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Short Communication

Effect of nitrogen on growth and yield of different varieties of Indian mustard (*Brassica juncea* L)

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Abstract

A field experiment was conducted to evaluate the field efficacy of varying nitrogen levels on growth and yield of different varieties of Indian mustard (*Brassica juncea* L.). Field experiment was conducted in a split plot design with four levels of nitrogen (0, 50, 100 and 150 kg/ha) in main plots and five varieties (RLC 1, RLC 11, RLC 12, PBR 210 and PBR 91) in the sub plots. Application of N significantly increased plant height, dry matter accumulation (DMA), leaf area index (LAI) and photosynthetically active radiation (PAR) interception over the control. Nitrogen application delayed initiation of flowering and significantly increased number of the secondary branches and number of siliquae per plant and seeds per siliquae over control. PBR 91 and PBR 210 exhibited significantly better growth in terms of plant height, DMA and LAI with higher PAR as compared to RLC 11 and RLC 1. PBR 91, RLC 1 and PBR 210 registered significantly higher test weight than RLC 11 and RLC 12. Application of 100 kg N/ha increased the seed yield significantly over the control and 50 kg N/ha but remained at par with 150 kg N/ha. All the test varieties produced statistically similar seed yields.

Keywords: *Growth, Indian mustard varieties, nitrogen dose, yield*

Introduction

India is the fourth largest vegetable oil economy in the world next to USA, China and Brazil. Oilseed are the second largest contributor in Indian agricultural economy after the cereals. India is the second largest grower (21.1%) after Canada, and third largest producer (12.6%) after Canada and China of rapeseed-mustard (Choudhary *et al.,* 2023). Among various oilseed crops grown in India, rapeseed-mustard group of crops (*Brassica spp.* L., Family Brassicaceae) comprising Indian rape (toria), Indian mustard (raya), oilseed rape (*Gobhi Sarson*), Ethopian mustard (African *Sarson*), yellow *Sarson*, brown *Sarson* and taramira, are next to soybean in terms of area and production. Cultivation of these crops in 28 states of the country under diverse agro-ecological situations over an area of 8.1 million hectares to produce 11.7 million tonnes signifies its importance in vegetable oil scenario of the country. Among these Brassica species, Indian mustard [*Brassica juncea* (L.) Czern & Coss.] with a share of about 80 per cent in area and production, occupies prominent position in India. Crop production largely depends on cultivation of high yielding cultivars and need based application of nutrients. Nitrogen (N) is the most important nutrient, and being a constituent of protoplasm and protein, it is involved in several metabolic processes that strongly influence growth, productivity and quality of crops (Kumar *et al*., 2000). The N fertilizer application accounts for significant crop production cost. Mustard has relatively high demand for N than many other crops owing to larger N content in seeds and plant tissues (Malagoli *et al* 2005). Yield increases in Indian mustard at various locations in India have been reported with application of N as high as 150 kg/ha or more (Singh *et al.,* 2023; Singh *et al.,* 2022; Singh *et al*., 2010). Brassicas are known to remove higher amount of N until flowering with relatively lower amount taken up during reproductive growth phase (Rathke *et al.,* 2006). Poor translocation of N from vegetative parts to seed during reproductive growth results in low nitrogen use efficiency. A significant part of the unused N is lost to environment causing pollution and contamination of water bodies (Malagoli *et al*. 2005) or gets converted to greenhouse gases such as oxides of N. Increasing N application also reduces oil content (Singh and Singh 2005; Singh *et al*., 2008). Since N fertilizers are costly, poor NUE is of great concern and therefore, attempts are needed to improve the contribution of applied N to production of grain and this approach will reduce the environmental and production costs in agriculture. Differences in N concentration in various plant parts of oilseed rape suggest that N uptake and distribution is an inherited character (Grami and La Croix, 1977). Spring oilseed rape cultivars producing lowest yields at lowest level of N application generally responded more markedly to increased N application rates than cultivars with higher yield at high N application (Yau and Thurling, 1987). Therefore, keeping these facts in view, the present investigation was undertaken to assess the effect of different nitrogen levels on growth and yield of Indian mustard varieties.

Materials and Methods

A field experiment was conducted during *Rabi* season of 2021-22 at the research farm of Swami Vivekanand University Sironja, Sagar, Madhya Pradesh. Sagar is characterized by sub-tropical, humid type of climate with hot and dry summer during April to June followed by hot and humid period during July to September and cold winter during December and January. The mean maximum and minimum temperatures show considerable variations during different months of the year. Temperature often exceeds 38°C during summer and sometimes touches 45°C with dry spells during May and June. Minimum temperature falls below 0.5°C with some frosty spells during the winter months of December and January. The average annual rainfall of the Sagar is 650 mm, about three-fourth of which is contributed by the south-west monsoon during July to September. Winter rains received in the months of December, January and February are scanty. The soil texture of experimental plot was loamy sand with pH of 7.60 and EC of was 0.15 dS/m. In addition to basal application of recommended dose of phosphorus and potassium, 50% of N as per treatments was also applied at time of field preparation before last planking. The remaining dose of N as per treatments was applied after first irrigation. Nitrogen, phosphorus and potassium were applied through urea (46% N), single super phosphate (16% P_2O_5) and muriate of potash (60% K_2O), respectively. The experiment was laid out in split plot design with 4 doses of nitrogen that were 0, 50, 100 and 150 kg N/ha in the main plots and 5 varieties of Indian mustard in the sub plots were RLC 1, RLC 11, RLC 12, PBR 210 and PBR 91. Treatments were replicated thrice. The test genotypes RLC 1, RLC 11, RLC 12 (quality oil/seed meal) and PBR 210 and PBR 91 (conventional) were sown on November 16, 2021 with manually operated seed drill at row spacing of 30 cm using seed rate of 4 kg/ha. Plants growth parameters such as emergence count, plant height, dry matter accumulation, leaf area index (LAI) and photosynthetically active radiation (PAR) were observed over the period of time at 30, 60, 90 and 120 DAS. The average of 5 plants were considered for final observation for all growth parameters. Yield attributes such as number of siliquae, number of seeds per silique, test weight, seed yield and stover yield were observed individually from each plots after harvest. Nitrogen uptake in seed and straw was estimated using modified micro-Kjeldahl method proposed by Subbiah and Asija (1956). The standard analysis of variance (ANOVA) technique prescribed for the split plot design was performed to compare the treatment means. Treatment means were compared at the 5% level of significance ($p=0.05$) using least significant difference.

Results and Discussion

Growth parameters

The effect of different varieties and nitrogen levels on growth parameters of Indian mustard viz., emergence count, plant height, dry matter accumulation, LAI and PAR was found significant (Table 1). It was observed that application of 150 kg N/ha produced taller plants and maximum dry matter accumulation, LAI and PAR which was at par with 100 kg N/ha. Among varieties PBR 210 and PBR 91 produced taller plant, maximum dry matter accumulation and LAI than any other varieties. But in case of PAR, the maximum was recorded with PBR 210, PBR 91 and RLC 12 which were statistically at par with each other. These results are in tally with that of Kumbhare *et al*. (2007) and Sandhu (2010).

The key factors of a crop's eventual yield are yield characteristics such as number of siliquae, number of seeds per silique, test weight, seed yield and stover yield was found significant and given in Table 2. Increase in dose of N up to 150 kg/ha increased the number of siliquae on main shoot as well as the total number of siliquae per plant followed by 100 kg N/ha. These results are in tally with Kumar and Yadav (2007). All the test varieties statistically similar number of siliquae on main shoot as well as the total number of siliquae per plant. Number of seeds per siliquae increased with application of N up to 100 kg/ha followed by 150 kg N/ha. RLC 11 produced significantly higher number of seeds per siliquae than rest of the test varieties *viz*. RLC 1, RLC 12, PBR 210 and PBR 91 which were statistically at par with each other. Application of 150 kg N/ha produced highest test weight which was at par with 100 kg N/ha. PBR 91 registered the highest test weight, while RLC 12 produced the lowest test weight. Application of 100 kg/ha of N increased the seed yield which was at par with 150 kg N/ha. All the test genotypes produced statistically similar seed yields. RLC 11 produced the lowest seed yield, whereas, the highest seed yield was produced by PBR 91. These results are in tally with Yadav *et al*. (2007) and Panda *et al*. (2004).

The effect of different varieties and nitrogen levels on nitrogen uptake is given in Table 3. The maximum N uptake in seed, stover and total biomass was recorded at 150 kg N/ha which was recorded significantly higher

Table 1: Growth parameters of Indian mustard as influenced by different nitrogen levels and varieties

Treatment	Plant height (cm)				Dry matter accumulation (kg/ha)				Leaf area index				Photosynthetically active radiation			
	Days after sowing (DAS)															
	30	60	90	120	30	60	90	120	30	60	90	120	30	60	90	120
N levels (kg/ha)																
0	12	48	149	180	74	673	4650	7052	0.2	1.3	2.3	1.2	21	61	82	68
50	14	53	174	198	84	852	5380	7714	0.3	2.1	3.7	1.8	24	76	91	81
100	14	54	179	200	103	1013	6748	8545	0.3	2.6	4.6	2.0	30	84	95	85
150	15	53	179	204	97	1009	7677	9240	0.4	3.0	5.5	2.2	30	86	96	87
CD (p=0.05)	1	2	5	8	19	172	532	659	0.1	0.3	0.6	0.2	5	4	2	4
Varieties																
RLC 1	15	46	170	195	86	875	5627	8073	0.3	2.0	3.8	1.5	26	76	90	78
RLC 11	11	58	170	195	80	740	5622	7911	0.3	2.1	3.9	1.7	25	76	90	79
RLC 12	13	52	166	195	72	906	5686	7880	0.3	2.2	4.1	1.7	26	75	92	80
PBR 210	15	52	173	193	110	1001	6877	8409	0.3	2.3	4.1	1.9	26	76	90	83
PBR 91	15	52	171	200	99	913	6758	8416	0.3	2.7	4.1	2.0	29	82	93	81
CD (p=0.05)	1	4	4	NS	20	159	835	364	NS	0.3	NS	0.2	NS	4	NS	NS

Table 2: Yield attributes and yield of Indian mustard as influenced by different N levels and varieties

Treatment N levels (kg/ha)	Siliquae/ plant	Seeds/ siliqua	Test weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)
0	301	11.8	3.5	1271	4917
50	354	13.2	3.6	1881	6924
100	368	13.4	3.6	2106	7916
150	383	13.2	3.7	2102	8137
CD (p=0.05)	32	1	NS	211	611
Varieties					
RLC 1	369	12.5	3.8	1826	6785
RLC 11	357	15.0	3.4	1800	6332
RLC 12	372	12.6	2.9	1833	7119
PBR 210	321	12.2	3.8	1840	7191
PBR 91	338	12.2	4.1	1902	7452
CD (p=0.05)	NS	0.8	0.1	NS	338

over the rest of the N levels, but remained on par with 100 kg N/ha in case of seed and total biomass. PBR 210 recorded the highest total N uptake followed by PBR 91, while least N uptake was recorded with RLC 11.

Table 3: Effect of different N levels and varieties on nitrogen uptake in different plant parts of Indian mustard

Treatment	N uptake in seed (kg/ha)	N uptake in stover (kg/ha)	Total nitrogen uptake (kg/ha)
N levels (kg/ha)			
0	45.8	24.2	70.1
50	68.4	36.3	104.8
100	79.9	49.0	128.9
150	83.0	57.9	141.0
CD (p=0.05)	9.3	4.4	12.4
Varieties			
RLC 1	68.5	37.9	106.5
RLC 11	64.6	39.9	99.5
RLC 12	71.9	40.5	112.5
PBR 210	69.5	49.4	118.9
PBR 91	71.8	49.7	118.6
CD (p=0.05)	NS	4.0	7.7

Conclusion

Nitrogen application favorably influenced the growth, yield attributes and seed yield of Indian mustard up to 100 kg/ha. Increase in seed and stover yields with application of N up to 100 kg/ha of N was significant. Differences among genotypes for seed yield was non-significant. The study indicates that under same agro-climatic conditions, quality mustard genotypes produced similar seed yields and required similar dose of N to that of conventional mustard genotypes.

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