Plant Archives Vol. 25, Supplement 1, 2025 pp. 1286-1292 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-1.175

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH, YIELD AND QUALITY OF INDIAN MUSTARD (*BRASSICA JUNCEA* L.)

Pradeep Kumar[1,2]*, Vishuddha Nand[1], Dheerendra Kumar[3], Deepu[2], Abhishek Mishra[2], Suryabhan[2], Sanjiv Kumar[2] and Janardan Prasad Bagri[2]

[1]Department of Agronomy, Acharya Narendra Deva University of Agriculture & Technology, Ayodhya- 224229, U.P., India

[2]Department of Agronomy, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur- 208002, U.P., India

[3]Department of Soil Science & Agri. Chemistry, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur- 208002, U.P., India

*Corresponding author Email: pradeepkumar25299@gmail.com

(Date of Receiving : 09-08-2023; Date of Acceptance : 26-10-2024)

ABSTRACT

The field experiment was carried out at Agronomy Research farm of Acharya Narendra Deva university of Agriculture and Technology, Kumarganj, Ayodhya (U. P.) during Rabi Season 2021-22 to study the "Effect of integrated nutrient management on growth, yield and quality of Indian mustard (*Brassica juncea* L.)" The experiment was laid out in Randomized Block Design with Three replications and Eleven treatments i.e. **T_1:** Control, **T_2:** 100% RDF (Inorganics), **T_3:** 100% RDN (Bio compost) + PSB, **T_4:** 100% RDN (VC) + PSB, **T_5:** 75% RDF + 25% RDN (Bio compost) + 40 kg S, **T_6:** 75% RDF + 25% RDN (VC) + 40 kg S, **T_7:** 50% RDF + 50% RDN (Bio compost) + 60 kg S, **T_8:** 50% RDF + 50% RDN (VC) + 60 kg S, **T_9:** 50% RDN (Bio compost) + 50% RDN (VC) + 60 kg S, **T_{10}:** 75% RDN (Bio compost) + 25% RDN (VC) + PSB, **T_{11}:** 75% RDN (VC) + 25% RDN (Bio compost) + PSB. The observation on different growth, yield and qualitative parameters were recorded and analyzed statistically. The experimental results revealed that among the treatments, treatment **T_6** 75% RDF + 25% RDN (VC) + 40 kg S recorded maximum, plant height, leaf area index, Number of branches, Days taken to 50% flowering, Days taken to maturity, Number of siliquae plant^{-1}, Number of seed siliqua^{-1}, Length of siliqua, Test weight, Grain yield, Stover yield, biological yield and Harvesting index. And lowest under the treatment **T_1** Control.

***Keywords* :** INM, RDF, Vermicompost, RDN, PSB

Introduction

Rapeseed and mustard belong to family Cruciferae, which is grown in northern India comprising traditionally grown indigenous species namely India mustard (*Brassica juncea*), brown sarson (*Brassica campestris* var. brown sarson), Yellow sarson (*Brassica campestris* var. yellow Sarson), Toria (*Brassica campestris* var. toria) and Taramira (*Eruca sativa*) along with nontraditional species like Gobhi sarson (*Brassica napus*), White mustard (*Brassica alba*) and Ethiopian mustard (*Brassica carinata*). It is the most important group of rabi oil seed crop and contribute a major share to the vegetable fat economy of the country. In India, seven edible oilseed crops groundnut, rapeseed and mustard, soybean, sunflower, niger, sesame, and safflower as well as two non-edible oilseed crops linseed and castor, provide more than 80% of the country's needs for vegetable oil and fats. It has 5 different ecotypes, which are under commercial cultivation, *viz.* brown seeded toria, yellow seeded toria. Lotni types brown sarson (cross pollinated), toria type brown sarson and yellow sarson. Out of these ecotype, brown season is the oldest form of *B. rapa* from which yellow season (mutant for seed color) and toria (selection for early materials have been evolved.

India is a key player in the world edible oils market accounting for around 7% share of production, 12% share of consumption and 20% share of the world edible oils imports during 2016-17 (USDA, 2018). India is one of the important among the 3rd leading oilseed producing countries of the world after Canada and China. Rapeseed-mustard production in the world in 2020–21 totaled 73.61 million tons over an area of about 34.6 million ha, with an average productivity of 1980 kg ha^{-1} (Anonymous, 2020-21). India accounts for 19.8% and 9.8% of the world's total acreage and production, respectively (USDA). In the past year, productivity climbed dramatically, going from 1840 kg/ha in 2010–11 to 1980 kg/ha in 2018–19 and production also increased, going from 61.64 metric tons in 2010–11 to 72.41 metric tons in 2018–19.

The oil content in mustard seeds varies from 37-49 percent Bhowmik *et al.* (2014), the seeds are highly nutritive containing 38-57 % erucic acid, and 27% oleic acid. The oil cake that remains after extraction is used as cow feed and manure, and it contains 5.1% N, 1.8% P_2O_5, and 1.1% K_2O. The seed is used as a condiment in the preparation of pickles and for flavoring curries and vegetables. The oil is utilized for human consumption throughout the northern India for cocking purpose. This is a potential crop in winter (*Rabi*) season due to its wider adaptability and suitability to exploit residual moisture Mukherjee (2010). Oil and fats comprise a vital component of human diet as these are good source of energy and act as carriers of fat-soluble vitamins. Oil cake or meal has high nutritional values in animal diet. Seed owing to its high content of good quality protein. In general, 55g edible oil per day head is essential for human diet.

Balanced nutrient management through conjunctive use of organic (FYM, Vermicompost, PM) inorganic and biofertilizers facilitate profitable and sustainable crop production and maintain soil health Singh and Sinsinawa (2006). In terms of agronomic efficiency, each kilogram of Sulphur plays an important role for increasing oil content in oil seed crop, it increases the yield of mustard by 7.7 kg Katyal *et al.* (1997). Azotobacter plays an important role in increasing the availability of nitrogen to the plants and helps in boosting the production through nitrogen fixation. Similarly, Inoculation with Phosphate Solubilizing Bacteria (PSB) plays a pivotal role in supplementary phosphorus requirement of crop. Poultry manure and vermicompost are a good source of organic matter and play a vital role in improving soil fertility and contains higher nitrogen and phosphorus Zamil *et al*. (2004) showed better performance in producing seed yield of mustard.

Materials and Methods

The experiment was carried out at the Agronomy Research Farm of the Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) India. The research farm is situated at a distance of about 42 km in south-east from Ayodhya on Ayodhya-Raebareli Road. Geographically, experimental site falls under the sub-tropical zone and located at 26^0 47 N latitude, 82^0 12 E longitude and an altitude of 113 meters above mean sea level and is subjected to extremes of weather conditions. The experiment was laid in uniform topography and well-drained soil which had invariably poor fertility status and saline-alkaline condition. The average annual rainfall is about 1073 mm and out of which about 80 percent is received by south-west monsoon while annual potential evapotranspiration is about 1667 mm. The actual rainfall during the period of investigation in the cropping year 2021-22 was only 25.8 mm. The dry spell prevailed in the mid vegetative growth periods. The experiment was laid out in Randomized Block Design with Three replications and Eleven treatments i.e. **T_1:** Control, **T_2:** 100% RDF (Inorganics), **T_3:** 100% RDN (Bio compost) + PSB, **T_4:** 100% RDN (VC) + PSB, **T_5:** 75% RDF + 25% RDN (Bio compost) + 40 kg S, **T_6:** 75% RDF + 25% RDN (VC) + 40 kg S, **T_7:** 50% RDF + 50% RDN (Bio compost) + 60 kg S, **T_8:** 50% RDF + 50% RDN (VC) + 60 kg S, **T_9:** 50% RDN (Bio compost) + 50% RDN (VC) + 60 kg S, **T_{10}:** 75% RDN (Bio compost) + 25% RDN (VC) + PSB, **T_{11}:** 75% RDN (VC) + 25% RDN (Bio compost) + PSB. The observation was recorded on various characters: Plant population, Plant Height. Leaf area index, Number of branching, Days taken to 50% flowering, Days taken to 50% maturity, Number of siliquae per plant, Number of seed per siliqua, Length of siliqua, Test weight, Grain yield, Stover yield, biological yield and Harvesting index.

Result and Discussion

Initial plant population meter^{-2} at 20 DAS

The maximum plant population (33.0 m^{-2}) in counted with the application of 75% RDF + 25% RDN (VC) + 40 kg S and the minimum plant population (30.0 m^{-2}) under control. The taller plant was obtained with the application of (75% RDF + 25% RDN (VC) + 40 kg S), which was at par with the application of T_5 (75% RDF + 25% RDN (Bio compost) + 40 kg S) all the growth stages except 30 DAS. While it was significantly over rest of the treatments at all the growth stages except 30 DAS.

Plant height (cm)

Data pertaining to plant height (cm) as influenced by different treatments of integrated nutrient management at 30, 60, 90 DAS and at harvest are presented in Table 1. The data revealed the significant influenced of various treatments at all stages except at 30 DAS, wherein, treatment failed to exert any significant impact on plant height. The maximum plant height was obtained with the application of $\mathbf{T_6}$ (75% RDF + 25% RDN (VC) + 40 kg S) at 30, 60, 90 DAS and at harvest in 24.20 cm, 74.60 cm, 156.66 cm, 189.56 cm respectively. The lowest plant height was obtained in all stages in treatment $\mathbf{T_1}$. which was at par with the application of $\mathbf{T_5}$ (75% RDF + 25% RDN (Bio compost) + 40 kg S) all the growth stages except 30 DAS. While it was significantly over rest of the treatments at all the growth stages except 30 DAS. Plant height is an important vegetative character as it is an index of plant growth and vigor. Increasing rate of plant height has been noticed between 30 to 60, 90 DAS. It is mainly acquired by the genetic make-up while it is also affected by integrated nutrient management. These beneficial effects might have been derived due to combined application of chemical fertilizers and organic manure which satisfied the immediate requirement of nutrients and provided favorable soil environment for better plant growth. Similar results were also reported by Jain and Sharma (2000).

Leaf area index (LAI)

Data on progressive leaf area index at the successive stage of crop growth as influenced by integrated nutrient management are summarized in Table 1. in general, leaf area index was increased at higher rate up to 60 days after sowing and then increased at slowest rate up to 90 DAS during investigation. However, the leaf area index at different fertility levels was significantly affected. The maximum leaf area index 1.69, 4.70 and 3.76 at 30, 60, 90 DAS respectively under $\mathbf{T_6}$ (75 % RDF+ 25% RDN (VC)+ 40 kg S), which was followed by $\mathbf{T_5}$ (75 % RDF + 25% RDN (Bio compost) + 40 kg S). The lowest leaf area index was obtained in all stages in treatment $\mathbf{T_1}$. however, it was significantly higher over rest of the treatments at 60 and 90 DAS, except 30 DAS. The beneficial effect of chemical fertilizers with FYM, Zn and seed treatment on plant height and leaf area index was also reported by several researchers in mustard (Singh and Pal, 2011, Tripathi *et al.,* 2010).

Table 1 : Plant population at 20 DAS, plant height, leaf area index as influenced by integrated nutrient management (INM).

Treatments	Plant population at 20 DAS	Plant height				Leaf area index		
		30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS
$\mathbf{T_1}$ - Control	30.00	22.40	58.60	120.13	138.15	1.57	3.60	2.88
$\mathbf{T_2}$ - 100% RDF (80:60:40 kg NPK ha^{-1})	32.00	23.90	69.30	147.00	177.87	1.67	4.41	3.35
$\mathbf{T_3}$ - 100% RDN (Bio compost) + PSB	31.60	22.60	60.70	127.47	154.24	1.58	3.82	3.06
$\mathbf{T_4}$ - 100% RDN (VC) + PSB	32.00	22.70	61.30	128.73	155.76	1.59	3.86	3.09
$\mathbf{T_5}$ - 75% RDF + 25% RDN (Bio compost) + 40 kg S ha^{-1}	32.60	24.00	71.90	149.52	180.92	1.68	4.49	3.59
$\mathbf{T_6}$ - 75% RDF + 25% RDN (VC) + 40 kg S ha^{-1}	33.00	24.20	74.60	156.66	189.56	1.69	4.70	3.76
$\mathbf{T_7}$ - 50% RDF + 50% RDN (Bio compost) + 60 kg S ha^{-1}	31.00	23.50	66.40	139.44	168.72	1.65	4.18	3.35
$\mathbf{T_8}$ - 50% RDF + 50% RDN (VC) + 60 kg S ha^{-1}	32.20	23.60	67.20	141.12	170.76	1.65	4.23	3.39
$\mathbf{T_9}$ - 50% RDN (Bio compost) + 50% RDN (VC) + 60 kg S ha^{-1}	30.60	23.20	64.50	136.08	164.66	1.62	4.08	3.27
$\mathbf{T_{10}}$ - 75% RDN (Bio compost) + 25% RDN (VC) + PSB	31.00	22.90	62.40	131.04	158.56	1.60	3.93	3.14
$\mathbf{T_{11}}$ - 75% RDN (VC) + 25% RDN (Bio compost) + PSB	32.00	23.10	64.00	134.40	162.62	1.62	4.03	3.23
SEm ±	0.51	0.33	0.92	2.57	3.02	0.02	0.06	0.05
CD at 5 %	NS	NS	2.72	7.58	8.92	NS	0.19	0.15

Number of branches plant^{-1}

The data pertaining to number of primary branches plant^{-1} at various stages have been presented in Table 2. The data revealed that the integrated nutrient management had significant influence on number of branches plant^{-1} of mustard. It was evident from the data that treatment $\mathbf{T_6}$ (75% RDF + 25% RDN from vermicompost + 40 kg S) recorded significantly maximum total number of branches (2.40, 19.60 and 24.50) at 30, 60, 90 DAS per plant respectively. however, it was found at par with treatment of $\mathbf{T_5}$ (75% RDF + 25% RDN (Bio compost) + 40 kg S $ha^{-1)}$ and $\mathbf{T_2}$ (100% RDF (80:60:40 kg NPK ha^{-1}) respectively and significantly higher over rest of treatments. Except 30 DAS. Also reported the similar results Singh and Kumar (2014).

Days taken to 50% flowering

Data pertaining to days taken to 50 per cent flowering of mustard as significantly affected by integrated nutrient management has been presented in Table 2. It is clear from the data that days taken to 50 per cent flowering increased when applied **T_6** (75% RDF + 25% RDN (VC) + 40 kg S ha^{-1}). Followed by **T_5, T_2, T_8, T_7, T_9, T_{11}, T_{10}.** All the treatment found non-significant in respect to 50% flowering. Days taken to 50% flowering did not influence significantly by different sources of integrated nutrient management (INM). The maximum value (63.0) of days taken to flowering was observed with the application of **T_6** (75% RDF + 25% RDN (VC) + 40 kg S ha^{-1}) and minimum value under treatment **T_1** Control. also reported the similar results Kumar and Kumar (2008).

Days taken to 50% maturity

The observation from data Table- 2. has been presented days taken to 50% maturity did not affect significantly by the application of integrated nutrient management. The maximum value of days taken to 50% maturity was observed 148.60 with the application of **T_6** (75% RDF + 25% RDN (VC) + 40 kg S ha^{-1}) followed by **T_5** (75% RDF + 25% RDN (Bio compost) + 40 kg S ha^{-1}), **T_2** (100% RDF (80:60:40 kg NPK ha^{-1}) and **T_8.** And minimum under **T_1** Control. Days taken to 50 per cent flowering and maturity increased with integrated nutrient management however of Sulphur had no effect on days taken to 50 per cent flowering and maturity of mustard. The earliness in flowering was probably since the Sulphur is closely related to rapid cell division and early development of plant. The days taken to maturity were not influenced by different sources of integrated nutrient management also reported the similar results Kumar and Kumar (2008).

Table 2 : Total number of branches, days taken to 50% flowering and days taken to maturity as influenced by integrated nutrient management.

Treatments	Total number of branches			Days taken to 50% flowering	Days taken to 50% maturity
	30 DAS	60 DAS	90 DAS		
T_1 - Control	2.20	11.20	13.40	56.00	134.40
T_2 - 100% RDF (80:60:40 kg NPK ha^{-1})	2.40	18.40	23.00	62.20	146.80
T_3 - 100% RDN (Bio compost) + PSB	2.20	15.90	19.90	58.80	138.80
T_4 - 100% RDN (VC) + PSB	2.25	16.10	20.10	59.00	139.20
T_5 - 75% RDF + 25% RDN (Bio compost) + 40 kg S ha^{-1}	2.36	18.70	23.40	62.40	147.20
T_6 - 75% RDF + 25% RDN (VC) + 40 kg S ha^{-1}	2.40	19.60	24.50	63.00	148.60
T_7 - 50% RDF + 50% RDN (Bio compost) + 60 kg S ha^{-1}	2.30	17.40	21.80	61.20	144.40
T_8 - 50% RDF + 50% RDN (VC) + 60 kg S ha^{-1}	2.33	17.60	22.00	61.40	145.00
T_9 - 50% RDN (Bio compost) + 50% RDN (VC) + 60 kg S ha^{-1}	2.30	17.00	21.30	60.20	142.00
T_{10} - 75% RDN (Bio compost) + 25% RDN (VC) + PSB	2.25	16.40	20.50	59.40	140.20
T_{11} - 75% RDN (VC) + 25% RDN (Bio compost) + PSB	2.28	16.80	21.00	60.00	141.60
SEm ±	0.03	0.27	0.40	1.06	2.29
CD at 5 %	NS	0.80	1.17	NS	NS

Number of siliques plant^{-1}

The number of siliquae plant^{-1} of mustard as affected significantly by integrated nutrient management presented in Table- 3. The data presented in table clearly indicates that number of siliquae plant^{-1} increased with the dose of integrated nutrient management. The maximum number of siliquae plant^{-1} (356.8) was recorded with application of **T_6** (75% RDF + 25% RDN (VC) + 40 kg S ha^{-1}) which was being at par with **T_5** 75% RDF + 25% RDN (Bio compost) + 40 kg S, of 348.80 and **T_2** 100% RDF (80:60:40 kg NPK ha^{-1}) of 345.60. and however minimum value of number of siliquae plant^{-1} (201.6) was counted **T_1** Control. Similar results were also reported by Kansotia *et al.* (2015)

Number of seeds siliqua^{-1}

The data presented in Table 3. indicated that the number of seeds siliqua^{-1} were affected significantly by various treatments. the maximum number of seeds siliqua^{-1} 15.80 seed per siliqua were observed with **T6** 75% RDF + 25% RDN (VC) + 40 kg S ha^{-1} which statically at par with **T_2** 100% RDF (80:60:40 kg NPK ha^{-1}) and **T_5** 75% RDF + 25% RDN (Bio compost) + 40 kg S ha^{-1} treatments respectively and significantly were over rest of the treatments. And the lowest number of seed per siliqua has been recorded 10.40

under the treatment of T_1 Control. Similar results were also reported by Saini *et al.* (2020).

Length of siliqua (cm)

The data pertaining to length of siliqua of mustard as affected by integrated nutrient management has been presented in Table-3. It is crystal clear from the data that length of siliqua increased as different sources of integrated nutrient management. The maximum length of siliqua of mustard was recorded 8.20 cm with the application of T_6 75% RDF + 25% RDN (VC) + 40 kg S ha^{-1} which was being at par with T_5 75% RDF + 25% RDN (Bio compost) + 40 kg S ha^{-1} and T_2 100% RDF (80:60:40 kg NPK ha^{-1}) treatments and statically superior over rest of the treatments. remaining found significant. And the lowest number of seed per siliqua has been recorded 7.00 under the treatment of T_1 Control. Similar results were also reported by Verma *et al.* (2012).

Test weight (1000 grain weight) (g)

The data present in Table- 3. revealed that test weight of mustard grains was affected significantly. The Maximum test weight (5.0 g) was recorded with application of T_6 (75% RDF + 25% RDN (VC) + 40 kg S). Which was being at par with treatments T_5 75% RDF + 25% RDN (Bio compost) + 40 kg S ha^{-1}. and T_2 100% RDF (80:60:40 kg NPK ha^{-1}) respectively and significantly higher over rest of the treatments. The application of 75% RDF + 25% RDN (VC) + 40 kg S recorded significantly higher test weight. This might be due to the adequate supply of nutrient, and better soil condition. Which increased photosynthesis, cell division, assimilation, and promoted the metabolized activities of plant ultimately increased the growth of plant and yield attribute. also reported similar results Jakhar and Singh (2004).

Table 3: Yield attributes of mustard as influenced by integrated nutrient management (INM).

Treatments	Number of siliquae plant^{-1}	Number of seeds siliqua^{-1}	Length of siliqua (cm)	Test weight (g)
T_1 - Control	201.60	10.40	7.00	4.55
T_2 - 100% RDF (80:60:40 kg NPK ha^{-1})	345.60	15.20	8.05	4.92
T_3 - 100% RDN (Bio compost) + PSB	243.20	12.00	7.35	4.56
T_4 - 100% RDN (VC) + PSB	252.80	12.10	7.40	4.60
T_5 - 75% RDF + 25% RDN (Bio compost) + 40 kg S ha^{-1}	348.80	15.40	8.15	4.98
T_6 - 75% RDF + 25% RDN (VC) + 40 kg S ha^{-1}	356.80	15.80	8.20	5.00
T_7 - 50% RDF + 50% RDN (Bio compost) + 60 kg S ha^{-1}	299.20	12.30	7.70	4.78
T_8 - 50% RDF + 50% RDN (VC) + 60 kg S ha^{-1}	302.40	12.50	7.80	4.84
T_9 - 50% RDN (Bio compost) + 50% RDN (VC) + 60 kg S ha^{-1}	286.40	12.20	7.66	4.75
T_{10} - 75% RDN (Bio compost) + 25% RDN (VC) + PSB	259.20	12.10	7.55	4.68
T_{11} - 75% RDN (VC) + 25% RDN (Bio compost) + PSB	268.80	12.20	7.60	4.71
SEm ±	5.39	0.21	0.12	0.06
CD at 5 %	15.91	0.63	0.37	0.18

Grain yield (qha^{-1})

The data regarding seed yield of mustard as significantly influenced due to integrated nutrient management are presented in Table 4. It was clearly shown from the result that the differences in seed yield due to various sources of integrated nutrient management. The maximum Grain yield (22.30 q ha^{-1}) of mustard recorded under the treatment T_6 (75% RDF + 25% RDN (VC) + 40 kg S), and the lowest Grain yield was recorded (12.60 q ha^{-1}) in treatment T_1 Control. However, it was at par with treatments T_5 75% RDF + 25% RDN (Bio compost) + 40 kg S ha^{-1} and T_2 100% RDF (80:60:40 kg NPK ha^{-1}) respectively. The increased in the seed yield, stover yield might be due to the essential role of boron in reproductive growth of plant, while Sulphur attributed to the stimulatory effect in cell elongation and cell division setting of cell structure and also higher dose of Sulphur may be responsible for increased leaf area and chlorophyll content causing higher photosynthesis and assimilation of metabolic activities might be responsible for overall reproductive phase and ultimately improved seed yield, stover yield of mustard. The results are corroborated with Lepcha *et al.* (2015).

Stover yield (qha^{-1})

The data pertaining to stover yield of mustard as influenced by different treatments are presented in Table 4. Result revealed that the differences in stover yield were found significant due to different treatments. The maximum stover yield (72.2 q ha^{-1}) of mustard was recorded under treatment T_6 (75% RDF + 25% RDN (VC) + 40 kg S) and lowest stover yield was recorded (46.0 q ha^{-1}) in treatment $\mathbf{T_1}$ Control it remains at par with treatments $\mathbf{T_5}$ 75% RDF + 25% RDN (Bio compost) + 40 kg S ha^{-1} and $\mathbf{T_2}$ 100% RDF (80:60:40 kg NPK ha^{-1}) treatments. And significantly higher over rest of other treatments. Similar results were also reported by Chand (2007).

Biological yield (qha^{-1})

The data presented in table 4. showed marked influences of integrated nutrient management on biological yield. It is crystal clear from the data that biological yield increased as the dose of $\mathbf{T_6}$ (75% RDF + 25% RDN (VC) + 40 kg S ha^{-1}). The biological yield of mustard was maximum (94.50 q ha^{-1}) with application of $\mathbf{T_6}$ (75% RDF + 25% RDN (VC) + 40 kg S ha^{-1}). which was being at par with $\mathbf{T_5}$ 75% RDF + 25% RDN (Bio compost) + 40 kg S $ha^{-1}$and $\mathbf{T_2}$ 100% RDF (80:60:40 kg NPK ha^{-1}) treatments respectively and found significantly superior over rest of the treatments. Similar results were also reported by Jat *et al*. (2015).

Table 4 : Yields and harvest index (HI) of mustard as influenced by integrated nutrient management (INM).

Treatments	Grain yield (qha^{-1})	Stover yield (qha^{-1})	Biological yield (qha^{-1})	Harvest index (%)
$\mathbf{T_1}$ - Control	12.60	46.00	58.60	21.50
$\mathbf{T_2}$ - 100% RDF (80:60:40 kg NPK ha^{-1})	21.60	70.12	91.72	23.55
$\mathbf{T_3}$ - 100% RDN (Bio compost) + PSB	15.20	50.00	65.20	23.31
$\mathbf{T_4}$ - 100% RDN (VC) + PSB	15.80	51.87	67.67	23.35
$\mathbf{T_5}$ - 75% RDF + 25% RDN (Bio compost) + 40 kg S ha^{-1}	21.80	70.70	92.50	23.57
$\mathbf{T_6}$ - 75% RDF + 25% RDN (VC) + 40 kg S ha^{-1}	22.30	72.20	94.50	23.60
$\mathbf{T_7}$ - 50% RDF + 50% RDN (Bio compost) + 60 kg S ha^{-1}	18.70	61.05	79.75	23.45
$\mathbf{T_8}$ - 50% RDF + 50% RDN (VC) + 60 kg S ha^{-1}	18.90	61.50	80.40	23.51
$\mathbf{T_9}$ - 50% RDN (Bio compost) + 50% RDN (VC) + 60 kg S ha^{-1}	17.90	58.55	76.45	23.41
$\mathbf{T_{10}}$ - 75% RDN (Bio compost) + 25% RDN (VC) + PSB	16.20	53.10	69.30	23.38
$\mathbf{T_{11}}$ - 75% RDN (VC) + 25% RDN (Bio compost) + PSB	16.80	55.00	71.80	23.40
SEm ±	0.27	1.01	1.30	0.36
CD at 5 %	0.80	3.00	3.85	NS

Harvest index (%)

The data containing to harvest index as influenced due to different integrated nutrient management are presented in Table 4. It was evident from the result that various treatments had failed to exert any significant influenced on the harvest index of mustard. The maximum harvest index (23.60 %) was recorded with the application of $\mathbf{T_6}$ 75% RDF + 25% RDN (VC) + 40 kg S ha^{-1} followed by $\mathbf{T_5}$ 75% RDF + 25% RDN (Bio compost) + 40 kg S ha^{-1}, $\mathbf{T_2}$ 100% RDF (80:60:40 kg NPK ha^{-1}) and $\mathbf{T_7}$ 50% RDF + 50% RDN (Bio compost) + 60 kg S ha^{-1} and minimum under control **($\mathbf{T_1}$).**

Conclusion

Application of $\mathbf{T_6}$ 75% RDF + 25% RDN (VC) + 40 kg S was found most suitable for achieving maximum growth, yield and oil content in Indian mustard as compared to other integrated nutrient management doses. Among the integrated nutrient management practices, application of 75% RDF + 25% RDN (VC) + 40 kg S recorded a greater number of siliquae palnt^{-1}, number of seed siliqua^{-1}, length of siliqua, test weight and yield. which was found at par with the application of $\mathbf{T_5}$ 75% RDF + 25% RDN (Bio compost) + 40 kg S.

References

Anonymous (2020-21). ICAR- Directorate of rapeseed-mustard research (*Indian council of agriculture research*) Sewar, Bharatpur (Rajasthan).

Bhowmik, B.; Mitra, B. and Bhadra, K. (2014). Diversity of insect pollinators and their effect on the crop yield of *Brassica juncea* L., NPJ-93, from Southern West Bengal. *International Journal of Recent Scientist Research,* **5**(6),1207-1213.

Chand, S. (2007). Effect of integrated nutrient management on yield and nutrient use efficiency in mustard (*Brassica juncea* L.). *SAARC Journal of Agriculture*, **5,** 93-100.

Jain, N.K. and Sharma, P.P. (2000). Integrated nutrient management in mustard. *J. oilseeds Res.,* **17** (1), 127-129.

Jakhar, S.R. and Singh, M. (2004). Residual effect of FYM, phosphorus and zinc levels on growth, yield, and quality of mustard. *Journal of Eco-Physiology*, **7,** 129- 136.

Jat, G.; Sharma, K.K., and Choudhary, R. (2015). Effect of FYM and mineral nutrients on yield, content, and uptake of nutrients in mustard. *Annals of Agricultural Research*, **34**(3).

Kansotia, B.C., Sharma, Y., Meena, R.S., Reager, M.L., & Dadhich, R.K. (2015). Effect of vermicompost and inorganic fertilizers on growth, yield, and quality of Indian mustard. *Bioinfolet-A Quarterly Journal of Life Sciences*, **12**(1a), 35-38.

Katyal, J.C., Sharma, K.L., Srinivas, K. (1997). Sulphur in Indian agriculture, Proc. TSI/ FAI/ IFA Symposium on Sulphur in balanced fertilization, ppKS-2/1-2/12.

Kumar, A. and Kumar, S. (2008). Crop growth rate and developmental characteristics of Indian mustard var Vardan to varying levels of nitrogen and Sulphur. *Indian Journal of Agriculture Research,* **42,** 112-15.

Lepcha, S., Moinuddin and Bhujel, K. (2015). Influence of Different Organic and Inorganic Sources of Nitrogen on Growth, Yield and Oil Content of Indian Mustard (*Brassica juncea* L.) Czernj & Cosson, *Journal of International Academic Research for Multidisciplinary*. **3**(11).

Mukherjee, D. (2010). Productivity, profitability, and apparent nutrient balance under different crop sequence in mid- hill condition. *Indian Journal of Agricultural Sciences*, **80**(5),420-22.

Saini, L.B., Kakraliya, M. and Kumar, P. (2020). Effects of Different Levels of NPK and Sulphur on Growth and Yield Attributes of Rapeseed (Brassica campestris var. toria). *Journal homepage, http,//www. ijcmas. com*, **9**(9), 2020.

Singh, M. and Kumar, M. (2014). Effect of nitrogen and Sulphur levels on seed yield and some other characters in mustard (*Brassica juncea* L.), *International Journal of Agricultural Sciences*, **10**(1), 449-452.

Singh, R. and Sinsinawa, B.S. (2006). 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*, **76,** 322-324.

Singh, S.P. and Pal, M.S. (2011). Effect of integrated nutrient management on growth performance of mustard (*Brassica juncea*). *Indian Journal of Agronomy*, **56,** 381-387.

Tripathi, M.K., Chaturvedi, S., Shukla, D.K. and Mahapatra, B.S. (2010). Yield performance and quality in Indian mustard as influenced by integrated nutrient management. *Indian J. Agron*., **55**(2), 138-141.

Verma, C.K., Prasad, K. and Yadav, D.D. (2012). Studies on response of Sulphur, zinc and boron levels on yield, economics, and nutrients uptake of mustard (*Brassica juncea* L.). *Crop Research*, **44**(1/2),75-78.

Zamil, S.S., Quadir, F.Q., Choudhary, M.A.H., Al-Adnan, W. (2004). Effect of different animal manures on yield, quality, and nutrient uptake by mustard. CV *Agrani. BRAC University Journal,* **1**(2), 59-66.