

Growth and yield of Indian mustard as affected by Effects of integrated nutrient management on growth, development and yield contributing characters of Indian mustard (*Brassica juncea* L.) under Doon valley condition of Uttarakhand

Abstract

Aims: To study the effects of integrated nutrient management practices on growth, development and yield of Indian mustard,
Study design: Randomized Block Design
Place and Duration of Study: Agricultural Research Farm Doon (P.G.) College of Agricultural Science and Technology, Selaqui, Dehradun during Rabi season (2023-2024).
Methodology: The experiment was laid out with three replication and ten treatments. The plot size was 4.5m × 3m with high yielding variety 'NRCHB 101' was taken for the study.
Results: Significantly the highest growth parameters at harvest viz. plant height(199.33cm), number of primary and secondary branches(10.00 and 15.66), leaf area index (3.64), dry matter (68.233g plant⁻¹), yield and yield attributing characters i.e. length of siliquae (6.433cm), number of siliquae plant⁻¹(323.667), number of seeds siliquae⁻¹(13.333), test weight (5.57g), grain yield (21.813q ha⁻¹), stover yield (71.343q ha⁻¹), biological yield (93.157q ha⁻¹), harvest index (23.407) were observed in T₁₀ (75% RDFNPK + FYM + Vermicompost + Azotobacter) and the lowest were observed in the in the T₁.
Conclusion: The significantly higher grain yield was observed in T₁₀ (75% RDF + Vermicompost @ 5 ton/ ha + FYM @ 10 ton/ ha + Azotobacter) while lowest in T₁.

Keywords: Azotobacter, Fertility, FYM, Growth, RDF, Vermicompost

1. INTRODUCTION

By 2050, India needs to produce 17.84 mt of vegetable oils for its nutritional fat requirement of projected 1685 million populations. This target is difficult to achieve at current status of technology and resources management in Indian agriculture (Hegde, 2012). Thus, enhancing the productivity of oilseeds is imperative for self-reliance. India holds 11.3 % of world's arable land and only 4% of the water resources to feed 16% of human population and 18% of animal population of the world. India oilseed scenario recently presented a picture of virtual stagnation. The technology mission on oilseed

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launched by government of India in 1986 has impacted to overall production of oilseed significantly. The transformation in mustard scenario is commonly known as “Yellow–Revolution” the quantum jump in production of mustard is to be attributed to the development of improved technology

The oilseeds have an important place in Indian agriculture next to cereals crops. The rapeseed-mustard group broadly includes Indian mustard, yellow sarson, brown sarson, raya, and toria crops. Indian mustard (*Brassica juncea* (L.) Czernj. & Coss.) is predominantly cultivated in Rajasthan, UP, Haryana, Madhya Pradesh, and Gujarat. It is also grown under some nontraditional areas of South India including Karnataka, Tamil Nadu, and Andhra Pradesh. The crop can be raised well under both irrigated and rainfed conditions.

India grows oilseeds on 12–15% of the world's total area, but its production accounts for less than 6–7% of global output, which is insufficient to feed roughly 16% of the world's population. In India, oilseeds are the second most important agricultural product after cereals, accounting for 10% of the value of all agricultural commodities and 13% of the gross cropped area. They also contribute close to 5% of the nation's GDP.

India's rapeseed-mustard acreage for 2022–2023 is estimated at 95.77 lakh hectares, which is lower than the Ministry of Agriculture's projection of 98.02 lakh hectares, based on the primary survey of nine major states (–West Bengal, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Madhya Pradesh, Rajasthan, Uttar Pradesh) and secondary survey of the remaining states,” stated SEA. It has been anticipated that the average productivity for 2022–2023 will be 1,203 kg/ha. Rajasthan is the highest producer of mustard and rapeseed (4.22 million tons) in India, followed by Haryana (1.15 million tons) and Uttar Pradesh (0.96 million tons) (GOI 2020). Mustard seeds range in oil content from 37 to 49%.

Mustard is cultivated mostly under temperate climates. It is also grown in certain tropical and subtropical regions as a cold weather crop. Rapeseed-mustard follows C₃ pathway for carbon assimilation. Therefore, it has efficient photosynthetic response at 15–20°C temperature. At this temperature the plant achieve the maximum CO₂ exchange range which declines thereafter. *Rai* is mostly grown as a rainfed crop, moderately tolerant to soil acidity, preferring a pH from 5.5 to 6.8, thrives in areas with hot days and cool night and can fairly sustain drought. Mustard requires well-drained sandy loam soil. Rapeseed-mustard has a low water requirement (240–400 mm) which fits well in the rainfed cropping systems. Nearly 20% area under these crops is rain fed. 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 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. It promotes flowering, setting of siliquae and increase the size of siliquae and yield (Singh and Meena, 2004). The judicious use of nutrients is very important as our country is importing most of the fertilizers from abroad. Under present situation, focus on nutrient management on mustard needs to

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be changed by integration with other option. The use of total organic or inorganic nutrient sources has some limitations.

The present study was carried out during the *Rabi* season of 2023-2024 at Agricultural Research Farm, Doon (P.G.) College of Agricultural Science and Technology, Selaqui, Dehradun under Doon Valley on the foothills of the Himalayas nestled between Song River, a tributary of Ganga on the east and the Asan river, a tributary of Yamuna on the west. Geographically, the experimental site is situated at 30°36' N latitude, 78°85' E longitude at an elevation of about 538 metres above the sea level. The meteorological data showed that the maximum and minimum temperature during the crop period varied from 21.2-33.9°C and 0.4-10.9°C, respectively.

The experiment was laid out in randomised block with three replication and ten treatments comprising of T₁-Control, T₂-100% RDF of NPK, T₃-100% RDF + FYM @ 10 ton/ha, T₄-100% RDF + Vermicompost @ 5 ton/ha, T₅-100% RDF + *Azotobacter*, T₆-FYM @ 10 ton/ha, T₇-Vermicompost @ 5 ton/ha, T₈-Vermicompost @ 5 ton/ha + FYM @ 10 ton/ha + *Azotobacter*, T₉-75% RDF + Vermicompost @ 5 ton/ha + FYM @ 10 ton/ha, T₁₀-75% RDF + Vermicompost @ 5 ton/ha + FYM @ 10 ton/ha + *Azotobacter*. The plot size maintained was 4.5m × 3m. High Yielding Variety 'NRCHB 101' was taken for the study.

The growth parameters viz. plant height, leaf area index, dry matter accumulation and yield attributes i.e. number of primary and secondary branches, length of siliquae, numbers of siliquae plant⁻¹, numbers of seeds/siliquae⁻¹, test weight, grain yield, stover yield, biological yield, harvest index of Indian mustard and were observed by adopting the standard scientific methods. The statistical analysis of the experimental data was processed by considering the concept of Gomez and Gomez (1984). The analysis of variance (ANOVA), the standard error of means (SEM±) and critical difference (CD) at 5% probability level of significance was analysed through MS Excel software and OP-STAT.

3. RESULTS AND DISCUSSION

3.1 Growth parameters

Significantly the highest plant height was observed in T₁₀ (75% RDF + Vermicompost @ 5 ton/ha + FYM @ 10 ton/ha + *Azotobacter*) at 30 DAS (31.933 cm), 60 DAS (136.333 cm), 90 DAS (194.5 cm) and at harvest (199.33 cm), as well as lowest plant height was observed in T₁. The Fig.1 showed that at harvest the treatment T₉ was observed at par with T₁₀ and there was no significant variation. Significantly the highest number of primary branches plant⁻¹ was observed in the same treatment T₁₀ (75% RDF + Vermicompost @ 5 ton/ha + FYM @ 10 ton/ha + *Azotobacter*) at 60 DAS, 90 DAS and at harvest (10) and lowest number of primary branches plant⁻¹ was observed in T₁ and at 60 DAS, the treatment T₉ was observed at par as well as at 90 DAS the treatment T₇ and T₉ were observed at par and at harvest the treatment T₇ and T₉ were observed at par and there was no significant variation. Significantly the highest number of secondary branches plant⁻¹ was observed in T₁₀ (75% RDF + Vermicompost @ 5 ton/ha + FYM @ 10 ton/ha + *Azotobacter*) at 60 DAS, 90 DAS and at harvest (15.667) while lowest number of secondary branches plant⁻¹ was observed in T₁. The

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treatments T₄, T₅, T₆, T₈ and T₉ were found at par and there was no significant variation at 60 DAS. The significantly highest dry matter (g/plant) was observed in T₁₀ (75% RDF + Vermicompost @ 5 ton/ha + FYM @ 10 ton/ha + Azotobacter) at 30, 60, 90 DAS days after sowing and at harvest (68.233 g plant⁻¹) as well as lowest dry matter was observed in T₁.

The leaf area index was observed at various growth stages and found that significantly the highest leaf area index was observed in T₁₀ (75% RDF + Vermicompost @ 5 ton/ha + FYM @ 10 ton/ha + Azotobacter) at 30, 60, 90 DAS days after sowing while lowest leaf area index was observed in T₁. At 60 days after sowing treatment T₉ was observed at par with other treatments and there was no significant variation.

The significantly highest plant height, number of primary and secondary branches were observed in T₁₀ (75% RDF + Vermicompost @ 5 ton/ha + FYM @ 10 ton/ha + Azotobacter) due to the combined application of NPK, FYM, vermicompost and seed inoculation with Azotobacter because Azotobacter promotes plant growth by producing biologically active substances, stimulating microbes, and modifying nutrient uptake and vermicompost contains enzymes and hormones like auxins and gibberellins which promotes plant growth and thus increase plant height and number of branches in plants.

The significantly highest leaf area index and dry matter (g/plant) were observed in T₁₀ (75% RDF + Vermicompost @ 5 ton/ha + FYM @ 10 ton/ha + Azotobacter) due to the slow decomposition rate of vermicompost in soil which enables plants to assimilate their essential nutrients throughout the growth period and it also reduces soil pH which results in higher dry matter content and leaf area index. Similar results were also observed by

The Similar results were also observed by Anand *et. al.* (2009), Yadav *et. al.* (2018), Kumar *et. al.* (2018), Vinod *et. al.* (2019).

3.2 Yield and yield attributing characters

The significantly highest length of siliquae, number of siliquae per plant, number of seeds siliquae⁻¹, and test weight (g) was observed in T₁₀ (75% RDF + Vermicompost @ 5 ton/ha + FYM @ 10 ton/ha + Azotobacter) while the lowest were observed in T₁.

The Table 1 showed that the significantly highest grain yield (21.813 q ha⁻¹) was observed in T₁₀ (75% RDF + Vermicompost @ 5 ton/ha + FYM @ 10 ton/ha + Azotobacter) and the lowest grain yield was observed in T₁. The significantly highest stover yield (71.343 q ha⁻¹) and biological yield (93.157 q ha⁻¹) were observed in T₁₀ (75% RDF + Vermicompost @ 5 ton/ha + FYM @ 10 ton/ha + Azotobacter) and the lowest were observed in T₁. The significantly highest harvest index (%) was recorded in T₁₀ (75% RDF + Vermicompost @ 5 ton/ha + FYM @ 10 ton/ha + Azotobacter) 23.407 and the lowest harvest index (%) was observed in T₁.

Significantly the highest length of siliquae (cm), number of siliquae plant⁻¹, number of seeds siliquae⁻¹, test weight, grain yield, stover yield, biological yield, and harvest index were observed in T₁₀ (75% RDF + Vermicompost @ 5 ton/ha + FYM @ 10 ton/ha + Azotobacter) due to better nutrient uptake and application of vermicompost increases soil microbial activity, enhances oxygen availability, regulating soil temperature, improves porosity, infiltration, nutrient content and boost crop yield as well as regular supply of nutrients throughout the crop growth period also increases the yield.

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Table 1 - Effects of integrated nutrient management on grain, stover, biological yield (qha⁻¹) and harvest index of mustard

S.No.	Treatments	Grain yield (qha ⁻¹)	Stover yield (qha ⁻¹)	Biological yield (qha ⁻¹)	Harvest Index (%)
T ₁	Control	9.233	39.387	48.753	18.997
T ₂	100% RDF of NPK	14.227	57.67	71.897	20.437
T ₃	100% RDF + FYM (10 ton/ ha)	12.5	53.193	65.693	19.23
T ₄	100% RDF + Vermicompost (5 ton/ ha)	17.483	65.277	82.76	21.507
T ₅	100% RDF + Azotobacter	18.683	66.087	84.77	22.08
T ₆	FYM @ (10 ton/ ha)	18.38	62.173	80.553	20.473
T ₇	Vermicompost @ (5 ton/ha)	19.043	66.223	85.267	22.297
T ₈	Vermicompost @ (5 ton/ha)+ FYM @ (10 ton/ ha + Azotobacter	18.33	65.2	83.507	21.883
T ₉	75% RDF + Vermicompost @ (5 ton/ha)+ FYM @ (10 ton/ ha	20.853	67.77	88.623	22.37
T ₁₀	75% RDF + Vermicompost @ (5 ton/ha) + FYM @ (10 ton/ ha) + Azotobacter	21.813	71.343	93.157	23.407
S. Em±		0.265	0.302	0.398	0.197
CD (P= 0.05)		0.792	0.905	1.192	0.591

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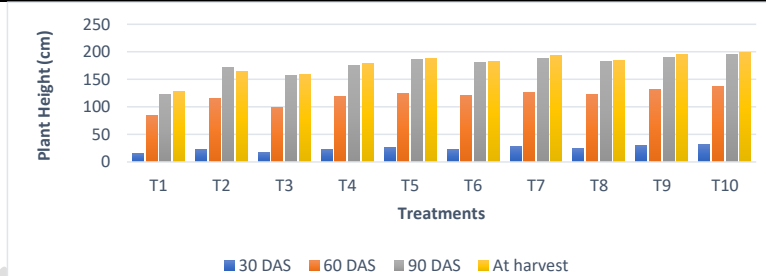


Fig.1 Effects of integrated nutrient management on plant height.

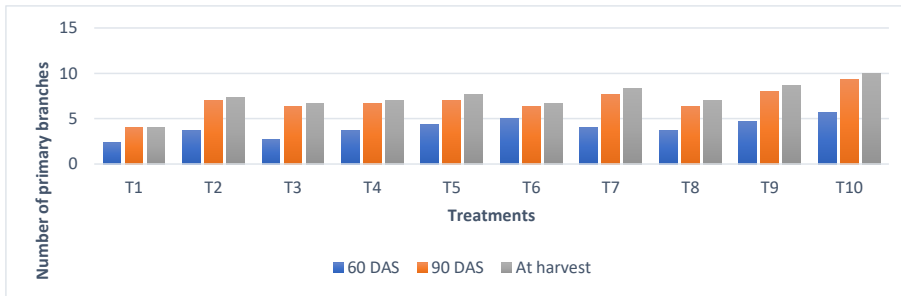


Fig.2 Effects of integrated nutrient management on primary branches⁻¹ of mustard.

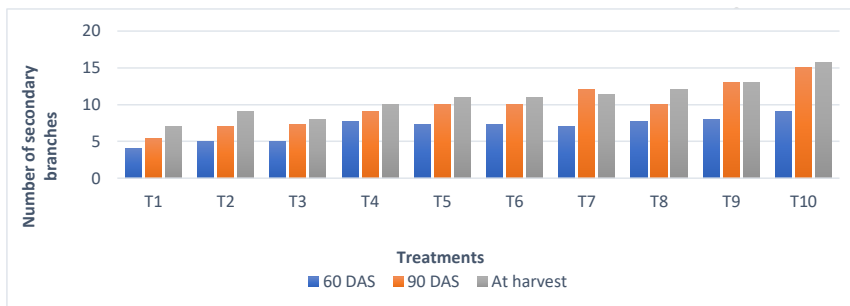


Fig. 3 Effects of integrated nutrient management on secondary branches⁻¹ of mustard.

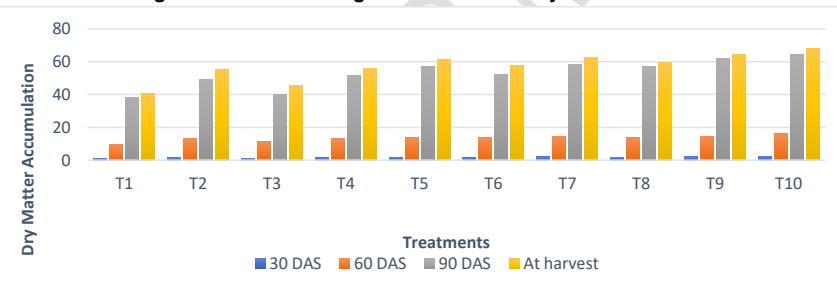


Fig.4 Effects of integrated nutrient management on Dry-dry matter- (gplant⁻¹) of mustard.

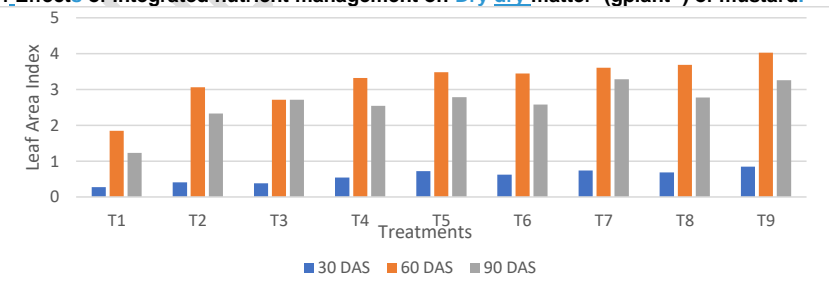


Fig.5Effect of integrated nutrient management on leaf area index

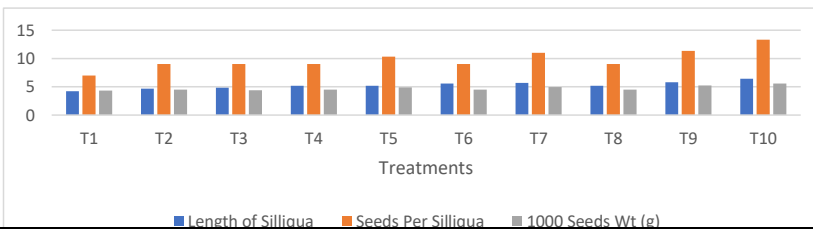


Fig.6 Effects of integrated nutrient management on length of siliquae(cm), seeds siliquae⁻¹ and test weight (g) of mustard.

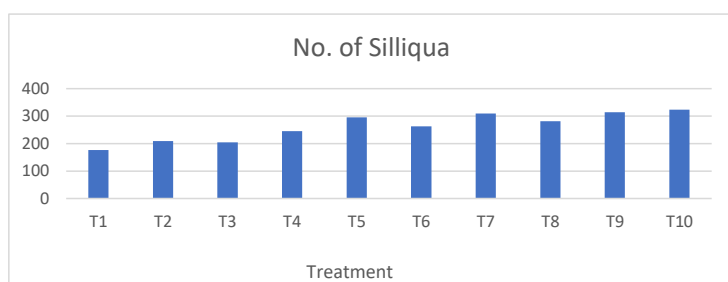


Fig.7 Effects of integrated nutrient management on number of Ssiliquae plant⁻¹ of mustard

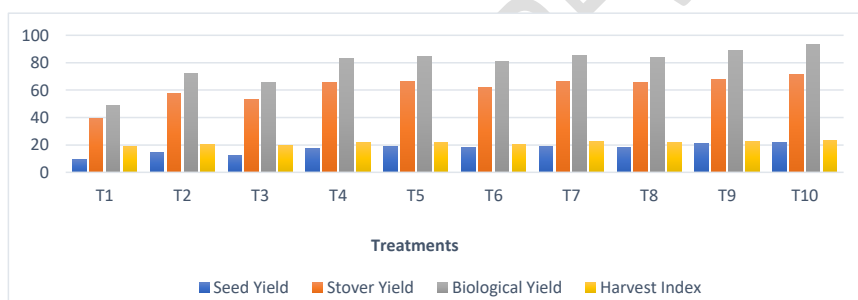


Fig.8 Effects of integrated nutrient management on grain, stover, biological yield(q ha⁻¹)harvest index of mustard

CONCLUSION

Based on the study findings, ~~one could draw the conclusion it can be concluded~~ that the application of only recommended dose of fertilizers is not capable of ~~exploiting-exploring~~ the potential ~~yield~~ of the *Brassica juncea L.* in sustainable manner. Therefore, ~~in addition of supplementary nutrients like Vermicompost, Farm Yard Manure and Azotobacter~~ ~~application of nutrients through integration of inorganic source, vermicompost, FYM and Azotobacter~~ is essential to get the higher production and productivity. The significantly higher grain yield was observed in T₁₀ (75% RDF + Vermicompost @ (5 ton/ ha + FYM @ (10 ton/ ha + Azotobacter) while lowest in T₁.

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