Effect of Integrated Nutrient Management (INM) Modules on yield, yield attributes and profitability of Indian mustard [*Brassica juncea* (L.)] in Western UttarPradesh

Abstract

A field experiment was conducted to study the effect of integrated nutrient management (INM) modules on indian mustard (*Brassica juncea* L.) in Western U.P., variety Pusa Vijay at Crop Research Centre (CRC), Main Campus, Modipuram Meerut, during *Rabi* season, 2020-21. The soil of experimental field was sandy loam texture, alkaline in nature with pH, low in organic carbon (0.42%) and available nitrogen (181.60 kg/ha), available phosphors (16.50 kg/ha), available potassium (230.47 kg/ha) and available sulphur (7.38 kg/ha). Ten treatments of different nutrient management practices consisting T_1 Control, T_2 100% RDN (120 kg. N/ha), T_3 75% RDN, T_4 75% RDN + 25% through Vermicompost (VC), T_5 75% RDN + 25% through Poultry Manure (PM), T_6 75% RDN + 25% through Press Mud Compost (PMC), T_7 75% RDN + 25% through [VC , PM (1:1)], T_8 75% RDN + 25% through [VC, PMC (1:1)], T_9 75% RDN + 25% through [PM , PMC (1:1)], T_{10} 75% RDN + 25% through [VC , PM, PMC (1:1:1)] were tested in randomized block design with three replications. The experimental results revealed that yield attributes (siliqua length, siliqua plant^{-1}, seeds siliqua^{-1} and test weight), grain and stover yield (q ha^{-1}). The increment in seed yield with application of 75% RDN + 25% through [VC, PM, PMC (1:1:1)] was 130.98 % over control. The maximum gross return and net return were recorded with the application of 75% RDN + 25% through [VC, PM, PMC (1:1:1)], however B:C ratio was lower than the use of RDF only but in application of vermicompost, press mud compost and poultry manure enhance soil fertility which improve the productivity and productivity of mustard.

Key words: Integrated Nutrient Management (INM) Modules, Yield, Yield attributes, Profitability

1. INTRODUCTION

Rapeseed and mustard are the major *Rabi* oilseed crops of India and stand next to groundnut in the oilseed economy, it is an important oilseed crops of the family Cruciferae and occupy a prominent place among the leading oilseed crops being next to groundnut both in area and production, meeting the fat requirement of about 50 per cent population in the state of Uttar Pradesh, Punjab, Rajasthan and Assam (Thaneshwar et al., 2017). Oilseeds, the second largest agricultural commodity after cereals in India, play a significant role in India's agrarian economy, sharing 14% of the gross cropped area and accounting for nearly 1.5% of the gross national production and 8% of the value of all agricultural products. The gap in supply is being met through huge imports costing more than Rs. 26000 crores during 2009-10 **(Hegde and Sudhakara, 2011).** It is cultivated over an area of about 65.17 lakh hectares with production of 57.4 lakh tonnes of seed in India. The average yield of mustard is 1234 kg/ha in 2014-15 and it is cultivated over an area of about 5.8 million hectare with production 6.3 million tons in 2014-2015 In India. In Uttar Pradesh, mustard is grown on 0.82 million hectare area with production of 0.90 million tones and productivity of 1141 kg/ha. **(Anonymous, 2015).** Identification of the critical inputs to enhance the mustard production is need of hour. Apart from improved varieties and judicious irrigation, use of balanced fertilizers is critical for realizing higher yield. Indian soils are becoming deficient in N, P, and K along with S, Zn, and B due to intensive cultivation and use of high analysis fertilizers. Under such situation organic manures can be exploited to boost the soil health condition vis-

à-vis production of crops and to improve fertilizer use efficiency. Nitrogen is the most important nutrient, which determines the growth of the mustard crop and increases the amount of protein and yield. Phosphorus and potash are known to be efficiently utilized in the presence of nitrogen. Nitrogen promotes flowering, setting of siliqua and increase the size of siliqua and yield **(Singh and Meena, 2004)**. Balanced combination of FYM, biofertilizers and chemical fertilizers facilitate profitable and sustainable production **(Singh and Sinsinwar, 2006)**. The integrated plant nutrient management is maintenance or adjustment of soil fertility and plant nutrient supply to an optimum level for sustaining desired crop production through optimization of benefits from all possible sources of plant nutrients. Various sources of plant nutrients such as organic manures, fertilizers and bio-fertilizers were applied in integrated manner to enhance the productivity of mustard crop **(Chand, 2007).** Fertilizers are very important sources of plant nutrients for increasing agricultural production. The mineral fertilizer could supply one or two nutrients but integrated use of macro- and micro-nutrient fertilizers and organic residues would provide N, P, K, S, Zn, Fe and B to plant and soil and resist occurrence of multiple nutrient deficiencies. The role of organic fertilizers in plant nutrition is now attracting the attention of agriculturists and soil scientists throughout the world. If sufficient quantity of organic manures is added along with mineral fertilizers then perhaps there would be no need of adding micronutrients **(Prasad *et al.*, 2009).**

The purpose of the current study was to investigate the response of Indian mustard (Brassica juncea L.) in terms of yield, yield attributes and profitability under different integrated nutrient management modules in Western Uttar Pradesh.

Material and method

The field experiment was conducted at CRC farm of the Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (Uttar Pradesh), lies on national highway 58 and is at a distance of 70 km from Delhi. The weekly mean maximum temperature during crop growing period varied between 34.4^{0}C to 18.2^{0}C, whereas the mean minimum temperature was between 5.9 ^{0}C to 20.7 ^{0}C. The area receives mean annual rainfall of 845 mm, of which more than 80% is in the month of July- September through south-west monsoon. The mean relative humidity during crop period varied between 94.8 to 26.5 per cent. Before sowing of mustard, soil samples to a depth of 0-15 cm were taken randomly from 10 places in the experimental field. The collected samples were mixed homogenously and a composite soil sample was drawn, air dried, powdered and allowed to pass through 2 mm sieve for analyses of soil physical and chemical properties. The soil of experimental site was sandy loam in texture, low in available nitrogen and organic carbon, available phosphorus and potassium and slightly alkaline in reaction. The predominant soil at the experimental site is classified as *Typic Ustochrept* with sandy-loam texture having pH 8.25, bulk density 1.49 g/cm^3, low organic carbon content (0.42%), Soil samples for 0–15 cm depth at the site were collected and tested prior to applying treatments and the basic properties were low available nitrogen, low organic carbon, available phosphorus, available potassium medium and alkali in reaction. The gross and net plot size were 5.1 x 4.3 m^2 and 4.1 x 2.7 m^2, respectively. In order to find out the best nutrient treatment in mustard, field investigation was carried out with ten treatments. Experiment was laid out randomized block design with three replications. Ten nutrient management treatments (T_1) Control, (T_2) 100% RDN recommended dose of nitrogen (120 kg N/ha), (T_3) 75 % RDN, (T_4) 75% RDN + 25% through Vermicompost (VC),

(T_5) 75% RDN + 25% through Poultry Mannure (PM), (T_6) 75% RDN + 25% through Press Mud Compost (PMC), (T_7) 75% RDN + 25% through [VC , PM (1:1)], (T_8) 75% RDN + 25% through [VC , PMC (1:1)], (T_9) 75% RDN + 25% through [PM , PMC (1:1)], (T_{10}) 75% RDN + 25% through [VC , PM, PMC (1:1:1)] were used for the experimentation. Plant-to-plant distance was maintained 45 cm and row to row spacing of 15 cm respectively. NPK was applied 120, 60, 40 kg/ha at the time of seed bed preparation as per recommendation. To ensure proper germination, field was prepared after *pre-sowing* irrigation and subsequent irrigation was given as per crop requirement. Economics of treatments was computed on the basis of prevailing market price of inputs and outputs under each treatment. The total cost of cultivation of crop was calculated on the basis of different operations performed and materials used for raising the crop including the cost of fertilizers and seeds. The cost of labour incurred in performing different operations was also included. Statistical analysis of the data was done as per the standard analysis of variance technique for the experimental designs following SPSS software based programme, and the treatment means were compared at $P<0.05$ level using t-test and calculating CD values.

Result and discussion

Yield attributes

The maximum length of siliqua (6.15 cm) was recorded in T_{10} (75% RDN + 25% through [VC, PM, PMC (1:1:1)], which remained statistically at par with T_9 (75% RDN + 25% through [PM, PMC (1:1)]) but significantly higher than rest of the treatments. The minimum (4.21 cm) length of siliqua was noted in T_1 (control). Number of siliqua plant^{-1} ranged from 175.30 to 318.70 under different treatments. The significantly maximum number of siliqua plant^{-1} 318.70 recorded in T_{10} (75% RDN + 25% Through [VC, PM, PMC (1:1:1)], over than rest of the treatments which was statistically at par with T_9 and T_7 respectively. The treatments T_{10} (318.70) recorded 81.80% higher number of siliqua plant^{-1} and the lowest was noticed in T_1 (control) respectively.

The maximum number of seed siliqua^{-1} (11.40) was found in T_{10} (75% RDN + 25% through [VC, PM, PMC (1:1:1)], which was significantly superior to rest of the treatments. The treatment T_{10} (11.40) recorded 52.00% more number of seed siliqua^{-1}. The minimum number of seed siliqua^{-1} was noticed in T_1 (control).

Table 1 Effect of Integrated Nutrient Management (INM) Modules on yield attributes of mustard

S.No.	Treatments	Length of siliqua (cm)	No. of siliqua plant^{-1}	Seed siliqua^{-1}	1000 seed weight (g)
T_1	Control	4.21	175.30	7.50	4.15
T_2	100% RDN (120 kg N/ha)	4.85	209.89	9.65	4.55
T_3	75% RDN	4.56	205.10	8.75	4.25
T_4	75% RDN + 25% through Vermicompost (VC)	5.06	241.66	9.86	4.63
T_5	75% RDN + 25% through Poultry Manure (PM)	5.65	296.60	10.11	4.90

T_6	75% RDN + 25% through Press Mud Compost (PMC)	5.36	262.40	9.90	4.72
T_7	75% RDN + 25% through [VC , PM (1:1)]	5.88	309.83	10.23	4.94
T_8	75% RDN + 25% through [VC, PMC (1:1)]	5.52	285.50	9.96	4.78
T_9	75% RDN + 25% through [PM , PMC (1:1)]	6.03	315.69	10.35	5.16
T_{10}	75% RDN + 25% through [VC , PM, PMC (1:1:1)]	6.15	318.70	11.40	5.25
	SEm ±	0.08	3.51	0.11	0.06
	CD (P= 0.05)	0.25	10.51	0.32	0.18

Test weight ranged from 4.15 to 5.25 g under different treatments. T_{10} 75% RDN + 25% through [VC , PM, PMC (1:1:1)] is significantly superior over rest of the treatments except T_9 (75% RDN + 25% Through [PM , PMC (1:1)]). Similar results have also been reported by **Mishra (2003), Premi *et al.* (2005) and Kumawat *et al.* (2014).**

Yield

The maximum seed yield (21.25 q ha^{-1}) was recorded in T_{10} (75% RDN + 25% Through [VC , PM, PMC (1:1:1)]) followed by T_9 (75% RDN + 25% through [PM, PMC (1:1)]. The seed yield obtained in T_{10} treatments was 130.98 percent higher than T_1. stover yield ranged from 39.40 to 70.90 q ha^{-1} under different treatments. The maximum stover yield 70.90 q ha^{-1} was recorded in T_{10} (75% RDN + 25% Through [VC , PM, PMC (1:1:1)]) followed by T_9 (75% RDN + 25% Through [PM, PMC (1:1)]) which was 79.95 percent higher than T_1. The minimum stover yield (39.40 q ha^{-1}) was noticed in T_1 (control).

Table 2 Effect of Integrated Nutrient Management (INM) Modules on yield (q ha^{-1}) and harvest index (%) of mustard

S.No.	Treatments	Seed Yield (q ha^{-1})	Stover yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest Index (%)
T_1	Control	9.20	39.40	48.40	19.01
T_2	100% RDN (120 kg N/ha)	14.65	57.93	72.58	20.65
T_3	75% RDN	12.96	53.14	66.10	19.61
T_4	75% RDN + 25% through Vermicompost (VC)	17.95	65.75	83.70	21.44
T_5	75% RDN + 25% through Poultry Manure (PM)	18.72	66.18	84.90	22.05
T_6	75% RDN + 25% through Press Mud Compost (PMC)	18.32	62.78	84.10	20.78
T_7	75% RDN + 25% through [VC , PM (1:1)]	18.98	66.09	85.07	22.31
T_8	75% RDN + 25% through [VC, PMC (1:1)]	18.45	65.86	84.31	21.88
T_9	75% RDN + 25% through [PM , PMC (1:1)]	20.40	67.85	89.10	22.89

T_{10}	75% RDN + 25% through [VC , PM, PMC (1:1:1)]	21.25	70.90	92.15	23.06
	SEm ±	0.20	0.96	0.85	0.37
	CD (P= 0.05)	0.61	2.88	2.54	1.10

The maximum biological yield (92.15 q ha^{-1}) was recorded in T_{10} 75% RDN + 25% through [VC , PM, PMC (1:1:1)], which was 90.39 percent higher than T_1. The minimum biological yield (38.69 q ha-1) was found in T_1 (control). The maximum harvest index recorded was in the treatment T10 75% RDN + 25% through [VC , PM, PMC (1:1:1)] followed by treatment T_9 75% RDN + 25% through [PM, PMC (1:1)]. The treatments T_9, T_7 and T_5 were at par with T_{10}. The minimum harvest index was noticed in T1 (control). Similar results have also been reported by **Tripathi et al. (2010), Kumar et al. (2011), Singh et al. (2012) and Neha et al. (2014).**

The maximum oil content in grain (40.58%) was found in T_{10} (75% RDN + 25% through [VC, PM, PMC (1:1:1)]), which was 26.02 percent highest than T_1 and remained statistically higher than all other treatments except treatment T_7 and T_9. The minimum oil content in grain (32.20%) was recorded in T_1 (Control).

Table 3 Effect of Integrated Nutrient Management (INM) Modules on oil content and protein content of mustard

S.No.	**Treatments**	**Oil content (%)**	**Protein content (%)**
T_1	Control	32.20	16.78
T_2	100% RDN (120 kg N/ha)	37.45	17.18
T_3	75% RDN	34.50	17.00
T_4	75% RDN + 25% through Vermicompost (VC)	37.60	17.35
T_5	75% RDN + 25% through Poultry Manure (PM)	38.70	17.78
T_6	75% RDN + 25% through Press Mud Compost (PMC)	38.10	17.43
T_7	75% RDN + 25% through [VC , PM (1:1)]	38.98	18.20
T_8	75% RDN + 25% through [VC, PMC (1:1)]	38.42	17.56
T_9	75% RDN + 25% through [PM , PMC (1:1)]	39.30	18.30
T_{10}	75% RDN + 25% through [VC , PM, PMC (1:1:1)]	40.58	18.58
	Control	0.58	0.26
	100% RDN (120 kg N/ha)	1.74	0.77

The protein content in grain was significantly affected by different treatments and ranged from 16.78 to 18.58% under different treatments. The maximum protein content in grain (18.58%) was found in T_{10} 75% RDN + 25% through [VC , PM, PMC (1:1:1)] than all other treatments except T_1 and T_9 respectively. The increament in protein content was 10.73 percent higher in T_{10} than T_1. The minimum protein content in grain 16.78% was recorded in T_1 (Control). Similar results have also been reported by **Kumar *et al.* (2011) and Singh *et al.* (2012).**

Economics

The maximum gross return (Rs. 108211) was obtained in T_{10} - 75% RDN + 25% through [VC , PM, PMC (1:1:1)] followed by T_8 (Rs 103840). The minimum gross return (Rs. 48590) was found in T_1 (control plot). The maximum net return (Rs. 72453) was obtained in T_{10} -75% RDN + 25% through [VC, PM, PMC (1:1:1)] followed by T_9 (Rs. 70636). The minimum net return (Rs. 25689) was found in T_1 (control plot).

Table 4. Effect of Integrated Nutrient Management (INM) Modules on economics of mustard

S.No.	Treatments	Cost of cultivation (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B: C ratio
T_1	Control	22901	48590	25689	1.12
T_2	100% RDN (120 kg N/ha)	28992	80012	51020	1.76
T_3	75% RDN	28800	67976	39176	1.36
T_4	75% RDN + 25% through Vermicompost (VC)	42875	92578	49703	1.16
T_5	75% RDN + 25% through Poultry Manure (PM)	31652	96071	64419	2.03
T_6	75% RDN + 25% through Press Mud Compost (PMC)	34146	93622	59476	1.74
T_7	75% RDN + 25% through [VC , PM (1:1)]	37263	97204	59941	1.61
T_8	75% RDN + 25% through [VC, PMC (1:1)]	37319	103840	57715	1.55
T_9	75% RDN + 25% through [PM , PMC (1:1)]	33204	95034	70636	2.12
T_{10}	75% RDN + 25% through [VC , PM, PMC (1:1:1)]	35758	108211	72453	2.03
	SEm ±	-	-	-	-
	CD (P= 0.05)	-	-	-	-

The highest benefit cost ratio (2.12) was recorded in T_9 75% RDN + 25% through [PM, PMC (1:1)] and the lowest benefit cost ratio (1.12) was found in T_1 (control). Similar results have also been reported by **Poornima *et al.* (2010), Tripathi *et al.* (2010**), **Verma *et al.* (2012) and Rohit *et al.* (2019)**

Conclusion

On the basis of results obtained from the current study, it may be concluded that the application of only RDF fertilizers is not capable of exploiting the potential of the *Brassica juncea L.* in sustainable manner. Therefore, addition of supplementary nutrients like

Vermicompost, Poultry manure and Pressmud compost are essential to get higher production and productivity. In the present study, the combination of 75% RDN + 25% through [VC, PM, PMC (1:1:1)] found to be more promising for boosting the productivity and profitability of mustard. For the confirmation of present findings the experiment need to be repeated for few more years to draw definite conclusion.

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