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Research Communication

Effect of nutrient levels on yield, nutrient uptake and economics of Indian mustard (*Brassica juncea*) in *tarai* region of Uttarakhand

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ABSTRACT

A field experiment was conducted during winter (*rabi*) season 2014–15 at the N.E. Borlaug Crop Research Centre of the Govind Ballabh Pant University of Agriculture and Technology, Pantnagar to study the effect of nutrient levels on yield, nutrient uptake and economics of Indian mustard [*Brassica juncea* (L.) Czernj and Cosson] cultivar 'RGN 73' in *tarai* region of Uttarakhand. Treatment consisted of 3 levels of nitrogen (60, 80 and 100 kg/ha), 2 levels of phosphorus (20 and 40 kg/ha) and 2 levels of potassium (0 and 30 kg/ha), which were evaluated thrice in a randomized block design. The highest seed yield (1.93 t/ha), nutrient (N : P_2O_5 : K) uptake (99 kg N, 42 P_2O_5 and 172 kg K_2O/ha), net returns (37.13 × 10^3 ₹/ha), gross returns (60.45 × 10^3₹/ha) and benefit: cost ratio (1.54) were recorded with application of 100 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha followed by 100 kg N + 40 kg P_2O_5 + 0 kg K_2O/ha and 100 kg N + 20 kg P_2O_5 + 30 kg K_2O/ha treatments.

Key words : Economics, Indian mustard, Nutrient management, Nutrient uptake, Yield

The requirement of vegetable oils and fats will be much higher in coming years in view of ever increasing population. India would need 58 million tonnes of oilseeds by 2020 for maintaining minimum edible oil requirement (Mittal, 2008). To produce an additional quantity of oilseeds, the only option is to enhance productivity under the limited land resource condition. Among the oilseed crops, rapeseed and mustard occupy rank next to soybean in acreage and production. The inadequate supply of inputs often leads to limit the yield potential of rapeseed and mustard (DACNET, 2014). Identification of the critical inputs to enhance the mustard production is the need of hour. Apart from improved varieties and irrigation, balanced fertilization is critical for realizing higher seed yield. Indian soils are becoming highly deficient in macronutrients [low nitrogen (N), medium in phosphorus (P) and medium/high in potassium (K) and low in sulphur (S)] and micronutrients due to intensive cultivation and use of high analysis fertilizers. The rapeseed-mustard requires relatively large amount of these nutrients for realization of yield potential, but inadequate supply often leads to low productivity. Under such situation, balanced fertilizers can be exploited to boost the production and also to improve nutrient uptake. However, the use of inadequate amount of nutrients has some limitations. Judicious use of chemical fertilizers facilitates profitable and sustainable production (Singh and Sinsinwar, 2006).

A field experiment was conducted during winter (*rabi*) season of 2014–15 at the N.E. Borlaug Crop Research Centre of the G.B Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, situated at 29°N latitude, 79.3°E longitude and at an altitude of 243.24 meters. The soil of experimental field was silty clay loam having *p*H 7.76, electrical conductivity 0.24 dS/m, medium in organic carbon (0.71%) and low in available nitrogen (203 kg/ha), medium in available phosphorus (18 kg/ha) and medium in available potassium (283 kg/ha). The experiment comprised of 12 treatments, viz. T_1, 60 kg N + 20 kg P_2O_5 + 0 kg K_2O/ha; T_2, 60 kg N + 20 kg P_2O_5 + 30 kg K_2O/ha; T_3, 60 kg N + 40 kg P_2O_5 + 0 kg K_2O/ha; T_4, 60 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha; T_5, 80 kg N + 20 kg P_2O_5 + 0 kg K_2O/ha; T_6, 80 kg N + 20 kg P_2O_5 + 30 kg K_2O/ha; T_7, 80 kg N + 40 kg P_2O_5 + 0 kg K_2O/ha; T_8, 80 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha; T_9, 100 kg N + 20 kg P_2O_5 + 0 kg

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K_2O/ha; T_{10}, 100 kg N + 20 kg P_2O_5 + 30 kg K_2O/ha; T_{11}, 100 kg N + 40 kg P_2O_5 + 0 kg K_2O/ha; and T_{12}, 100 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha with 3 replications were tested under randomized block design. The fertilizer nutrients were supplied through urea, single superphosphate and muriate of potash. Full dose of phosphorus, potassium and half of nitrogen (as per treatment) were applied at sowing. Remaining half of nitrogen was applied after first irrigation. Mustard cultivar 'RGN-73' was sown in rows 30 cm apart on October 22, with a seed rate of 5 kg/ha. Pre-sowing irrigation was applied for land preparation and germination of seed. Thinning was done 10–15 days after sowing to maintain plant to plant distance of 10 cm.

The crop was harvested in March during crop season. The processed plant samples were analyzed by Micro Kjeldahl method (Jackson, 1973) to determine nitrogen content and wet digestion (di-acid) method (Jackson, 1973) was used for preparation of aliquot to determine P and K content in plant samples. The crop was raised with recommended package of practices.

Data revealed that the yield attributes of Indian mustard were affected significantly due to different fertility levels (Table 1). At harvest stage significantly highest number (8.4) of primary branches was observed under the application of 100 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha treatment which was at par with 100 kg N + 40 kg P_2O_5 + 0 kg K_2O/ha treatment but was significantly higher over rest of the fertility levels. However, lowest number (5.1) of primary branches was found in 60 kg N + 20 kg P_2O_5 + 0 kg K_2O/ha treatment which was at par with 60 kg N + 20 kg P_2O_5 + 30 kg K_2O/ha, 60 kg N + 40 kg P_2O_5 + 0 kg K_2O/ha, 60 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha and 80 kg N + 20 kg P_2O_5 + 0 kg K_2O/ha treatments but significantly lower than remaining treatments. Higher number (9.3) of secondary branches was recorded with the application of 100 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha treatment, which was at par with 100 kg N + 40 kg P_2O_5 + 0 kg K_2O/ha, 100 kg N + 20 kg P_2O_5 + 30 kg K_2O/ha and 100 kg N + 20 kg P_2O_5 + 0 kg K_2O/ha treatments. However, the lowest number (6.5) of secondary branches was recorded in 60 kg N + 20 kg P_2O_5 + 0 kg K_2O/ha treatment which was at par with 60 kg N + 20 kg P_2O_5 + 30 kg K_2O/ha, 60 kg N + 40 kg P_2O_5 + 0 kg K_2O/ha, 60 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha and 80 kg N + 20 kg P_2O_5 + 0 kg K_2O/ha treatments but significantly lowest than other treatments. Application of 100 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha recorded significantly higher values for number of siliquae/plant (256.6), length of siliqua (4 cm), number of seeds/siliqua (13.8) and 1,000-seed weight (3.9 g) over application of 60 kg N + 20 kg P_2O_5 + 0 kg K_2O/ha, (Table 1). This may be ascribed to overall improvements in vigour and crop growth. Since all essential plant nutrients, its incorporation in soil promotes rapid vegetative growth and branching, thereby increasing the sink size in terms of flowering, fruiting and seed setting. The improved overall growth and profused branching owing to 100 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha application coupled with transport of photosynthates towards reproductive structures on the other hand, might have increased the yield attributes (Singh and Pal, 2011). The higher values of yield attributes is the result of higher nutrient availability resulted in better growth and more translocation of photosynthates from source to sink (Tripathi *et al*., 2010).

Data revealed that the seed and stover yields of Indian mustard were affected significantly due to different fertility levels (Table 2). Higher seed yield (1.925 t/ha) was

Table 1. Yield attributes as influenced by different nutrient levels at harvest

Treatment	Primary branches/plant	Secondary branches/plant	Siliquae/ plant	Seeds/ siliqua	Length of siliqua (cm)	1,000-seed weight (g)
$N:P_2O_5:K_2O$ (kg/ha)						
T_1 (60:20:0)	5.1	6.5	205	9.9	2.9	3.1
T_2 (60:20:30)	5.9	6.8	207	10.8	3.2	3.1
T_3 (60:40:0)	6.0	6.8	213	11.2	3.3	3.2
T_4 (60:40:30)	6.0	6.9	214	11.3	3.3	3.3
T_5 (80:20:0)	6.0	7.5	215	11.7	3.3	3.4
T_6 (80:20:30)	6.6	7.7	217	11.7	3.4	3.5
T_7 (80:40:0)	6.6	7.8	229	12.3	3.4	3.6
T_8 (80:40:30)	6.7	8.3	232	12.3	3.5	3.6
T_9 (100:20:0)	7.0	8.4	235	12.4	3.6	3.7
T_{10} (100:20:30)	7.1	8.6	238	13.0	3.7	3.7
T_{11} (100:40:0)	7.6	8.6	241	13.1	3.7	3.7
T_{12} (100:40:30)	8.4	9.3	256	13.8	4.0	3.9
SEm±	0.36	0.45	9.8	0.6	0.1	0.1
CD (P=0.05)	1.07	1.34	28.9	1.8	0.4	0.4

recorded with application of 100 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha treatment. The lowest seed yield (1.069 t/ha) was recorded with 60 kg N + 20 kg P_2O_5 + 0 kg K_2O/ha treatment. The treatment T_{12} which was at par with T_{10} and T_{11} produced significantly higher seed yield over remaining fertility levels. As seed yield is the resultant outcome of the effect of various growth and yield parameters, its expression was observed with their integrated influence. Balanced supply of essential nutrients to Indian mustard increased their availability, acquisition, mobilization and influx into the plant tissues increased and finally improved growth attributes and yield components and finally the yield. These results are in agreement with the findings of Singh and Sinsinwar (2006). Among the different treatments higher stover yield (7.638 t/ha) was recorded with the application of 100 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha treatment which was statistically at par with all the treatments except 60 kg N + 20 kg P_2O_5 + 0 kg K_2O/ha and 60 kg N + 20 kg P_2O_5 + 30 kg K_2O/ha treatments. However, the lowest stover yield (6.916 t/ha) was recorded under 60 kg N + 20 kg P_2O_5 + 0 kg K_2O/ha treatments which was statistically at par with 60 kg N + 20 kg P_2O_5 + 30 kg K_2O/ha, 60 kg N + 40 kg P_2O_5 + 0 kg K_2O/ha, 60 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha and 80 kg N + 20 kg P_2O_5 + 0 kg K_2O/ha treatments but significantly lower than remaining treatments. The increase in stover yield under adequate nutrient supply might be ascribed, mainly due to balanced nutrition and increased photosynthesis, dry matter accumulation. These results are in conformity with those of Akter *et al.* (2007) and Singh and Pal (2011).

The cost of cultivation was the lowest 21.5×10^3₹/ha with application of 60 kg N + 20 kg P_2O_5 + 0 kg K_2O/ha treatment, whereas, it was the highest 24.1×10^3₹/ha with application of 100 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha treatment. Highest net returns (37.1×10^3₹/ha) and benefit: cost ratio (1.54) was noted with 100 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha treatment (Table 2). This was due to higher productivity with this treatment. The lowest net returns (12.9×10^3₹/ha) was noted with 60 kg N + 20 kg P_2O_5 + 0 kg K_2O/ha treatment and also the lowest benefit: cost ratio (0.60).

Nutrient uptake by crop varied significantly due to different fertility levels (Table 2). The highest nutrient uptake 99 kg N, 42 kg P_2O_5 and 172 kg K_2O/ha, respectively by mustard was noted with the application of 100 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha treatment that could be ascribed to balanced nutrition to crop that has increased biomass production and nutrients uptake. Similar results were reported by Mandel and Sinha (2002). Nutrient uptake is a numerical product of nutrient content and dry matter accumulation which was significantly low, under 60 kg N + 20 kg P_2O_5 + 0 kg K_2O/ha treatment than other treatments. Higher nutrient uptake might be attributed to more proliferation of root system and higher dry matter accumulation by individual plant which in turn yielded higher in comparison to other treatments. The increase in nutrient uptake was mainly due to better nutrition, which resulted in better growth and yield and ultimately in higher uptake of nutrients. The results confirm the findings of Singh and Singh (2002).

Thus, on the basis of above study it can be concluded that Indian mustard cultivar 'RGN-73' fertilized with 100 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha sustained higher seed, stover and biological yields, nutrient uptake, net returns

Table 2. Seed yield, stover yield, cost of cultivation, net returns, benefit: cost ratio and nutrient uptake as influenced by different nutrients levels

Treatment	Seed yield (t/ha)	Stover yield (t/ha)	Cost of cultivation (× 10^3₹/ha)	Net returns (× 10^3₹/ha)	Benefit: cost ratio	Nutrient uptake (kg/ha)		
						N	P	K
$N:P_2O_5:K_2O$ (kg/ha)								
T_1 (60:20:0)	1.07	6.92	21.5	13.0	0.60	59.0	28.0	140.5
T_2 (60:20:30)	1.12	7.16	22.4	13.8	0.62	61.9	29.9	147.0
T_3 (60:40:0)	1.17	7.22	22.6	15.0	0.67	64.3	31.7	147.6
T_4 (60:40:30)	1.27	7.30	23.4	17.3	0.74	67.5	32.9	151.8
T_5 (80:20:0)	1.34	7.32	21.9	21.1	0.95	71.5	33.5	152.5
T_6 (80:20:30)	1.38	7.37	22.7	21.6	0.96	74.4	35.2	157.0
T_7 (80:40:0)	1.46	7.47	22.9	24.0	1.05	77.4	36.2	160.1
T_8 (80:40:30)	1.60	7.58	23.7	27.2	1.15	82.6	37.4	162.1
T_9 (100:20:0)	1.63	7.59	22.2	29.9	1.35	84.6	38.1	162.8
T_{10} (100:20:30)	1.74	7.60	23.0	32.3	1.40	90.5	38.7	164.5
T_{11} (100:40:0)	1.80	7.62	23.3	34.0	1.46	93.7	40.3	170.2
T_{12} (100:40:30)	1.92	7.64	24.1	37.1	1.54	99.1	41.8	172.1
SEm±	0.09	0.15	-	-	-	3.6	2.0	6.3
CD (P=0.05)	0.27	0.44	-	-	-	10.8	5.9	18.8

and benefit: cost ratio under *tarai* condition of Uttarakhand.

REFERENCES

Akter, S., Hossain, K., Rahaman, S. and Ullah, M.M. 2007. Effect of fertilizer on yield and yield component of mustard. *International Journal of Agricultural Science and Technology* **3**(5): 93–96.

DACNET. 2014. Directorate of Economics and Statistics, DAC, Ministry of Agriculture Government of India, New Delhi.http://eands.dacnet.nic.in./StateData_12-13 Year.htm.

Jackson, M.L. 1973. *Soil Chemical Analysis.* Prentice Hall of India Pvt. Ltd., New Delhi, pp. 498.

Mandel, K.G. and Sinha, A.C. 2002. Effect of integrated nutrient management on growth, yield, oil content and nutrient uptake of Indian mustard (*Brassica juncea*) in foothills soils of eastern India. *Indian Journal of Agronomy* **47**(1): 109–113.

Mittal, S. 2008. *Demand Supply Trend and Projections of Food in India.* Indian Council for Research on International Economic Relations, pp. 1–20.

Singh, R. and Sinsinwar, B.S. 2006. Effect of integrated nutrient management on growth, yield, oil content and nutrient uptake of Indian mustard (*Brassica juncea*). *Indian Journal of Agricultural Sciences* **76**(5): 322–324.

Singh, S.K. and Singh, G. 2002. Response of Indian (*Brassica juncea*) varieties to nitrogen under varying sowing dates in eastern dates in Eastern Uttar Pradesh. *Indian Journal of Agronomy* **47**(2): 242–248.

Singh, S.P. and Pal, M.S. 2011. Effect of integrated nutrient management on productivity, quality, nutrient uptake and economics of mustard (*Brassica juncea*). *Indian Journal of Agronomy* **54**(4): 381–387.

Tripathi M.K., Chaturvedi, S., Shukla D.K. and Mahapatra, B.S. 2010. Yield performance and quality in Indian mustard (*Brassica Juncea*) as affected by integrated nutrient management. *Indian Journal of Agronomy* **55**(2): 138–142.