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Effect of different levels of Fertilisers on yield, nutrient uptake and economics of Indian Mustard (*Brassica juncea* L.)

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Abstract
The present study was carried out with the objectives to study the growth the effect of different levels of fertilisers on yield, nutrient uptake and economics of the Indian mustard variety NRCHB-101 under graded doses of fertilizer. The field experiment was conducted during 2016-17 at the Agronomy Main Research Station, OUAT, Bhubaneswar laid out in a Factorial Randomized Block Design with three replications and twelve treatments. The dose of 100kg N ha^{-1} produced maximum amount of seed and the dose of 80kg N ha^{-1} produced maximum stover. As regards P application, 40 kg P ha^{-1} had the highest yield of seed and stover. Highest seed yield and stover yield were obtained from 30 kg K ha^{-1}. The total N uptake by Indian mustard var. NRCHB-101 was highest at N_3 (120 Kg ha^{-1}) and lowest at P_1 (20 kg ha^{-1}) *i.e.*, 64.08 kg ha^{-1} and 60.95 kg ha^{-1}, respectively. The total P uptake was highest at N_3 (120 Kg ha^{-1}) and lowest at N_1 (80 kg ha^{-1}) *i.e.*, 27.32 kg ha^{-1} and 21.51 kg ha^{-1}, respectively. The total K uptake by Indian mustard var. NRCHB-101 was highest at N_3 (120 Kg ha^{-1}) and lowest at N_1 (80 kg ha^{-1}) *i.e.*, 51.79 kg ha^{-1} and 45.60 kg ha^{-1}, respectively. The highest net return was obtained in case of the treatment with nutrient doses of $N_2P_2K_2$ (100-40-30) *i.e.*, Rs 21112 ha^{-1}. The gross returns per rupee investment was calculated to be highest for the treatment with nutrient combination $N_2P_2K_2$ (100-40-30) *i.e.*, 1.80.

Keywords: Indian mustard, nutrient uptake, yield, economics

Introduction
Role of oilseeds in Indian agriculture needs hardly any emphasis. Oilseeds constitute an important group of crops next to cereals. India is a premier oilseed growing country. India is the fourth largest oilseed economy in the world. Among the seven edible oilseeds cultivated in India, rapeseed-mustard contributes 28.6 per cent of the total area. Presently, rapeseed-mustard is the third most important oilseed crop in India after groundnut and soybean. India is one of the largest producer, consumer and importer of oilseeds in the world. Out of nine major oilseeds grown in India, Indian mustard (*Brassica juncea*) is an important winter season *Rabi* crop. The gap between production and demand of rapeseed-mustard is progressively widening and therefore, the production is to be increased for self sufficiency. Indian mustard requires relatively larger amount of nutrients for realization of higher yield potential. Moreover, with increase in irrigated area and introduction of high yielding varieties, it becomes imperative to work out the response of Indian mustard to nitrogen, phosphorus and potassium in Odisha condition. The mustard growing areas in India are experiencing the vast diversity in the agro climatic conditions and different species of rapeseed-mustard are grown in some or other part of the country. Under marginal resource situation, cultivation of rapeseed-mustard becomes less remunerative to the farmers. This results in a big gap between requirement and production of mustard in India.

Therefore site-specific nutrient management through soil-test recommendation based should be adopted to improve upon the existing yield levels obtained at farmers field. Effective management of natural resources, integrated approach to plant-water, nutrient and pest management and extension of rapeseed-mustard cultivation to newer areas under different cropping systems will play a key role in further increasing and stabilizing the productivity and production of rapeseed-mustard.

With this backdrop, the present paper on Indian mustard high yielding variety NRCHB-101 entitled "Effect of different levels of fertilisers on yield, nutrient uptake and economics of Indian mustard (*Brassica juncea* L.)" has been presented with the objectives to study the yield, nutrient uptake and economics of the variety under different fertility levels.

Materials and methods

The field experiment was conducted during *Rabi* 2016-17 at the Agronomy Main Research Station, Odisha University of Agriculture and Technology, Bhubaneswar (20026'N, 85081'E, 25.9m above MSL), Odisha. The soil of the experimental sandy loam acidic (pH-5.4) medium in organic carbon (0.628%) and available nitrogen (1673.3kg/ha), phosphorus (64.5kg/ha) and potassium (123.4 kg/ha). The experiment was laid out in a factorial randomized block design with three replications. Twelve treatment combinations comprising 3 nitrogen levels (80, 100, 120 kg N/ha), two (20, 40 kg P205/ha) and two potassium levels (0, 30 kg K2O/ha) were tested in the experiment. Indian mustard variety 'NRCHB-101' was sown 30 cm row distance. Thinning was done as 15 DAS to maintain plant to plant distance of 10 cm. All the recommended agronomic practices are done throughout the crop season. The crop was sown on 20th November and harvesting was done manually during last week of February. The seed yield, stover yield, harvest index and oil content was recorded after harvest of the crop. The N,P and K uptake in seed and stover was estimated by following standard procedure described by Jackson (1973) [6]. The economics was computed and all the data were analysed as per standard statistical procedures. (Gomez and Gomez, 1984) [4].

Result and Discussion

Yield of Indian Mustard

Among various nitrogen levels, there was no significant difference between the yields. However, numerically higher yield (1272.25Kg) was found at N_2 *i.e.,* 100 Kg ha^{-1}. After that, as dose of N increases, yield also increases. Among P levels, significantly higher seed yield (1378.16 Kg) was found at 40 kg P_2O_5 ha^{-1}. Similar kind of result was also found in K level where significantly higher seed yield (1344.50 kg) was found at 30 kg K_2O ha^{-1}. In both P and K, yield increases as the levels of P and K increase. Yield of mustard increased with increase in N level was reported by Mozaffari *et al.* (2012) [11]. This established the significance of N in the metabolic activities of the oilseeds. Being involved in formation of chlorophyll, glucosinate and erusic acid and inactivation of enzymes, it determines the seed and oil yields in mustard as reported by Ghimire and Bana (2011) [3].

There was no significant difference between the stover yields among various nitrogen levels. However, numerically higher yield (1867.30Kg) was found at N_1 *i.e.,* 80 Kg ha^{-1} which was at par with N_3 i.*e.,* 120 Kg/ha. But, at different P levels, there was significant difference in stover yield. Significantly higher stover yield (1980.20 Kg) was found at 40 kg P_2O_5 ha^{-1}. Stover yield increases as the levels of P increase. Unlike P, stover yield decreased with increasing K level. Significantly higher stover yield (1922.00 kg) was found at 0 kg K_2O ha-. The increasing doses of nutrients have a positive effect on the stover yield. In case of N these results corroborated with the results of Mohiuddin *et al.* (2011) [10]. Same results for P and K were reported by Singh *et al.* (2010) [12]. The stover yields of Indian mustard were significantly obtained under application of higher levels of N and P could be ascribed to better transformation of growth and yield attributes into yield which corroborated with findings of Dabi *et al.* (2015) [2].

There was significant difference between the harvest indices among various nitrogen levels. Higher HI (32.13) was found at N_3 *i.e.,* 120 Kg/ha. HI increased with increasing levels of N. But, HIs was found to be at par with each other at different levels of P and K. However, numerically higher HI was witnessed at 40 kg P_2O_5 ha^{-1} *i.e.*, 30.85 and at 30 kg K_2O ha^{-1} *i.e.,* 30.70. HI increased as the levels of P and K increased. The HI increased significantly with increased doses of N application. This was because of the corresponding higher increase in seed and stover yield. Increased HI with increasing levels of nutrients has been reported by Bohra *et al.* (2002) [1]. Among nitrogen levels, there was significant difference between the oil content of which, N_3 *i.e.,* 120 Kg/ha reported highest oil content of 37.78 per cent. A direct relationship was evident between levels of N and oil content. Adequate supply of N at higher levels accelerated the synthesis of amino acid. The relationship between N supply and oil content in seed was reported by Kumar *et al.* (2010) [8]. Among P levels, significantly higher oil content (37.12 per cent) was found at 40 kg P_2O_5 ha^{-1}. In both P and K, yield increases as the levels of P and K increase. The increase in oil content seems to be due to more accumulation of nitrogen in seed under high supplies of nutrients which decreases the proteinaceous substance in seed and increases the oil content. The increase in oil content is favoured by P application due to less formation of lecithin, a form of phospholipids. However, the oil content at different levels of K was at par with each other where, numerically highest oil content (36.95 per cent) was found at 30 kg K_2O ha^{-1}. These results corroborated with the findings of Khan *et al.* (2004) [7] and Mozaffari *et al.* (2012) [11]. The increased oil yield was attributed to increase in seed yield which confirm the findings of Dabi *et al.* (2015) [2].

Table 1: Seed yield, stover yield, harvest index and oil content of Indian mustard as influenced by different nitrogen, phosphorus and potassium levels

Yield Studies				
Treatment	**Seed Yield (kg ha^{-1})**	**Stover yield (kg ha^{-1})**	**Harvest index (%)**	**Oil content (%)**
N-levels (kg ha^{-1})				
80	1249.17	1867.3	40.08	35.68
100	1272.25	1815.5	41.20	37.11
120	1268.01	1867.2	40.44	37.78
SE(m)±	30.02	47.98	2.02	1.57
CD(P=0.05)	NS	NS	NS	NS
P_2O_5 levels (kg ha^{-1})				
20	1148.13	1719.8	40.03	36.59
40	1378.16	1980.2	41.03	37.12
SE(m)±	24.51	39.17	2.45	1.28
CD(P=0.05)	59.62	95.27	NS	NS
K_2O levels (kg ha^{-1})				
0	1181.71	1778.0	39.92	36.76
30	1344.57	1992.0	40.29	36.95
SE(m)±	24.51	39.17	2.64	1.28
CD((P=0.05)	59.27	94.72	NS	NS

Nutrient Uptake

The N uptake was significant for different levels of N, P and K. The N uptake increases as the doses of N, P and K increases. The seed uptake was highest at K_2 (30 Kg ha^{-1}) and lowest at N_2 (100 kg ha^{-1}) *i.e.,* 52.12 kg ha^{-1} and 49.33 kg ha^{-1}, respectively. The stover N uptake was highest at N_3 (120 Kg ha^{-1}) and lowest at N_1 (80 kg ha^{-1}) *i.e.,* 12.64 kg ha^{-1} and 10.90 kg ha^{-1}, respectively. The total N uptake in seed by Indian mustard var. NRCHB-101 is highest at N_3 (120 Kg ha^{-1}) and lowest at P_1 (20 kg ha^{-1}) *i.e.,* 64.08 kg ha^{-1} and 60.95 kg ha^{-1}, respectively. The higher uptake at the increased doses of N was due to higher efficiency of the crop to make use of the increased levels of N because of increased growth and vigour.

Similar results of N uptake with increasing levels of N have been reported by Kumawat *et al.* (2014) [9] and Dabi *et al.* (2015) [2].

Table 2: Nitrogen uptake by Indian mustard as influenced by nitrogen, phosphorus and potassium levels

Nitrogen Uptake			
Treatment	**Seed Yield (kg ha^{-1})**	**Stover Yield (kg ha^{-1})**	**Total (kg ha^{-1})**
N-levels (kg ha^{-1})			
80	50.17	10.90	61.07
100	49.33	12.05	61.38
120	51.44	12.64	64.08
SE(m)±	2.26	0.56	2.82
CD(P=0.05)	NS	1.36	NS
P_2O_5 levels (kg ha^{-1})			
20	49.51	11.44	60.95
40	51.11	12.28	63.39
SE(m)±	1.84	0.46	2.30
CD(P=0.05)	NS	NS	NS
K_2O levels (kg ha^{-1})			
0	49.82	11.62	61.44
30	52.12	11.80	63.92
SE(m)±	1.84	0.46	2.30
CD((P=0.05)	NS	NS	NS

Table 3: Phosphorus uptake by Indian mustard as influenced by nitrogen, phosphorus and potassium levels

Phosphorus Uptake			
Treatment	**Seed (kg ha^{-1})**	**Stover (kg ha^{-1})**	**Total (kg ha^{-1})**
N-levels (kg ha^{-1})			
80	15.80	5.71	21.51
100	17.13	7.13	24.26
120	19.00	8.32	27.32
SE(m)±	0.49	0.35	0.84
CD(P=0.05)	1.19	0.86	2.05
P_2O_5 levels (kg ha^{-1})			
20	17.19	5.71	22.9
40	19.26	7.13	26.39
SE(m)±	0.40	0.29	0.69
CD(P=0.05)	0.97	0.70	1.67
K_2O levels (kg ha^{-1})			
0	16.92	6.73	23.65
30	17.69	7.38	25.07
SE(m)±	0.40	0.29	0.69
CD((P=0.05)	NS	NS	NS

Phosphorus

The seed uptake was highest at P_2 (40 Kg ha^{-1}) and lowest at N_1 (80 kg ha^{-1}). The stover P uptake was highest at N_3 (120 Kg ha^{-1}) *i.e.*, 8.32 kg ha^{-1}. The lowest stover P uptake was observed at N_1 (80 kg ha^{-1}) and P_1 (20 kg ha^{-1}) *i.e.*, 5.71 kg ha^{-1}. The total P uptake in seed by Indian mustard var. NRCHB-101 is highest at N_3 (120 Kg ha^{-1}) and lowest at N_1 (80 kg ha^{-1}) *i.e.*, 27.32 kg ha^{-1} and 21.51 kg ha^{-1}, respectively. The P uptake was significant for different levels of N, P and K. The P uptake increases as the doses of N, P and K increases. The total P uptake by both, seed and stover, is highest at N_3 P_2 K_2 *i.e.*, 19.82 kg ha^{-1} and 8.83 kg ha^{-1}, respectively. The P uptake by both, seed and stover, was significant for all the interactions. These results for P uptake corroborated with the findings of Ghimire and Bana (2011) [3]. The higher removal of N and P might be due to synergistic effect chlorophyll content, cell division, photosynthetic rate and root activities of plants.

Potassium

The seed uptake was highest at N_3 (120 Kg ha^{-1}) and lowest at N_1 (80 kg ha^{-1}) *i.e.*, 13.42 kg ha^{-1} and 10.24 kg ha^{-1}, respectively. The stover K uptake was highest at P_2 (40 Kg ha^{-1}) and lowest at K_1 (0 kg ha^{-1}) *i.e.*, 38.75 kg ha^{-1} and 35.26 kg ha^{-1}, respectively. The total K uptake in seed by Indian mustard var. NRCHB-101 is highest at N_3 (120 Kg ha^{-1}) and lowest at N_1 (80 kg ha^{-1}). The K uptake was significant for different levels of N, P and K. The K uptake increases as the doses of N, P and K increases. Similar results have been reported by Grewal *et al.* (2009) [5]. The highest K uptake by seed was at N_3P_2 *i.e.*, 13.35 kg ha^{-1}. The highest K uptake by stover was at N_3P_2 *i.e.*, 38.87 kg ha^{-1}. The total K uptake by both, seed and stover, is highest at N_3 P_2 K_2 followed by N_3 P_2 K_1 in seed and stover, respectively. The K uptake by both, seed and stover, was significant for all the interactions.

Table 4: Potassium uptake by Indian mustard as influenced by nitrogen, phosphorus and potassium levels

Potassium Uptake			
Treatment	**Seed (kg ha^{-1})**	**Stover (kg ha^{-1})**	**Total (kg ha^{-1})**
N-levels (kg ha^{-1})			
80	10.24	35.26	45.60
100	11.51	36.13	47.64
120	13.42	38.37	51.79
SE(m)±	0.35	0.83	1.18
CD(P=0.05)	0.85	2.02	2.87
P_2O_5 levels (kg ha^{-1})			
20	11.11	36.22	47.33
40	13.02	38.75	51.77
SE(m)±	0.22	0.68	0.9
CD(P=0.05)	0.70	1.65	2.35
K_2O levels (kg ha^{-1})			
0	11.25	35.78	47.03
30	11.93	37.45	49.38
SE(m)±	0.29	0.68	0.97
CD((P=0.05)	0.69	1.65	2.45

Economics

The cost of cultivation was maximum for the treatment with combination N_3 P_2 K_2 (120-40-30) *i.e.*, Rs 26590 ha^{-1}. The highest net return was obtained in case of the treatment with nutrient doses of $N_2P_2K_2$ (100-40-30) *i.e.*, Rs 21112 ha^{-1}. The gross returns per rupee investment was calculated to be

highest for the treatment with nutrient combination $N_2P_2K_2$ (100-40-30) *i.e.*, 1.80.

The higher returns in the nutrient combination $N_2P_2K_2$ (100-40-30) is ascribed to the reason of higher yield from the specific treatment.

Table 5: Economics of Indian Mustard Cultivation

Treatment	Cost of Cultivation (Rs ha^{-1})	Gross Return (Rs ha^{-1})	Net Return (Rs ha^{-1})	Gross Returns per rupee investment (Rs Re^{-1})
$N_{80}P_{20}K_0$	24175	33832	9657	1.39
$N_{80}P_{20}K_{30}$	25060	40801	15741	1.62
$N_{80}P_{40}K_0$	25175	43072	17897	1.71
$N_{80}P_{40}K_{30}$	26060	46685	20625	1.79
$N_{100}P_{20}K_0$	24435	34291	9856	1.40
$N_{100}P_{20}K_{30}$	25320	41739	16419	1.64
$N_{100}P_{40}K_0$	25435	43965	18530	1.72
$N_{100}P_{40}K_{30}$	26320	47432	21112	1.80
$N_{120}P_{20}K_0$	24695	34560	9865	1.39
$N_{120}P_{20}K_{30}$	25580	41416	15836	1.62
$N_{120}P_{40}K_0$	25695	43549	17854	1.69
$N_{120}P_{40}K_{30}$	26590	47345	20755	1.78

Conclusion

The dose of 100kg N ha^{-1} produced maximum amount of seed and the dose of 80kg N ha^{-1} produced maximum stover. As regards P application, 40 kg P ha^{-1} had the highest yield of seed and stover. Highest seed yield and stover yield were obtained from 30 kg K ha^{-1}. The total N uptake by Indian mustard var. NRCHB-101 was highest at N_3 (120 Kg ha^{-1}) and lowest at P_1 (20 kg ha^{-1}) *i.e.*, 64.08 kg ha^{-1} and 60.95 kg ha^{-1}, respectively. The total P uptake was highest at N_3 (120 Kg ha^{-1}) and lowest at N_1 (80 kg ha^{-1}) *i.e.*, 27.32 kg ha^{-1} and 21.51 kg ha^{-1}, respectively. The total K uptake by Indian mustard var. NRCHB-101 was highest at N_3 (120 Kg ha^{-1}) and lowest at N_1 (80 kg ha^{-1}) *i.e.*, 51.79 kg ha^{-1} and 45.60 kg ha^{-1}, respectively. The highest net return was obtained in case of the treatment with nutrient doses of $N_2P_2K_2$ (100-40-30) *i.e.*, Rs 21112 ha^{-1}.

References

1. Bohra JS, Sah D, Shukla DN. Effect of nitrogen, phosphorus and sulfur on growth attributes and nutrient uptake of mustard. Crop Research. 2002; 31(1):234-236.
2. Dabi B, Singh JK, Singh RK, Viswakarma A. Quality and profitability of Indian mustard (*Brassica juncea*) as affected by nutrient management practices under irrigated condition. Indian Journal of Agronomy. 2015; 60(1):168-171.
3. Ghimire TB, Bana OPS. Effect of fertility levels on mustard (*Brassica juncea*, L.) on seed yield, quality and economics under varying poplar tree densities. Indian Journal of Agronomy. 2011; 56(4):346-350.
4. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. John Wiley and Sons, Second Edition, New York, 1984, 680.
5. Grewal KS, Godara OP, Malik RS. Effect of potassium application on groundnut yield, quality and uptake in soil of southern Haryana. Haryana Journal of Agronomy. 2009; 25(1-2):43-47.
6. Jackson ML. Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi, 1973, 498.
7. Khan HZ, Malil MA, Saleem MF, Aziz I. Effect of Differen Potassium Fertilization Levels on Growth, Seed Yield and Oil Contents of Canola (*Brassica napus* L.). Int. J Agri. Biol. 2004; 6(3):557-559.
8. Kumar A, Kumar D, Arya KPS. Effect of calcium and sulphur on growth and yield of mustard. International journal of Plant Science. 2010; 5(1):162-164.
9. Kumawat N. Effect of sowing date, seed rates and INM on production potential and profitability of rainfed linseed. Archives of Agronomy and Soil Science. 2014; 60(9):1207-1227.
10. Moinuddin K, Singh M, Nandan R. Growth and productivity behaviour of mustard (*Brassica juncea*) under different dates of sowing and nitrogen levels. Extended summaries: 3rd International Agronomy Congress, New Delhi, India, 2011.
11. Mozaffari SN, Delkhosh B, Rad AS. Effect of nitrogen and potassium levels on yield and some of the agronomical characteristics in Mustard. Indian Journal of Science and Technology. 2012; 5(2):2051-2054.
12. Singh Y, Singh T, Singh UN, Rajput PK. Effect of nutrient management on yield, quality and economics of irrigated Indian mustard (*Brassica juncea*). Indian Journal of Agricultural Sciences. 2010; 80(2):691-694.