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Enhancing nutrient uptake and crop yield in mustard (*Brassica juncea* L.) via integrated nutrient management approaches

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Abstract

During the *Rabi* season of 2020-21, an experiment took place at College Farm, Agricultural College, Polasa, Jagtial. The objective of the study was to investigate the impact of integrated nutrient management on the yield and nutrient uptake of mustard (*Brassica juncea* L.) crop in the Northern Telangana Zone. The experiment was conducted in sandy clay loam soil and followed a randomized block design with nine treatments, each replicated three times. The treatments include T1: 100% Recommended dose of Fertilizer (RDF), T2: 100% RDF + FYM, T3: 100% RDF + FYM + Biofertilizer consortium, T4: 75% RDF, T5: 75% RDF + FYM, T6: 75% RDF + FYM + Biofertilizer consortium, T7: Soil Test Based NPK, T8: 75% STB NPK + FYM and T9: 75% STB (Soil Test Based) NPK + FYM + Biofertilizer consortium. Among the treatments, the combination of 75% STB NPK + FYM + Biofertilizer consortium resulted in the highest seed yield for mustard (1666 kg ha⁻¹), statistically equivalent to STB NPK (1644 kg ha⁻¹), 100% RDF + FYM + Biofertilizer consortium (1593 kg ha⁻¹) and 75% STB NPK + FYM (1565 kg ha⁻¹). This treatment also exhibited significantly greater uptake of nitrogen, phosphorus, potassium, sulphur and zinc, comparable to the effects observed with Soil Test Based NPK, 100% RDF + FYM + Biofertilizer consortium, and 75% STB NPK + FYM treatments. Further, it was observed that lower N, P, K, S and Zn uptakes in seed and stover and at different stages of crop were recorded in the treatment 75% RDF. The positive effects of organics and biofertilizers contributed to increased nutrient availability and uptake which promoted the increase of mustard yield.

Keywords: Indian mustard, biofertilizers, FYM, nutrient uptake, seed and Stover yield.

Introduction

Oilseeds rank as India's second largest agricultural commodity, trailing only cereals, with a production of 31.3 million tonnes across 24.65 million hectares (Agricultural Statistics at a Glance 2018) ^[1]. Among these oilseeds, rapeseed and mustard hold the second most crucial position as *Rabi* oilseed crops, contributing nearly 26% to the country's total oilseed production (Ajnar and Namdeo, 2021) ^[2]. On a global scale, India stands as the third highest producer of rapeseed and mustard, following China and Canada. This crop constitutes approximately one-third of India's oil output, solidifying its significance in the nation's edible oil seed sector. In terms of worldwide figures, India accounts for 28.3% of cultivated area and 12.0% of production (Mhetre *et al.*, 2019) ^[13]. Within India, it holds the status of being the third most vital edible oil crop, trailing behind soybean and groundnut, contributing 27.8% to the oil economy. However, in India, inadequate nutrient utilization and suboptimal management practices have led to an average rapeseed mustard yield of just 1,089 kg per hectare (Anonymous, 2014) ^[3]. The productivity of rapeseed mustard is constrained by factors like rainfed cultivation on marginal land and suboptimal fertilizer use. Moreover, mineral nutrition significantly impacts the quality of mustard oil and cake (Tripathi *et al.*, 2010) ^[24]. Overuse of chemical fertilizers can harm the soil's biological vitality, a process that must be prevented, as soil microbial communities drive all nutrient transformations. Excessive chemical fertilizer use, unbalanced or insufficient application and restricted organic fertilizer utilization contribute not only to nutrient deficiency in soil but also to its deterioration. Integrated Nutrient Management (INM) emerges as a flexible approach that minimizes reliance on chemical nutrient sources while maximizing farmer profitability.

INM incorporates chemical fertilizers, organic manures, legumes, crop residues and biological fertilizers. Adopting integrated plant nutrient supply and management strategies holds crucial importance for enhancing soil quality, input efficiency and crop yield, thereby boosting food and nutrition security in Indian agriculture (Swarup, 2010) [22]. Integrated nutrient management is vital not only for sustained high yields over time (Verma *et al.*, 2010) [25] but also for advancing soil health and ensuring environmental safety. The choice of fertilizer sources significantly influences plant nutrient uptake. Hence, the present study was conducted to assess mustard yield and nutrient uptake under diverse integrated nutrient management scenarios.

Material and methods

A field experiment was carried out at College Farm of Agricultural College, Jagtial with mustard as a test crop during Rabi, 2020. The experimental farm was located at 18° 50' 58" N latitude and 78° 56' 97" E longitude at an altitude of 243.4 m above mean sea level (MSL). The weekly mean maximum temperature ranged from 33.5°C to 30.8°C during the crop growth period. The mean minimum temperature for the corresponding period ranged from 12.8 °C to 18.6 °C, while the average maximum and minimum temperatures during the same period were 31.4 °C and 16.0 °C, respectively. The average relative humidity was 66.7%. The weekly mean evaporation ranged from 1.8 mm to 4.3 mm during the crop growth period. The cultivar used for the study was NRCHB-101. The experiment was laid out in Randomized Block Design (RBD) with three replications and nine treatments which includes T1: 100% Recommended Dose of Fertilizer (RDF), T2: 100% RDF + FYM, T3: 100% RDF + FYM + Biofertilizer consortium, T4: 75% RDF, T5: 75% RDF + FYM, T6: 75% RDF + FYM + Biofertilizer consortium, T7: Soil Test Based (STB) NPK, T8: 75% STB NPK + FYM and T9: 75% STB NPK + FYM + Biofertilizer consortium. Biofertilizer consortium includes Azotobacter + Phosphate Solubilizing Bacteria + Potassium Solubilizing Bacteria + Zinc Solubilizing Bacteria. The treatments were allotted randomly in each replication.

Site description

The initial analysis of soil samples revealed that the experimental soil is sandy clay loam texture. It exhibited low availability of nitrogen (196 kg ha⁻¹), while phosphorus content was notably high (26.6 kg ha⁻¹), as was potassium content (360 kg ha⁻¹) and available sulphur content (26.8 kg ha⁻¹). The recommended fertilizer dosage for mustard comprised 60 kg ha⁻¹ of nitrogen, 40 kg ha⁻¹ of phosphorus, and 40 kg ha⁻¹ of potassium. These nutrients were applied in the form of urea (46% N), single super phosphate (16% P₂O₅), and muriate of potash (60% K₂O), respectively. Initial applications incorporated phosphorus, potassium and half of the nitrogen during the crop's sowing stage, while the remaining half of the nitrogen was applied at the flowering phase of the mustard (55-60 days after sowing). Biofertilizers and farm yard manure (FYM) corresponding to each treatment were added into the soil before sowing.

Plant sampling and analysis

Plant samples at 30 DAS, 60 DAS and at harvest were collected from each plot after eliminating the border rows and the samples were washed with tap water followed by 0.1 N HCl and distilled water. They were first dried under shade and then in hot air oven at 60°C. Oven dried plant samples were ground in grinder and stored in butter paper covers and later analysed for N, P, K, S and Zn. Nitrogen content in plant sample was determined by micro kjeldahl distillation method using Kelplus equipment (Jackson,

1973) [8], Phosphorous content in the extract was estimated by reacting the extract with vanadomolybdate forming yellow colour complex in HNO₃ medium and the content of potassium in diacid extract was determined by using flame photometer (Jackson, 1967) [7] and was expressed as percentage. Sulphur content in the extract was estimated by developing turbidity with supplementing of stabilizing agent, gum acacia and a pinch of barium chloride to the diacid extract and Zinc in diacid extract at 30, 60 DAS and at harvest in plants was determined by using ICP-AES as per the specifications mentioned by Lindsay and Norvell (1978) [12].

Results and discussion

Seed and stover yield

Different integrated nutrient management options significantly influenced the seed yield of mustard (Table 1). The results of the experiment revealed that the seed yield showed variation from 1143 kg ha⁻¹ to 1666 kg ha⁻¹ with a mean seed yield of 1416 kg ha⁻¹. Significantly higher seed yield was recorded under the treatment 75% STB NPK + FYM + Biofertilizer consortium (1666 kg ha⁻¹) which was on par with STB NPK (1644 kg ha⁻¹), 100% RDF + FYM + Biofertilizer consortium (1593 kg ha⁻¹), 75% STB NPK + FYM (1565 kg ha⁻¹) and the lower seed yield was recorded under the treatment 75% RDF (1143 kg ha⁻¹). INM and soil test based fertilizer treatments recorded 34.4, 32.6, 28.5 and 26.2% higher seed yield under 75% STB NPK + FYM + Biofertilizer consortium, STB, 100% RDF + FYM + Biofertilizer consortium, 75% STB + FYM respectively as compared to 100% RDF. Higher seed yields under STB NPK + FYM + Biofertilizer consortium treatment was due to the combined application of nutrients through inorganic and organic sources provided balanced nutrition to the crop and improved the physical, chemical and biological properties of soil and maintained the nutrient supply throughout the plant growth stages which promoted vegetative growth and ultimately increased seed yield (Parmar *et al.* 2020 and Singh *et al.* 2006) [17, 19-20]. The comprehensive application of chemical fertilizers, organic fertilizers and microbial agents provided sufficient nutrients throughout the growth period. These results are in conformity with the finding of Ajnar and Namdeo (2021) [2]. Similar to seed yield stover yield of mustard was recorded significantly higher under the treatment 75% STB NPK + FYM + Biofertilizer consortium (3546 kg ha⁻¹) which was on par with STB (3475 kg ha⁻¹), 100% RDF + FYM + Biofertilizer consortium (3359 kg ha⁻¹) and 75% STB NPK + FYM (3307 kg ha⁻¹). The lower stover yield was recorded under the treatment 75% RDF (2675 kg ha⁻¹). The increase in stover yield can be attributed to the general improvement in plant organs (plant height and branches) associated with faster and more uniform vegetative growth of crops under the effect of INM and soil test based fertilizer application treatments. Similar findings were also reported by Parmar *et al.* (2020) [17]. The higher straw yield was mainly due to higher dry matter accumulation and also more translocation of photosynthates towards sink which is observed in treatments receiving integration of RDF along with organics and biofertilizers (Kaparwan *et al.* 2020, Chand *et al.* 2004 and Arya *et al.* 2007) [9, 5, 4].

Dry matter production

Dry matter production of mustard recorded at 30 DAS, 60 DAS and at harvest differed significantly due the effect of integrated nutrient management (Table 1). At 30 DAS, significantly the higher dry matter production of 451 kg ha⁻¹ was recorded with application of 75% STB NPK + FYM + Biofertilizer consortium which was comparable with application of Soil Test Based NPK

recorded the dry matter production of 437 kg ha⁻¹, 100% RDF+FYM+ Biofertilizer consortium (415 kg ha⁻¹) and 75% STB NPK + FYM (409 kg ha⁻¹). The lower dry matter production of (324 kg ha⁻¹) was recorded with the application of 75% RDF. Significantly higher dry matter production of 2032 kg ha⁻¹ at 60 DAS was recorded with application of 75% STB NPK+ FYM + Biofertilizer consortium which was comparable with application of Soil Test Based NPK recorded the dry matter production of 2010 kg ha⁻¹ followed by 100% RDF + FYM + Biofertilizer consortium (1982 kg ha⁻¹) and 75% STB NPK + FYM (1962 kg ha⁻¹). The lower dry matter production of 1540 kg ha⁻¹ was recorded with the application of 75% RDF. The reason behind increased dry matter in integrated nutrient supply is due to proper establishment of crop plants, increased height and larger vegetative growth (Thaneshwar *et al.* 2017) [23]. All the growth parameters increased with INM, it might be due to organic manures and biofertilizers releases some macro/micro nutrients and some growth promoting substances resulting in increase in cell division, cell enlargement which increases rate of photosynthesis, primary and secondary branches which in turn increase the drymatter production. (Kumar *et al.* 2019) [10, 11].

Table 1: Dry biomass produced (kg ha⁻¹), seed yield (kg ha⁻¹) and stover yield (kg ha⁻¹) of mustard as influenced by different integrated nutrient management treatments.

Treatment	30 DAS	60 DAS	Seed yield	Stover yield	Harvest Index
100% RDF	335	1636	1240	2812	30.5
100% RDF+ FYM	401	1834	1459	3213	31.2
100% RDF+ FYM+ BC	415	1982	1593	3359	32.2
75% RDF	324	1540	1143	2675	29.9
75% RDF + FYM	332	1597	1182	2733	30.2
75% RDF + FYM+ BC	357	1747	1251	2888	30.3
STB NPK	437	2010	1644	3475	32.1
75% STB NPK+FYM	409	1962	1565	3307	32.1
75% STB NPK+FYM + BC	451	2032	1666	3546	32.0
Mean	385	1816	1416	3112	31.2
Sem±	14.4	54.9	68.1	105	0.73
CD (P=5)	43.6	166	206	317	NS
CV	6.49	5.24	8.33	5.83	4.08

BC= Biofertilizer consortium, RDF= Recommended dose of fertilizer, STB NPK= Soil test based NPK

Nutrient uptake

The percentage of nutrient content in the seed and the dry matter formulation influence nutrient uptake. N, P, K, S and Zn uptake was recorded significantly higher with the integrated application of 75% STB NPK + FYM + Biofertilizer consortium which was on par with STB NPK, 100% RDF+FYM+ Biofertilizer consortium and 75% STB NPK + FYM at 30 DAS, 60 DAS, seed and in stover. Further observation of data revealed that lower uptake of these nutrients was recorded in treatment receiving 75% RDF. Nitrogen uptake in plants at 30 DAS was recorded significantly higher under 75% STB NPK + FYM + Biofertilizer consortium (8.90 kg ha⁻¹) which was on par with STB NPK (8.58 kg ha⁻¹), 100% RDF+FYM+ Biofertilizer consortium (8.13 kg ha⁻¹) and 75% STB NPK + FYM (7.85 kg ha⁻¹). Further it was observed that lower N uptake of 4.87 kg ha⁻¹ was recorded in the treatment 75% RDF (Table 2). Similar to nitrogen, P, K, S and Zn followed the same trend at 30 DAS. Phosphorus, potassium, sulphur and zinc uptake ranged from 0.83 to 1.50 kg ha⁻¹, 4.60 to 8.99 kg ha⁻¹, 0.95 to 1.86 kg ha⁻¹ and 9.19 to 17.8 g ha⁻¹,

respectively. Nutrient uptake at 60 DAS also followed the similar trend as at 30 DAS. At 60 DAS after sowing nitrogen uptake ranged from 26.3 to 41.2 kg ha⁻¹, phosphorus uptake varied from 5.86 to 11.0 kg ha⁻¹, potassium uptake varied from 24.9 to 8.99 kg ha⁻¹, sulphur ranged from 5.86 to 11.2 kg ha⁻¹ and zinc uptake varied from 47.5 to 86.4 g ha⁻¹. Integrated application of 75% STB NPK + FYM + Biofertilizer consortium recorded the higher nitrogen uptake in seed (48.6 kg ha⁻¹) which was comparable with application of Soil Test Based NPK (47.3 kg ha⁻¹), 100% RDF + FYM + Biofertilizer consortium (45.1 kg ha⁻¹) and 75% STB NPK + FYM (43.2 kg ha⁻¹). Similar to nitrogen, the phosphorus, potassium, sulphur and zinc uptake was also recorded higher with the integrated application of 75% STB NPK + FYM + Biofertilizer consortium, Soil Test Based NPK, 100% RDF + FYM + Biofertilizer consortium and 75% STB NPK + FYM. In seed, phosphorus uptake ranged from 5.33 to 10.9 kg ha⁻¹, potassium uptake was 5.63 to 10.8 kg ha⁻¹ and sulphur uptake ranged from 5.62 to 11.2 kg ha⁻¹. Lower uptake of all these nutrients was recorded in the treatment 75% RDF. Combined application of organics, inorganics and biofertilizers significantly influenced the nitrogen uptake by mustard stover. Significantly higher N uptake of 23.4 kg ha⁻¹ was recorded with the application of 75% STB NPK + FYM + Biofertilizer consortium which was on par with Soil Test Based NPK (22.8 kg ha⁻¹), 100% RDF + FYM + Biofertilizer consortium (21.5 kg ha⁻¹) and 75% STB NPK + FYM (20.5 kg ha⁻¹). Further it was observed that lower N uptake of 12.9 kg ha⁻¹ in stover was recorded in the treatment 75% RDF. Similar to nitrogen, the phosphorus, potassium, sulphur and zinc uptake in stover was also recorded higher with the integrated application of 75% STB NPK + FYM + Biofertilizer consortium which was comparable to Soil Test Based NPK, 100% RDF + FYM + Biofertilizer consortium and 75% STB NPK + FYM. In stover phosphorus, potassium, sulphur and zinc uptake ranged from 4.29 to 8.17 kg ha⁻¹, 38.7 to 68.1 kg ha⁻¹, 12.3 to 22.1 kg ha⁻¹ and 35.2 to 73.4 g ha⁻¹, respectively.

It is observed that integrated application of RDF along with FYM and biofertilizers showed significant increase in nutrient uptake of different macronutrients (N, P, K and S) and dry matter accumulation might be due to positive effect of inorganic fertilizer applied along with FYM and biofertilizers. Balanced supply of nutrients to the soil leads to well developed root system which results in better absorption of water and nutrients (Sahoo, 2013 and Singh and Sinsinwar 2006) [18, 19-20]. FYM application might have created favourable physical and chemical environment for root to uptake nutrients (Ajnar and Namdeo 2021). More over FYM and biofertilizer consortium might add additional amount of nutrients to soil and making them available for longer period which synchronies with plant needs (Das *et al.* 2010 and Kumar *et al.* 2019) [6, 11].

Increased uptake of N by the crop with FYM application might be due to the favourable effect of FYM on N absorption by the plant (Singh, 2020 and Kumar and Singh, 2019) [10, 11]. Increased P availability by applied fertilizers and native soil P and combined effect of released organic acids and organic anions on decomposition of farmyard manure in soil increased P uptake. Similar findings were reported by Mohapatra and Dixit (2010) [15] and Parihar *et al.* (2012) [16]. The findings on the increase in nutrient content and uptake by application of chemical fertilizers with FYM and biofertilizers are in agreement with the observations made by Mitra and Mandal (2012) [14].

Table 2: Effect of integrated nutrient management on nitrogen uptake (kg ha⁻¹) at different crop growth stages.

Treatment	30 DAS	60 DAS	Seed	Stover	Total uptake
100% RDF	5.13	28.5	29.7	14.4	44.1
100% RDF+ FYM	7.18	33.4	38.3	19.1	57.3
100% RDF+ FYM+ BC	8.13	39.0	45.1	21.5	66.6
75% RDF	4.87	26.2	26.8	12.9	39.7
75% RDF + FYM	5.01	27.6	27.6	13.6	41.3
75% RDF + FYM+ BC	5.41	31.2	30.4	15.3	45.7
STB NPK	8.58	39.8	47.3	22.8	69.9
75% STB NPK+FYM	7.85	38.3	43.2	20.5	63.6
75% STB NPK+FYM + BC	8.90	41.2	48.6	23.4	72.0
Mean	6.78	33.9	37.5	18.2	55.6
Sem±	0.45	1.51	1.86	1.18	2.47
CD (P=5)	1.35	4.58	5.62	3.59	7.48
CV	11.4	7.74	8.58	11.3	7.71

BC= Biofertilizer consortium, RDF= Recommended dose of fertilizer, STB NPK= Soil test based NPK

Table 3: Effect of integrated nutrient management on phosphorus uptake (kg ha⁻¹) at different crop growth stages.

Treatment	30 DAS	60 DAS	Seed	Stover	Total uptake
100% RDF	0.91	6.61	6.11	4.79	10.9
100% RDF+ FYM	1.07	8.81	8.34	6.54	14.8
100% RDF+ FYM+ BC	1.33	10.3	10.0	7.39	17.4
75% RDF	0.83	5.86	5.33	4.29	9.60
75% RDF + FYM	0.90	6.23	5.69	4.38	10.1
75% RDF + FYM+ BC	1.02	7.36	6.27	4.93	11.2
STB NPK	1.43	10.7	10.5	7.68	18.1
75% STB NPK+FYM	1.24	9.84	9.68	7.29	16.9
75% STB NPK+FYM + BC	1.50	11.0	10.9	8.17	19.1
Mean	1.14	8.53	8.09	6.16	14.2
Sem±	0.10	0.51	0.40	0.43	0.58
CD (P=5)	0.29	1.55	1.21	1.31	1.77
CV	14.7	10.4	8.58	12.2	7.11

BC= Biofertilizer consortium, RDF= Recommended dose of fertilizer, STB NPK= Soil test based NPK

Table 4: Effect of integrated nutrient management on potassium uptake (kg ha⁻¹) at different crop growth stages.

Treatment	30 DAS	60 DAS	Seed	Stover	Total uptake
100% RDF	5.13	27.6	6.24	41.8	48.1
100% RDF+ FYM	6.95	34.7	8.47	55.2	63.5
100% RDF+ FYM+ BC	7.74	39.3	10.0	62.2	72.2
75% RDF	4.60	24.9	5.63	38.7	44.3
75% RDF + FYM	4.97	26.3	5.87	40.2	46.0
75% RDF + FYM+ BC	5.51	29.7	6.39	43.4	49.8
STB NPK	8.56	41.4	10.5	65.8	75.8
75% STB NPK+FYM	7.60	38.2	9.72	58.4	67.9
75% STB NPK+FYM + BC	8.99	42.3	10.8	68.1	78.8
Mean	6.67	33.8	8.19	52.7	60.7
Sem±	0.46	1.85	0.40	3.67	2.49
CD (P=5)	1.40	5.58	1.20	11.1	7.52
CV	12.0	9.45	8.38	12.1	7.09

BC= Biofertilizer consortium, RDF= Recommended dose of fertilizer, STB NPK= Soil test based NPK

Table 5: Effect of integrated nutrient management on sulphur uptake (kg ha⁻¹) at different crop growth stages.

Treatment	30 DAS	60 DAS	Seed	Stover	Total uptake
100% RDF	1.01	6.72	6.52	13.6	20.7
100% RDF+ FYM	1.46	9.00	8.69	17.8	27.1
100% RDF+ FYM+ BC	1.62	10.5	10.5	19.9	31.5
75% RDF	0.95	5.86	5.62	12.3	18.4
75% RDF + FYM	1.00	6.23	5.91	12.6	19.1
75% RDF + FYM+ BC	1.11	7.52	6.52	14.2	21.1
STB NPK	1.77	10.9	11.0	21.7	32.8
75% STB NPK+FYM	1.61	10.2	9.91	19.3	29.9
75% STB NPK+FYM + BC	1.86	11.2	11.2	22.1	33.9
Mean	1.38	8.69	8.42	17.0	26.1
Sem±	0.10	0.49	0.68	0.92	0.93
CD (P=5)	0.31	1.50	2.05	2.80	2.83
CV	13.1	9.86	13.9	9.39	6.21

BC= Biofertilizer consortium, RDF= Recommended dose of fertilizer, STB NPK= Soil test based NPK

Table 6: Effect of integrated nutrient management on zinc uptake (g ha^{-1}) at different crop growth stages.

Treatment	30 DAS	60 DAS	Seed	Stover	Total uptake
100% RDF	10.5	54.5	41.9	43.2	85.1
100% RDF+ FYM	13.5	66.9	52.3	55.7	108
100% RDF+ FYM+ BC	15.6	77.9	61.0	64.7	126
75% RDF	9.19	47.5	35.1	35.2	70.3
75% RDF + FYM	9.87	51.7	37.7	39.6	77.3
75% RDF + FYM+ BC	11.8	61.6	43.1	48.5	91.6
STB NPK	17.0	82.8	65.1	69.8	135
75% STB NPK+FYM	14.9	75.3	59.0	61.3	120
75% STB NPK+FYM + BC	17.8	86.4	68.1	73.4	141
Mean	13.3	67.2	51.5	54.6	8.72
Sem $\pm$	0.99	4.44	4.73	4.35	26.4
CD (P=5)	2.99	13.4	14.3	13.2	14.2
CV	12.8	11.5	15.9	13.8	85.1

BC= Biofertilizer consortium, RDF= Recommended dose of fertilizer, STB NPK= Soil test based NPK

Conclusion

In conclusion, the present study highlights the significant impact of nutrient content in seeds and the formulation of dry matter on nutrient uptake in mustard plants. The integrated application of 75% STB NPK + FYM + Biofertilizer consortium exhibited noteworthy outcomes, leading to increased nitrogen (N), phosphorus (P), potassium (K), sulphur (S), and zinc (Zn) uptake across various growth stages and plant parts. At 30 DAS and 60 DAS, this integrated approach yielded higher N uptake, with 75% STB NPK + FYM + Biofertilizer consortium demonstrating comparable results to STB NPK, 100% RDF + FYM + Biofertilizer consortium, and 75% STB NPK + FYM. Similar trends were observed for P, K, S, and Zn uptake. Furthermore, the seed nutrient content was positively influenced by the integrated approach, particularly with regards to N, P, K, and S uptake, indicating the potential for improved seed quality and yield. This enhanced nutrient uptake is attributed to the synergistic effects of balanced nutrient management, including inorganic fertilizers, FYM, and biofertilizers. The combined application of these elements created a conducive soil environment, promoting robust root development and efficient nutrient absorption. The positive effects of FYM on N absorption and the release of organic acids and anions further contributed to nutrient availability and uptake. The findings underscore the importance of a comprehensive nutrient management strategy that incorporates both organic and inorganic sources, supported by biofertilizers. This holistic approach not only enhances nutrient uptake and plant growth but also holds promise for sustainable and improved agricultural productivity. The results of this study align with previous research, reinforcing the value of integrated nutrient management practices for optimizing crop performance and nutrient utilization.

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Conflict of interest: Nil

References

- Directorate of Economics and Statistics, Department of Agriculture, Cooperation & Farmers Welfare, Government of India. Agricultural Statistics at a Glance. 2018. p. 140–141.
- Ajnar P, Namdeo S. Effect of integrated nutrient management on Indian mustard yield attributes and yield. Journal of Pharmacognosy and Phytochemistry. 2021;10(2):545–548.
- Anonymous. Agricultural Statistics at a Glance. Directorate of Economics and Statistics, Government of India; 2014.
- Arya RL, Varshney JG, Lalit K. Effect of integrated nutrient application in chickpea-mustard intercropping system in the semi-arid tropics of North India. Communications in Soil Science and Plant Analysis. 2007;38(1–2):229–240.
- Chand S, Tripathi HN, Tripathi AK. Phosphorus requirement of gram (*Cicer arietinum*) + Indian mustard (*Brassica juncea*) intercropping system under irrigated conditions. Indian Journal of Agricultural Sciences. 2004;74(4):207–209.
- Das A, Patel DP, Munda GC, Ghosh PK. Effect of organic and inorganic sources of nutrients on yield, nutrient uptake and soil fertility of maize (*Zea mays*)-mustard (*Brassica campestris*) cropping system. Indian Journal of Agricultural Sciences. 2010;80(1):85–88.
- Jackson ML. Soil Chemical Analysis. New Delhi: Prentice Hall of India Private Limited; 1967.
- Jackson ML. Soil Chemical Analysis. New Delhi: Prentice Hall of India Private Limited; 1973.
- Kaparwan D, Rana NS, Vivek, Dhyani BP. Effect of different row ratios and nutrient management strategies on growth, yield and quality of mustard in chickpea + mustard intercropping system. Journal of Pharmacognosy and Phytochemistry. 2020;9(3):852–857.
- Kumar R, Kumar A, Kumar A, Bharati AK, Kumar S. Impact of integrated nutrient management on growth, seed yield and quality of mustard (*Brassica juncea* L.). Journal of Pharmacognosy and Phytochemistry. 2019;8(3):2265–2267.
- Kumar V, Singh S. Effect of fertilizers, biofertilizers and farmyard manure on sustainable production of Indian mustard (*Brassica juncea* L.). Annals of Plant and Soil Research. 2019;21(1):25–29.
- Lindsay WL, Norvell WA. Development of DTPA soil test for zinc, iron, manganese and copper. Soil Science Society of America Journal. 1978;42:421–428.
- Mhetre AG, Vaidya AA, Dademal AA, Kapse VD. Effect of integrated nutrient management on yield and quality of mustard (*Brassica juncea* L.) on Alfisols of Konkan (MS). The Pharma Innovation Journal. 2019;8(8):147–149.
- Mitra B, Mandal B. Effect of nutrient management and straw mulching on crop yield, uptake and soil fertility in rapeseed (*Brassica campestris*)-greengram (*Vigna radiata*)-rice (*Oryza sativa*) cropping system under Gangetic plains of India. Archives of Agronomy and Soil Science.

- 2012;58(2):213–222.
15. Mohapatra AKB, Dixit L. Integrated nutrient management in rainy season groundnut (*Arachis hypogaea*). Indian Journal of Agronomy. 2010;55(2):123–127.
 16. Parihar CM, Rana KS, Jat ML, Jat SL, Parihar MD, Kantwa SR, et al. Carbon footprint and economic sustainability of pearl millet-mustard system under different tillage and nutrient management practices in moisture stress conditions. African Journal of Microbiology Research. 2012;6(23):5052–5061.
 17. Parmar N, Jat JR, Malav JK, Kumar S, Pavaya RP, Patel JK. Growth, quality, yield and available nutrient status after harvest of summer sesamum (*Sesamum indicum* L.) in loamy sand as influenced by integrated nutrient management. Journal of Pharmacognosy and Phytochemistry. 2020;9(3):388–392.
 18. Sahoo RC. Integrated nutrient management in mustard (*Brassica juncea* L.) [M.Sc. thesis]. Udaipur, Rajasthan, India: Maharana Pratap University of Agriculture and Technology; 2013.
 19. Singh R, Sinsinwar BS. Effect of integrated nutrient management on growth, yield, oil content and nutrient uptake of Indian mustard (*Brassica juncea*) in Eastern part of Rajasthan. Indian Journal of Agricultural Sciences. 2006;76(5):322–324.
 20. Singh S, Singh RN, Prasad J, Singh BP. Effect of integrated nutrient management on yield and uptake of nutrients by rice and fertility in rainfed uplands. Journal of the Indian Society of Soil Science. 2006;54(3):327–330.
 21. Singh V. Effect of integrated nutrient management on yield and uptake of nutrients in pearl millet (*Pennisetum glaucum*)-mustard (*Brassica juncea*) crop sequence. Annals of Plant and Soil Research. 2020;22(4):349–353.
 22. Swarup A. Integrated plant nutrient supply and management strategies for enhancing soil quality, input use efficiency and crop productivity. Journal of the Indian Society of Soil Science. 2010;58(1):25–31.
 23. Thaneshwar, Singh V, Prakash J, Kumar M, Kumar S, Singh RK. Effect of integrated nutrient management on growth and yield of mustard (*Brassica juncea* L.) in irrigated condition of upper Gangetic plain zone of India. International Journal of Current Microbiology and Applied Sciences. 2017;6(1):922–932.
 24. Tripathi MK, Chaturvedi S, Shukla DK, Mahapatra BS. Yield performance and quality in Indian mustard (*Brassica juncea*) as affected by integrated nutrient management. Indian Journal of Agronomy. 2010;55(2):138–142.
 25. Verma G, Mathur AK, Bhandari SC, Kanthaliya PC. Long-term effect of integrated nutrient management on properties of a Typic Haplustept under maize-wheat cropping system. Journal of the Indian Society of Soil Science. 2010;58(3):299–302.