (q/ha)	Harvest index (%)
T ₁ - 100% RDF (Control)	270.03	12.00	6.10	9.70	42.73	22.70
T ₂ - 75% RDF + FYM	290.15	14.63	6.55	10.84	49.89	21.72
T ₃ - 75% RDF + Vermicompost	296.23	15.57	6.66	11.08	51.84	21.37
T ₄ - 75% RDF + <i>Azotobacter</i> + PSB	287.23	14.26	6.42	10.67	48.90	21.83
T ₅ - 75% RDF + <i>Azotobacter</i> + KSB	285.24	13.74	6.32	10.45	47.03	22.23
T ₆ - 75% RDF + PSB + KSB	280.15	12.81	6.26	9.96	45.24	22.03
T ₇ - 75% RDF + <i>Azotobacter</i> + PSB + KSB	291.42	15.02	6.59	10.95	51.28	21.35
T ₈ - 75% RDF + FYM + <i>Azotobacter</i> + PSB + KSB	302.05	15.85	6.70	11.22	52.24	21.49
T ₉ - 75% RDF + Vermicompost + FYM + <i>Azotobacter</i> + PSB + KSB	306.02	16.02	6.80	11.33	53.39	21.26
SEm ±	3.784	0.215	0.049	0.080	0.699	-
CD 5%	11.346	0.645	0.146	0.239	2.096	-

Conclusion

Result concluded that the various treatments of FYM, Vermicompost, and biofertilizers with different recommended doses of fertilizers were significantly influenced the growth and yield parameters of mustard. It was observed that the maximum growth and yield parameters were observed under treatment T₉ - 75% RDF + Vermicompost + FYM + *Azotobacter* + PSB + KSB and it was the best treatment as compared to rest of all. The maximum net returns (₹ 47680 /ha) was noted in treatment T₇ - 75% RDF + *Azotobacter* + PSB + KSB and the maximum benefit cost ratio (3.8) was recorded in treatment T₄ - 75% RDF + *Azotobacter* + PSB.

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