Plant Archives Vol. 26, No. 1, 2026 pp. 651-656 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.no.1.089

IMPACT OF INTEGRATED INORGANIC AND ORGANIC FERTILIZER MANAGEMENT ON GROWTH, YIELD, AND YIELD ATTRIBUTES OF INDIAN MUSTARD (*BRASSICA JUNCEA* L.) UNDER DEHRADUN (INDIA) CONDITIONS

Sayakumari Thingbaijam[1], Sophia Thokchom[2], Shangkhil Chonmila Jocyleen[3], Laishram Menaka Devi[2], Preety Yengkokpam[4], Aashu Rajput[5]* and Sharad Pandey[6]

[1]Department of Agronomy, Jigyasa University, Dehradun, Uttarakhand, India
[2]Department of Plant Pathology, Uttaranchal University, Dehradun, Uttarakhand, India
[3]Department of Rural Development and Agricultural Production, North Eastern Hill University, Shillong, Meghalaya, India
[4]Department of Vegetable Science (Horticulture), South Asian Institute of Rural and Agricultural Management, Manipur, India
[5]School of Agriculture, Uttaranchal University, Dehradun, Uttarakhand, India
*Corresponding author E-mail: aashurajput.1997@gmail.com
(Date of Receiving-30-11-2025; Date of Revision-30-01-2026; Date of Acceptance-15-02-2026)

ABSTRACT

A key oilseed crop that is extensively grown in India during the *Rabi* season, Indian mustard (*Brassica juncea* L.) is essential to the manufacture of edible oil. To maximize mustard development and output, nutrient control is essential, particularly for nitrogen (N), phosphorus (P), potassium (K), and sulfur (S). This study assessed how Indian mustard growth metrics, yield characteristics, and seed production were affected by integrated nutrient management (INM) using inorganic fertilizers, vermicompost, and biofertilizers (*Azotobacter* + PSB) under the Dehradun agroclimatic conditions. Using a Randomized Block Design, nine treatment combinations comprising different dosages of prescribed fertilizers (RDF), vermicompost, and biofertilizers were used in a field experiment carried out during the *Rabi* season of 2023–2024. At various stages of growth, growth metrics such plant height, population, and dry matter accumulation were measured. Additionally, evaluated were yield parameters such as test weight, seed yield, siliqua length, siliqua number per plant, and seeds per siliqua. When compared to using only organic or inorganic fertilizer, the results demonstrated that integrated treatments greatly increased growth and production. The treatment that combined 80% RDF + vermicompost (9 kg) + biofertilizers (T4) consistently produced the highest seed yield (22.70 q ha^{-1}), siliqua quantity (242.4 per plant), seeds per siliqua (14.62), and superior plant height (58.84 cm at 30 DAS). Furthermore, T4 displayed the highest biological and stover production, suggesting better biomass buildup. The 80% RDF + vermicompost (T2) group had the greatest harvest index, indicating effective assimilate partitioning. The results demonstrate that integrated nutrient management improves crop yield, soil health, and nutrient usage efficiency, providing a sustainable and profitable method of growing mustard in Dehradun and other agro-ecological zones.

***Key words*:** Indian mustard (*Brassica juncea* L.), Yield characteristics, Integrated Nutrient Management

Introduction

One of India's most significant oilseed crops, Indian mustard (*Brassica juncea* L.), is grown extensively throughout the *Rabi* season in a variety of agroclimatic zones. It makes a substantial contribution to India's edible oil industry and ranks third in oilseed production, behind soybean and groundnut. With an average production of 8.58 q ha^{-1}, mustard is grown on 16,974 hectares in Uttarakhand, underscoring its significance both regionally and nationally (Directorate of Agriculture, Uttarakhand, 2021–22). The crop is an important source of both income and nourishment because mustard seeds are prized for their high oil content (37–49%), proteins (17–25%), and other necessary nutrients.

The availability of nutrients, especially nitrogen (N), phosphorus (P), potassium (K), and sulfur (S), which are critical for physiological functions such root establishment, photosynthesis, and seed development, has a significant impact on mustard crop growth and yield performance (Ye *et al*., 2022). While balanced fertilizer administration guarantees ideal growth features such plant height, number of branches, siliquae formation, and eventually increased seed yield, inadequate fertilization results in decreased productivity. Enhancing nutrient-use efficiency, maintaining soil fertility, and increasing crop production are all made possible by Integrated Nutrient Management (INM), which blends inorganic fertilizers with organic additions such as vermicompost, farmyard manure (FYM), and biofertilizers (Thakur *et al*., 2009; Pal & Pathak, 2016).

Assessing the growth and production dynamics of mustard under various fertilizer regimes is essential given the rising demand for edible oil and the requirement for sustainable intensification. Dehradun offers an ideal setting for evaluating the crop's reaction to integrated nutrient delivery because of its subtropical temperature and variety of soil types. Thus, the current study examines how growth metrics and production attributes of Indian mustard at Dehradun circumstances are affected by organic and inorganic fertilizers.

Effect of Inorganic and Organic Fertilizer on Growth Parameters of Mustard

It has been extensively documented that applying both organic and inorganic fertilizers together improve the growth performance of Indian mustard. According to Gupta *et al*., (2023), the highest values of plant height (128.96 cm), branches (44.82), and leaves per plant (19.50) were obtained when 100% RDF was combined with FYM (20 t ha^{-1}) and biofertilizers (*Azotobacter* + PSB). The efficiency of organic nutrient sources was further demonstrated by Sharma *et al*., (2023), who reported the greatest plant height at consecutive growth stages (33.3 to 205.2 cm up to harvest) under 100% RDN by Panchgavya.

Vegetative development was consistently improved by integrated nutrient management techniques that included manures and biofertilizers. According to Bhanuwanti *et al*., (2022), the maximum number of branches per plant, dry matter accumulation, and plant height (210.47 cm) were achieved by combining *Azotobacter*, PSB, vermicompost (5 t ha^{-1}), and 50% RDF. Similarly, Bharti *et al*., (2022) emphasized the importance of biofertilizers, stating that RDF and zinc-soluble biofertilizers increased plant height by up to 173.60 cm.

These results are also supported by experiments conducted outside of India. According to Devkota *et al*., (2020), broadleaf mustard plants grew much taller (989 cm) when half the necessary NPK was applied in addition to poultry manure. Additionally, with integrated fertilizer utilization of NPK with FYM, PSB, and sulfur, Maurya *et al*., (2019) observed increased functional leaves (19.36) and branches (25.23).

Studies conducted in various locations show that adding chemical fertilizers to organic manures enhances growth characteristics like branching, height, and leaf output (Noviyanty & Salingkat, 2018; Bisht *et al*., 2018; Kumar *et al*., 2018). Singh *et al*., (2018) further verified that, in comparison to applying fertilizer alone, RDF in combination with vermicompost, FYM, and biofertilizers resulted in higher plant height and siliqua number. According to Dhruw *et al*., (2017) and Thaneshwar *et al*., (2017), adding sulfur and vermicompost to RDF can improve growth indices. Higher FYM rates also increased plant height and leaf area at high elevations, according to Mukherjee (2016).

Collectively, these studies indicate that integrated use of FYM, vermicompost, and biofertilizers with inorganic fertilizers significantly improves vegetative growth, branching, and dry matter accumulation in mustard.

Effect of Inorganic and Organic Fertilizer on Yield Attributes and Yield of Mustard

Yield attributes and productivity of mustard are closely linked to balanced nutrient application. Gupta *et al*., (2023) reported maximum siliqua per plant (121.67), siliqua length (7.19 cm), seeds per siliqua (17.53), and seed yield under 100% RDF + FYM + biofertilizers, followed by 75% RDF with FYM and biofertilizers. Similarly, Bhanuwanti *et al*., (2022) found that the integrated use of vermicompost, *Azotobacter*, PSB, and 50% RDF gave superior yield attributes such as seeds per siliqua (13.90), siliqua per plant (371.63), and seed yield (2.28 t ha^{-1}).

The beneficial effects of biofertilizers and manures in raising siliqua number, seed weight, and biological yield were also emphasized by Bharti *et al*., (2022) and Gora *et al*., (2022). Ajnar and Namdeo (2021) showed in another study that 75% RDF combined with vermicompost, sulfur, and biofertilizers resulted in notable improvements in seed output (5916 kg ha^{-1}) and siliqua per plant (494.81). Additionally, Mhetre *et al*., (2019) found that applying 50% RDN through chicken manure together with inorganics and sulfur resulted in greater seed output (19.60 q ha^{-1}) and siliqua per plant (257.89).

Similar findings were observed by other trials conducted throughout India. While Vinod *et al*., (2019)

Table 1: Influence of organic and inorganic fertilizer on the growth parameters of mustard under INM.

Treatment	Plant Population	Plant height (cm)				DMA	
		30 DAS	60 DAS	90 DAS	At Harvest	Wet Weight	Dry Weight
T1 (100% RDF @ N:83.58g, P:75.12g, K:47.4g)	86.67	53.71	126	158.63	184.07	141.2	93.13
T2 (80% RDF + Vermicompost @9kg)	93.67	53.37	117.41	153.48	181.29	119.57	87.33
T3 (80% RDF + Biofertilizer)	103.67	49.53	108.3	142.88	172.97	108.53	84.14
T4 (80% RDF + Vermicompost + Biofertilizer)	87	58.84	133.62	160.97	190.06	199.03	132.03
T5 (60% RDF + Vermicompost@10.8kg)	97.67	51	109.67	147.01	177.43	116.6	86.13
T6 (60% RDF + Biofertilizer)	116.67	48.26	102	132.04	166.61	107.13	82.83
T7 (60% RDF + Vermicompost + Biofertilizer)	128	57.67	138.29	166.65	193.62	159.53	110.74
T8 (100% Vermicompost @20kg)	99	45.07	97.18	128.56	162.23	103.03	75.7
T9 (100% Biofertilizer)	106.67	42.62	90.63	124.71	149.74	102.77	48.1
C.D.	N/A	1.32	7.37	8.48	2.64	N/A	N/A
SE(m)	9.21	0.44	2.44	2.81	0.87	48.18	19.65

DMA: Dry matter accumulation (g)

revealed higher fresh and dry weight, test weight, and straw production with integrated manures and fertilizers, Chandan *et al*., (2019) demonstrated that RDF combined with sulfur and vermicompost enhanced seed and stover output. According to Bisht *et al*., (2018) and Kumar *et al*., (2018), RDF combined with FYM, vermicompost, and biofertilizers greatly increased yield parameters including siliqua number, seed weight, and biological yield. While Dhruw *et al*., (2017) highlighted the synergistic effect of NPK with sulfur in improving seed yield and oil content, Singh *et al*., (2018) demonstrated increased seed yield under RDF with vermicompost, FYM, and biofertilizers. Thaneshwar *et al*., (2017) also documented increased seed weight and siliqua number under RDF with vermicompost.

Overall, these findings suggest that yield attributes such as siliqua number, seeds per siliqua, siliqua length, and seed weight, along with seed and stover yield, are maximized under integrated nutrient management compared to sole fertilizer or organic application.

Material and Methods

The field experiment entitled "Impact of Inorganic and Organic Fertilizer on Growth and Yield of Indian Mustard *(Brassica juncea L.)* under Dehradun conditions" was conducted during the *Rabi* season of 2023–24 at the Research Farm of Agronomy Block, Agriculture Department, Jigyasa University (Formerly Himgiri Zee University), Dehradun, Uttarakhand. The experiment was laid out in a Randomized Block Design (RBD) with nine treatments i.e., T1: 100% RDF @N:83.58g, P:75.12g, K:47.4g,T2:80% RDF @ N: 69.65g, P: 62.60g, K:32g + Vermicompost @9kg, T3:80% RDF @ N: 69.65g, P: 62.60g, K:32g + Biofertilizer (*Azotobacter*+ PSB@500 ml Kg^{-1} Seed), T4:80% RDF @ N: 69.65g, P: 62.60g, K:32g + Vermicompost @9kg + Biofertilizer (*Azotobacter*+ PSB@500 ml Kg^{-1} Seed), T5: 60% RDF@N:52.24g, P: 46.95, K:24g + Vermicompost @10.8 kg, T6:60% RDF @ N:52.24g, P: 46.95, K:24g + Biofertilizer (*Azotobacter*+ PSB@ 500 ml Kg^{-1} Seed), T7:60% RDF @N:52.24g, P: 46.95,K:24g + Vermicompost@10.8 kg + Biofertilizer (*Azotobacter* + PSB@ 500 ml Kg^{-1} Seed), T8 100% Vermicompost @20 Kg and T9:100% Biofertilizer (*Azotobacter*+ PSB@500 ml Kg^{-1} Seed) and three replications. The mustard variety HY-805 was sown on 20th October 2023 at a spacing of 45 cm × 10 cm, with a plot size of 3 m × 2 m. The recommended dose of fertilizer (RDF) was 80:60:40 kg ha^{-1} N:P:K, supplemented with vermicompost and biofertilizers (*Azotobacter* + PSB) as per treatment combinations. Standard agronomic practices were followed throughout the cropping period.

Five randomly tagged plants per plot were used to record growth attributes at regular intervals (30, 60, 90, and 120 DAS). Plant height, plant population, and dry matter buildup were all noted. Yield attributes such as number of siliquae $plant^{-1}$, siliqua length, seeds $siliqua^{-1}$, test weight (1000-seed weight), and harvest index (%) were measured from the same tagged plants. On March 5, 2024, net plots were harvested, and the final seed yield, stover output, and biological yield were measured.

Result and Discussion

Effect of Inorganic and Organic Fertilizers on Growth Parameters of Mustard

Plant Height (cm):

As shown in Table 1, the integrated application of inorganic and organic fertilizers significantly increased mustard plant height at all growth phases (30, 60, 90 DAS, and at harvest). Treatment T7 [60% RDF + Vermicompost

Table 2: Impact of organic and inorganic fertilizer on the yield attributes and yield of Mustard.

Treatment	NSP	LS	SS	TW	SY	St.Y	BY	HI
T1 (100% RDF @ N:83.58g, P:75.12g, K:47.4g)	224.27	5.95	13.33	4.17	17.38	52.1	69.48	25.03
T2 (80% RDF + Vermicompost @9kg)	212.33	5.44	12.63	4.1	19.63	48.05	67.68	29.01
T3 (80% RDF + Biofertilizer)	195.33	5.08	12.11	3.82	17.13	43.41	60.54	28.3
T4 (80% RDF + Vermicompost + Biofertilizer)	242.4	6.64	14.62	4.84	22.7	57.73	80.43	28.22
T5 (60% RDF + Vermicompost@10.8kg)	197.67	5.12	12.35	4.02	18.02	47.16	65.18	27.64
T6 (60% RDF + Biofertilizer)	180.07	5.04	12.05	3.73	15.76	43.93	59.68	26.4
T7 (60% RDF + Vermicompost + Biofertilizer)	234.04	6.44	13.8	4.24	19.68	56.99	76.67	25.65
T8 (100% Vermicompost @20kg)	161.67	4.85	11.11	3.7	15.62	42.75	58.37	26.75
T9 (100% Biofertilizer)	152.67	4.54	10.39	3.63	15.37	39.13	54.5	28.24
C.D.	9.2	0.25	1.19	N/A	1.07	1.22	1.57	1.31
SE(m)	3.04	0.08	0.4	0.53	0.36	0.4	0.52	0.43

NSP: No. of siliqua plant^{-1}; LS: Length of siliqua (cm); SS: Seed siliqua^{-1}; TW: Test Weight (g); SY: Seed yield (q ha^{-1}); St.Y: Stover yield (q ha^{-1}); BY: Biological yield (q ha^{-1}); HI: Harvest Index (%)

@10.8 kg + Biofertilizer (*Azotobacter* + PSB @500 ml/kg seed)] consistently performed well at 60 DAS (138.29 cm), 90 DAS (166.65 cm), and at harvest (193.62 cm), resulting in the highest plant height. T4 [80% RDF + Vermicompost @9 kg + Biofertilizer] did, however, record the maximum plant height (58.84 cm) at 30 DAS.

On the other hand, treatment T9 [100% Biofertilizer] showed the lowest plant heights at all stages, suggesting that organic inputs might not be enough to promote the best vegetative growth. The progressive release and microbial stimulation from vermicompost and biofertilizers, along with the nutrient availability from RDF, may have contributed to the notable increase in plant height under integrated treatments. The results of Selvi *et al*., (2004), Jadhav *et al*., (2009), and Tripathi *et al*., (2011), who highlighted the complementary roles of organic and inorganic sources in enhancing plant development indices, are consistent with our findings.

Population of Plants:

Different fertilizer treatments had a considerable impact on the post-thinning plant population (Table 1). T7 had the largest plant population (128.00), whilst T1 (100% RDF) had the smallest (86.67). Improved soil structure and increased microbial activity may be the cause of the larger population under T7, which would boost seedling emergence and survival. This demonstrates the value of vermicompost and biofertilizers in creating robust plant stands.

Accumulation of Dry Matter:

T4 had the largest accumulation of both wet and dry matter per plant at harvest (199.03 g wet weight and 132.03 g dry weight), followed by T7. According to Table 1, T9 had the lowest values (wet: 102.77 g; dry: 48.10 g). Improved photosynthetic activity and nutrient uptake are suggested by this notable increase of dry matter with integrated nutrient management. These results are consistent with comparable findings in mustard published by Kashved *et al*., (2010) and Mandal and Sinha (2004).

Effect of Inorganic and Organic Fertilizers on Yield Attributes and Yield of Mustard (Table 2)

Siliqua Plant Count $^{-1}$:

Table 2 shows that the number of siliqua per plant varied from 152.67 to 242.40, with T4 having the highest value. The combined RDF, vermicompost, and biofertilizer treatments (T4 and T7) performed noticeably better than the individual organic treatments, indicating improved reproductive development and nutrient absorption. These results are consistent with Singh and Singh (2006) and Kashved *et al*., (2010).

Siliqua's length (cm):

The treatments also had a substantial effect on silica length. T4 recorded the longest siliqua (6.64 cm), whereas T9 recorded the shortest (4.54 cm). The enhanced availability of nutrients and assimilates during the reproductive phase may be the cause of this improvement in siliqua size with integrated nutrient supply.

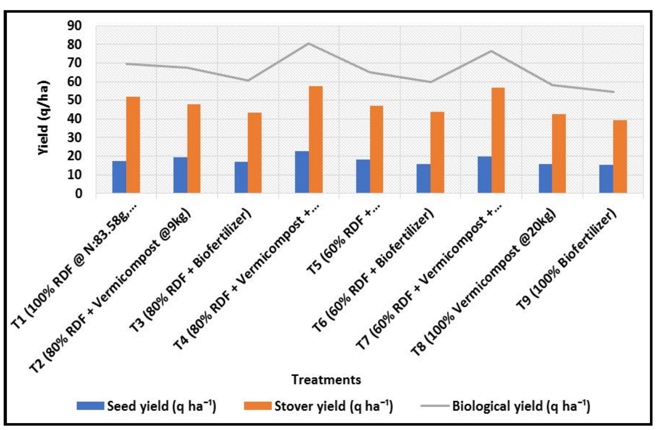

Fig. 1: Effect of organic and inorganic fertilizer on seed, stover and biological yield of mustard.

Siliqua seeds^{-1}:

Seeds per siliqua showed a similar pattern. The number of seeds was highest in T4 (14.62) and lowest in T9 (10.39). In line with Mandal and Sinha (2004), this improvement under integrated treatments suggests improved pod growth and flower preservation.

Weight of Test (g):

T4 had the greatest test weight (4.84 g), followed by T7 and T1, while T9 had the lowest (3.63 g). Better seed filling and assimilate translocation may be the cause of this increase in test weight under integrated nutrition systems.

Seed yield:

T4 had the highest seed output (22.70 q ha^{-1}), whereas T9 had the lowest (15.37 q ha^{-1}) (Table 2 and Fig. 1). The effectiveness of combining 80% RDF with vermicompost and biofertilizer to maximize seed production is confirmed by T4's superior performance. The higher yield under T4 was probably caused by improved yield qualities, greater plant development, and enhanced nutrient uptake.

Yield of Stover (q ha^{-1}):

T4 had the highest yield (57.73 q ha^{-1}), and the trend for stockpile yield was comparable to that of seed yield. The increased output of stover was largely due to the enhanced vegetative biomass under integrated treatments.

Biological yield (q ha^{-1}):

T4 once again outperformed all other treatments in terms of biological yield, which is the total of seed and stover output and ranged from 54.50 to 80.43 q ha^{-1}. The findings show that integrated nutrition management increases overall biomass accumulation in addition to seed productivity.

Harvest Index (%):

Harvest index values varied from 25.03% to 29.01%, with T2 (80% RDF + Vermicompost) having the highest index and T1 (100% RDF) having the lowest. In comparison to vegetative biomass, the greater harvest index in T2 suggests a more effective partitioning of assimilates towards seed formation. However, there was no discernible difference in the harvest index across the majority of treatments, suggesting that increases in total biomass were the main cause of production improvements.

The outcomes unequivocally show that integrated nutrient management (INM) is superior to using only organic or inorganic fertilizers. In terms of growth characteristics, yield attributes, and seed yield, treatments that combined 80% RDF with vermicompost and biofertilizers (T4) continuously performed better than other combinations. The increased siliqua formation, plant height, dry matter accumulation, and biological output show that using organic and bio-inputs in place of some chemical fertilizers improves soil health, productivity, and nutrient use efficiency. These findings are in accordance with previous studies by Brar *et al*., (2016), Bisht *et al*., (2018), and Saha *et al*., (2010), further supporting the use of INM for sustainable mustard cultivation.

Summary

During the *Rabi* season of 2023–2024, this study evaluated the effects of both organic and inorganic fertilizers on the growth, yield characteristics, and seed yield of Indian mustard in Dehradun. A Randomized Block Design was used to investigate nine treatment combinations with different concentrations of vermicompost, biofertilizers, and recommended dose fertilizers (RDF). Measurements were made of yield components such siliqua number, siliqua length, seeds per siliqua, and test weight, as well as growth characteristics like plant height, population, and dry matter buildup.

When compared to single applications, integrated nutrient management treatments particularly the combination of 80% RDF with vermicompost and biofertilizers (T4) significantly enhanced growth, yield characteristics, and seed production. Because of its superior biomass accumulation and nutrient uptake, T4 produced the highest seed and stover yields. The harvest index peaked at 80% RDF with vermicompost (T2), suggesting that assimilates were allocated to seedlings efficiently.

Conclusion

The study finds that under Dehradun conditions, integrated nutrient management that combines vermicompost and biofertilizers (T4) with 80% of the recommended amount of inorganic fertilizers greatly improves Indian mustard growth metrics, yield attributes, and seed production. Compared to using only organic or inorganic fertilizer, this integrated strategy enhances nutrient availability, soil health, and biomass formation, resulting in better crop performance. In order to increase productivity and financial returns while preserving soil fertility, mustard growers in Dehradun and other agro-ecological zones are advised to implement such sustainable nutrient management techniques.

References

Ajnar, A. and Namdeo S. (2021). Impact of integrated nutrient management on growth, yield and quality of mustard (*Brassica juncea* L.). *International Journal of*

Agriculture Sciences, **13(2)**, 45–48.

Bhanuwanti, R., Meena R.K. and Singh A.K. (2022). Influence of organic manures and fertilizers on growth and yield of mustard (*Brassica juncea* L.). *Journal of Oilseeds Research*, **39(4)**, 284–289.

Bharti, P., Pandey R. and Kumar S. (2022). Effect of nutrient management practices on soil fertility and yield of mustard under eastern Uttar Pradesh conditions. *Indian Journal of Agronomy*, **67(3)**, 295–299.

Bisht, S., Pandey A. and Tripathi R.S. (2018). Effect of integrated nutrient management on growth and yield of Indian mustard (*Brassica juncea* L.). *International Journal of Current Microbiology and Applied Sciences*, **7(12)**, 2139–2144.

Brar, B.S., Singh J., Singh G. and Kaur G. (2016). Effects of long-term application of inorganic and organic fertilizers on soil organic carbon and physical properties in maize–wheat system. *Soil & Tillage Research*, **166**, 59–66.

Chandan, S. and Kumar D. (2019). Impact of integrated nutrient management on yield and economics of mustard (*Brassica juncea* L.). *International Journal of Agricultural Sciences*, **9(2)**, 142–146.

Devkota, K.P., Singh M. and Tripathi R. (2020). Integrated nutrient management for sustainable productivity of mustard in the Indo-Gangetic plains. *Journal of Plant Nutrition*, **43(15)**, 2339–2349.

Dhruw, P.S. and Singh R. (2017). Effect of organic and inorganic fertilizers on yield and quality of mustard (*Brassica juncea* L.). *Annals of Plant and Soil Research*, **19(3)**, 309–313.

Directorate of Agriculture, Uttarakhand (2022). Statistical Abstract of Agriculture 2021–22. Government of Uttarakhand, Dehradun.

Gora, A., Singh P. and Meena R.S. (2022). Influence of integrated nutrient management on productivity and profitability of mustard (*Brassica juncea* L.) under semi-arid conditions. *Indian Journal of Agricultural Research*, **56(1)**, 42–47.

Gupta, R. and Sharma V. (2023). Integrated nutrient management in mustard (*Brassica juncea* L.) for higher yield and profitability. *Indian Journal of Agronomy*, **68(2)**, 120–125.

Jadhav, A.S. and Patil P.R. (2009). Effect of integrated nutrient management on productivity of mustard (*Brassica juncea* L.) under rainfed conditions. *Journal of Maharashtra Agricultural Universities*, **34(3)**, 307–310.

Kashved, R. and Sinha S.K. (2010). Response of mustard to organic and inorganic nutrient sources in eastern India. *Environment and Ecology*, **28(1A)**, 473–475.

Kumar, A. and Singh P. (2018). Effect of integrated nutrient management on growth and yield of mustard (*Brassica juncea* L.). *International Journal of Chemical Studies*, **6(4)**, 2872–2876.

Mandal, K.G. and Sinha A.C. (2004). Nutrient management effects on mustard (*Brassica juncea* L.) productivity and soil fertility in Indo-Gangetic plains. *Indian Journal of Agronomy*, **49(2)**, 116–120.

Maurya, S.P. and Singh S. (2019). Effect of organic manures and fertilizers on yield and economics of mustard (*Brassica juncea* L.). *Journal of Pharmacognosy and Phytochemistry*, **8(5)**, 285–288.

Mukherjee, D. (2016). Integrated nutrient management for sustainable production of oilseed crops. *Journal of Oilseeds Research*, **33(3)**, 140–146.

Noviyanty, S. and Salingkat M. (2018). Effect of organic and inorganic fertilizers on growth and yield of mustard (*Brassica juncea* L.). *International Journal of Agriculture, Environment and Bioresearch*, **3(4)**, 35–42.

Pal, S. and Pathak R. (2016). Effect of integrated nutrient management on mustard yield and nutrient uptake. *International Journal of Agricultural Sciences*, **8(2)**, 210–213.

Saha, S. and Singh P. (2010). Integrated nutrient management for improving productivity and quality of Indian mustard (*Brassica juncea* L.). *Journal of Oilseeds Research*, **27(1)**, 57–60.

Selvi, D. and Rajendran R. (2004). Effect of integrated nutrient management on growth, yield and quality of mustard (*Brassica juncea* L.). *Agricultural Science Digest*, **24(4)**, 250–253.

Sharma, V. and Gupta R. (2023). Response of mustard (*Brassica juncea* L.) to integrated nutrient management under north Indian conditions. *Indian Journal of Agronomy*, **68(2)**, 120–125.

Singh, A.K. and Singh P. (2006). Effect of integrated nutrient management on growth, yield and economics of mustard (*Brassica juncea* L.). *Indian Journal of Agricultural Research*, **40(3)**, 216–219.

Thaneshwar, D. and Singh R. (2017). Effect of nutrient management practices on productivity and profitability of mustard (*Brassica juncea* L.). *International Journal of Current Microbiology and Applied Sciences*, **6(8)**, 1458–1464.

Thakur, R., Singh M. and Sharma R. (2009). Integrated nutrient management in oilseed crops: A review. *Agricultural Reviews*, **30(2)**, 130–137.

Tripathi, R. and Singh M. (2011). Effect of integrated nutrient management on yield, nutrient uptake and quality of mustard (*Brassica juncea* L.). *Indian Journal of Agronomy*, **56(2)**, 123–127.

Vinod, K., Singh R.P. and Verma S. (2019). Effect of organic and inorganic nutrient sources on yield and quality of mustard (*Brassica juncea* L.). *International Journal of Current Microbiology and Applied Sciences*, **8(5)**, 1270–1277.

Ye, T. and Zhang X. (2022). Role of integrated nutrient management in enhancing oilseed productivity and soil health: A global perspective. *Agronomy Journal*, **114(8)**, 3031–3042.