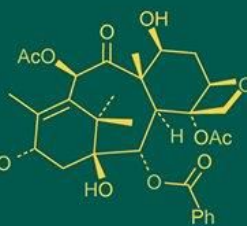


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Effect of fertilizer, bioinoculant and liquid micronutrient on yield and economics of mustard (*Brassica juncea* L.)

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Abstract

A field experiment was carried out at Agronomy Farm, College of Agriculture, Nagpur during *rabi* season of 2024-25 entitled "Effect of fertilizer, bioinoculant and liquid micronutrient on yield and economics of mustard (*Brassica juncea* L.)". The experiment was laid out in Randomized Block Design with eleven treatments and three replications. Among the treatments, application of 100% RDF was at par with treatments 75% RDF + *Azotobacter* + PSB + Consortia and 75% RDF + Consortia + PDKV Liquid Micro grade II significantly higher number of silique plant⁻¹, number of seeds silique⁻¹, seed yield plant⁻¹ (g), test weight, seed yield (q ha⁻¹), straw yield (q ha⁻¹), harvest index, cost of cultivation (₹ ha⁻¹), gross monetary returns (₹ ha⁻¹), net monetary returns (₹ ha⁻¹) and benefit cost ratio were all comparable treatments.

Keywords: Mustard, *azotobacter*, PSB, consortia, PDKV liquid micro grade ii, yield

1. Introduction

India's primary *rabi* oilseed crop is mustard. Rai is the usual term for Indian mustard (*Brassica juncea* (L.), Czern & Coss). Given that the supposed parent species, *B. nigra* and *B. campestris*, would have crossed, the Middle East appears to be the origin. (Mizushima and Tsunoda 1967, Olson 1960) [6-7]. Its seeds contain a suitable amount of linolenic acid (4.5-13%) and erucic acid (40-60%). Due to its abundance of unsaturated fatty acids, mustard oil is good for human consumption and health. According to Brar *et al.*, (2016) [2], seed meal has 14-15% carbs, 35-40% protein, 10-12% fiber, 4-6% ash, 1.0-1.5% vitamins and minerals and only 2-3% glucosinolate.

Besides China and Canada, India is the world's third-largest producer of rapeseed-mustard, accounting for around 14% of global production. According to the ICAR-Indian Institute of Rapeseed-Mustard Research, Bharatpur 2023-24, rapeseed-mustard makes up 30.3% of the total acreage and 33.2% of the production under the nine oilseed crops grown in India. In comparison to the combined oilseed crop production of 1314 kg ha⁻¹, the average yield of rapeseed and mustard is around 1443 kg ha⁻¹. While most states in the nation plant rapeseed-mustard, Rajasthan (45.40%), Madhya Pradesh (13.28%), Uttar Pradesh (14.24%), Haryana (10.78%) and West Bengal (6.0%) account for the majority of production.

The administration of chemical fertilizers in commercial agriculture cannot be completely eliminated. However, integrated applications of multiple fertilizer sources are needed to maintain soil fertility and the desired level of crop output. Depending on how well they mobilize various nutrients, biofertilizers provide a less expensive, less capital-intensive and environmentally friendly way to increase farm output. Micronutrients provide many advantages for agricultural productivity in a variety of climates. At various phases of crop growth, the combined application of chemical fertilizers, bioinoculants and liquid micronutrients shows great promise for improving production qualities, enhancing yield potential and conserving soil health.

2. Materials and Methods

The present experiment was conducted during the *rabi* season of 2024-25 at Agronomy Farm, College of Agriculture, Nagpur.

An experiment was laid out in Randomized Block Design consisting of eleven treatments viz., T₁-100% RDF, T₂-75% RDF + *Azotobacter*, T₃-75% RDF + PSB, T₄-75% RDF + Consortia, T₅-75% RDF + *Azotobacter* + PSB, T₆-75% RDF + *Azotobacter* + Consortia, T₇-75% RDF + PSB + Consortia, T₈-75% RDF + *Azotobacter* + PSB + Consortia, T₉-75% RDF + *Azotobacter* + PDKV Liquid Micro grade II, T₁₀-75% RDF + PSB + PDKV Liquid Micro grade II and T₁₁-75% RDF + Consortia + PDKV Liquid Micro grade II which are replicated thrice. The gross plot size was 5.00 m × 4.50 m. In accordance with the treatments, the seed of mustard variety TAM 108-1 was sown in corresponding plots during first fourth night of November 2024 at a spacing 45 cm × 10 cm. Recommended dose of fertilizer with splitting dose of nitrogen and mustard seeds were treated with biofertilizers at the time of sowing. The foliar spray of PDKV liquid Micro grade II at vegetative stage and flowering stage DAS of mustard was applied. After 10 and 15 days of sowing, gap filling and thinning was done respectively.

Biometric observation like number of siliqua plant⁻¹, five observational plants were counted in order to determine the average number of siliquae, the five observational plant's siliquas were collected, individually threshed and the number of seeds siliqua⁻¹ was counted, seed yield plant⁻¹ (g) was recorded by threshing five observation plants and threshed seeds were separated from stover and weighted, test weight (g) was calculated by weighted 1000 seeds from each treatment with the help of electronic balance, seed yield (q ha⁻¹) arising from harvested produce of each net plot was threshed manually and yield obtained from each net plot was then converted into grain yield q ha⁻¹, straw yield q ha⁻¹ was recorded by separating the threshed seed from straw and then weight it, harvest index is distinct as the ratio of grain yield to the total biological yield (seed and straw) and is expressed in percentage, the total cost of cultivation was calculated by considering the inputs used in each treatment with prevailing market rates, the total value of produce i.e., grain and straw yield was calculated treatment wise as per the prevailing market rate and gross monetary returns were calculated, Net monetary returns were calculated by subtracting the cost of cultivation ha⁻¹ from gross monetary returns ha⁻¹ and the benefit cost ratio was calculated by dividing the gross monetary returns with total cost of cultivation.

3. Results and Discussion

3.1 Yield attributes

3.1.1 Number of siliqua plant⁻¹

Application of 100% RDF (T₁) produced the highest number of siliqua plant⁻¹ (218.57 siliqua) compared to all other treatments, though it was statistically at par with the treatments 75% RDF + *Azotobacter* + PSB + Consortia (T₈) and 75% RDF + Consortia + PDKV Liquid Micro grade II (T₁₁). These results might be due to enhanced vegetative growth and increased photosynthetic activity under recommended dose of fertilizer application, which improved the translocation of assimilates to developing reproductive parts. These findings are in close accordance with those reported by Meena *et al.*, (2013) [4] and Sunil Kumar *et al.*, (2016) [10].

3.1.2 Number of seeds siliqua⁻¹

Application of 100% RDF (T₁) gave significantly higher number of seeds siliqua⁻¹ (12.19 g) over rest of the treatments but was at par with the treatments 75% RDF +

Azotobacter + PSB + Consortia (T₈), 75% RDF + Consortia + PDKV Liquid Micro grade II (T₁₁), 75% RDF + PSB + Consortia (T₇), 75% RDF + *Azotobacter* + Consortia (T₆), 75% RDF + *Azotobacter* + PSB (T₅), 75% RDF + PSB + PDKV Liquid Micro grade II (T₁₀) and 75% RDF + *Azotobacter* + PDKV Liquid Micro grade II (T₉). The observed increase in the number of seeds siliqua⁻¹ due to providing balanced and readily available nutrients that support efficient flowering, fertilization and seed development. Adequate nitrogen and phosphorus supply improves pollen viability and ovule fertilization, resulting in a higher seed set within each siliqua. The results are in consonance with Kumar and Sharma (2018) [3] and Pradeep Dhaka *et al.*, (2023) [9].

3.1.3 Seed yield plant⁻¹ (g)

Among the treatment, application of 100% RDF (T₁) recorded significantly maximum seed yield plant⁻¹ (9.18 g) over rest of the treatments and was at par with the treatments 75% RDF + *Azotobacter* + PSB + Consortia (T₈) and 75% RDF + Consortia + PDKV Liquid Micro grade II (T₁₁) at harvest. The increased seed yield plant⁻¹ (g) was likely due to the abundant nutrient supply provided by the treatment, due to these higher photosynthesis and translocation of assimilates towards reproductive structures which led to greater seed yield production. Similar result on variation in seed yield plant⁻¹ was also reported by Patle *et al.*, (2022) [8] and Pradeep Dhaka *et al.*, (2023) [9].

3.1.4 Test Weight (g)

The test weight (g) of mustard was not significantly influenced by different treatments. The maximum test weight (5.31 g) was found in treatment with 100% RDF (T₁) while the minimum test weight (4.68 g) was recorded in 75% RDF + PSB (T₃).

3.1.5 Seed yield (q ha⁻¹)

Application of 100% RDF (T₁) found significantly highest seed yield (12.08 q ha⁻¹) over all rest of the treatments but was at par with the treatments of 75% RDF + *Azotobacter* + PSB + Consortia (T₈) and 75% RDF + Consortia + PDKV Liquid Micro grade II (T₁₁). The higher seed yield (q ha⁻¹) may be attributed to the integration and consistent supply of mineral fertilizers, particularly nitrogen, which ensured uninterrupted nutrient availability throughout the crop's growth stages. This prevented nutrient stress, promoted vigorous growth and supported efficient assimilate partitioning towards reproductive structures, ultimately resulting in improved seed yield. These results are in accordance with the findings of Pradeep Dhaka *et al.*, (2023) [9] and Tripathy *et al.*, (2023) [11].

3.1.6 Straw yield (q ha⁻¹)

Application of 100% RDF (T₁) found significantly highest straw yield (32.64 q ha⁻¹) over all rest of the treatments but was at par with the 75% RDF + *Azotobacter* + PSB + Consortia (T₈), 75% RDF + Consortia + PDKV Liquid Micro grade II (T₁₁) and 75% RDF + *Azotobacter* + Consortia (T₆). These results might be due to the application of N & P fertilizers, which enhanced phosphorus availability and its active role in promoting root and shoot development, thereby improving overall plant growth and contributing to higher straw yield in mustard. These results are in agreement with those reported by Vinay Singh and R. B. Singh (2020) [12] & Patle *et al.*, (2022) [8].

3.1.7 Harvest index (%)

Numerically highest value of harvest index recorded (27.01%) with 100% RDF (T₁) while the lowest number of

harvest index of mustard was recorded (24.31%) in treatment of 75% RDF + *Azotobacter* (T₂).

Table 1: Yield and yield parameters of mustard as influence by various treatments

Treatments	Number of silique plant ⁻¹	Number of seeds silique ⁻¹	Seed yield plant ⁻¹ (g)	Test weight (g)	Seed yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	Harvest index (%)
T ₁	218.57	12.19	9.18	5.31	12.08	32.64	27.01
T ₂	167.83	9.85	6.52	4.96	8.61	26.81	24.31
T ₃	162.12	9.01	6.15	4.68	8.30	24.73	25.13
T ₄	164.70	9.19	6.34	4.82	8.38	26.01	24.38
T ₅	182.38	11.13	7.28	5.10	9.92	30.31	24.65
T ₆	181.35	11.56	7.29	5.03	10.07	30.90	24.57
T ₇	180.97	11.65	7.25	5.02	9.59	29.41	24.59
T ₈	209.30	12.07	8.90	5.14	11.01	32.23	25.47
T ₉	181.13	10.72	6.96	4.94	8.98	27.83	24.40
T ₁₀	175.87	10.80	6.95	4.82	8.89	27.32	24.55
T ₁₁	205.05	11.98	8.27	5.12	10.92	32.12	25.36
SE (m) ±	11.30	0.72	0.64	NS	0.57	0.77	-
CD at 5%	33.38	2.14	1.88	NS	1.69	2.28	-
GM	184.48	10.92	7.37	4.99	9.70	29.12	24.95

4. Economic studies

4.1 Cost of cultivation (₹ ha⁻¹)

The cost of cultivation found higher with application of 75% RDF + *Azotobacter* + PDKV Liquid Micro grade II (T₉) and 75% RDF + PSB + PDKV Liquid Micro grade II (T₁₀) were ₹ 26799 ha⁻¹ and ₹ 26799 ha⁻¹ respectively. The minimum cost of cultivation found in treatment of 75% RDF + Consortia (T₄) was ₹ 25684 ha⁻¹.

4.2 Gross monetary returns (₹ ha⁻¹)

Application of 100% RDF (T₁) recorded significantly maximum gross monetary returns (₹ 75131 ha⁻¹) than other treatments. The minimum gross monetary returns (GMR) of ₹ 51879 ha⁻¹ were recorded with the application of 75% RDF + PSB (T₃). This was due to produce higher seed and straw yield resulting gave maximum gross returns (₹ ha⁻¹). The similar results were noticed by Mehetre *et al.*, (2019) [5] and Tripathy *et al.*, (2023) [11].

4.3 Net monetary returns (₹ ha⁻¹)

It was observed that, significantly highest net monetary returns recorded with application of 100% RDF (T₁) (₹ 48893 ha⁻¹) over rest of the treatments. This was due to produce higher seed and straw yield resulting gave maximum net returns (₹ ha⁻¹). These findings were in agreement with Meena *et al.*, (2013) [4], Mehetre *et al.*, (2019) [5] and Tripathy *et al.*, (2023) [11].

4.4 B:C ratio

The maximum benefit cost ratio (2.86) of mustard was recorded by application of 100% RDF (T₁) followed by 75% RDF + *Azotobacter* + PSB + Consortia (T₈) & 75% RDF + Consortia + PDKV Liquid Micro grade II (T₁₁) and the lowest benefit cost ratio (2.02) was obtained with the application of 75% RDF + PSB (T₃). Benefit cost ratio was high due to higher production of seed and stover yield of Indian mustard crop.

Table 2: Economics of mustard as influence by various treatments

Treatments	Cost of cultivation (₹ ha ⁻¹)	Gross monetary returns (₹ ha ⁻¹)	Net monetary returns (₹ ha ⁻¹)	B:C ratio
T ₁	26238	75131	48893	2.86
T ₂	25709	53929	28220	2.10
T ₃	25709	51879	26170	2.02
T ₄	25684	52490	26806	2.04
T ₅	25739	62026	36287	2.41
T ₆	25714	62986	37272	2.45
T ₇	25714	60007	34293	2.33
T ₈	25744	68746	43002	2.67
T ₉	26799	56222	29423	2.10
T ₁₀	26799	55637	28838	2.08
T ₁₁	26774	68164	41390	2.55
SE (m) ±	-	3379	3379	-
CD at 5%	-	9969	9969	-
GM	26057	60656	34600	2.33

5. Conclusion

From the present studies, it can be concluded that application of 100% RDF shows higher yield & yield attributing characters and economics viz., number of silique plant⁻¹, number of seeds silique⁻¹, seed yield plant⁻¹ (g), test weight, seed yield (q ha⁻¹), straw yield (q ha⁻¹) and harvest

index also recorded highest value of gross monetary returns, net monetary returns and B:C ratio in mustard crop which comparable with treatment 75% RDF + *Azotobacter* + PSB + Consortia and 75% RDF + Consortia + PDKV Liquid Micro grade II as this was at par to each other.

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