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Enhancing economics and quality of mustard (*Brassica juncea* L.) through bio-fertilizer with nutrient management in central plain zone of U.P.

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Abstract

An experiment was conducted during Rabi season of 2021-22 at the Student Instructional Farm of Chandra Shekhar Azad University Agriculture & Technology, Kanpur (U.P.). To find out the suitable dose of nutrients and bio-fertilizer on economic and quality of mustard crop. The experiment was laid out in a Factorial Randomized Block Design with three replication. The experiment was comprised of sixteen treatment combinations in which four levels of nutrient management viz., Control, 75% RDF, 100% RDF, 125% RDF and four levels of bio-fertilizer viz., Control, Azotobacter @10 ml kg⁻¹ seed, PSB @10 ml kg⁻¹ seed, Azotob. @ 5ml + PSB @ 5ml kg⁻¹ seed. The result showed that the different nutrient management, applied of 125% RDF gave significantly better grain yield (18.74 q ha⁻¹), gross income (Rs. 104725.60 ha⁻¹), net income (Rs. 64388.39 ha⁻¹) and B:C ratio (2.60) and quality aspects viz., oil content (39.19%), oil yield (735.05 kg ha⁻¹), protein content (19.99%), and protein yield (374.85 kg ha⁻¹) in compare to control, 75% and 100% RDF, respectively. Application of bio-fertilizer, as Azotobacter @5 ml + PSB @5 ml kg⁻¹ seed gave significantly higher seed yield (18.11q ha⁻¹), gross income (Rs. 101278.90 ha⁻¹), net income (Rs. 63109.26 ha⁻¹), B:C ratio (2.63) oil content (39.20%), oil yield (658.95 Kg ha⁻¹), protein content (19.91%) and protein yield (361.06 Kg ha⁻¹) in compare to rest nutrient management. Therefore, the application of 125% RDF with Azotob. @5 ml + PSB @5 ml kg⁻¹ seed resulted significantly higher grain yield (21.75 q ha⁻¹), gross income (Rs. 121370.00 ha⁻¹), net income (Rs. 81007.50 ha⁻¹) and B: C ratio (3.00) during Rabi season of mustard crop.

Keywords: Economics, quality, nutrient management, bio-fertilizer, mustard

Introduction

Oilseed crops are the most important commercial crops in India. Indian mustard (*Brassica juncea* L.) is the most popular one among different species of rapeseed and mustard grown in India. Mustard oil production in India is estimated to increase by 28.5% (8.2 lakh tons) to 3.67 million tonnes in the 2021-22 crop year, whereas in 2020-21, 2.85 million tonnes was produced. (Anonymous, 2022) [1]. Although, a number of factor are responsible for low productivity mainly imbalance fertilization. Apart from bio-fertilizer and judicious use of Azotobacter and PSB without accompanying use of adequate amount of nutrient leads to nutrient mining and imbalance resulting in now a day we are facing crisis of low soil fertility hidden hunger and low factor productivity optimum amount and balanced fertilization is critically required for achieving higher yield from bio-fertilizer. Primary nutrients i.e. nitrogen, phosphorous and potash play a pivoted role in crop yield. Therefore this study was initiated to evaluate the various levels of nutrients on the productivity profitability and quality of Indian mustard.

Materials and Method

The study was undertaken during Rabi season of 2021-22 at the Student Instructional Farm of Chandra Shekhar Azad University Agriculture and Technology, Kanpur, (U.P.) The soil of experimental field was sandy loam in texture, pH is slightly alkaline (7.3). The experiment was laid out in a Factorial Randomized Block Design with three replications in which four Nutrient management viz., Control, 75% RDF, 100% RDF and 125% RDF and four Bio-fertilizer viz., Control, Azotobacter @10 ml kg⁻¹ seed, PSB @10 ml kg⁻¹ seed, Azotob. @ 5ml + PSB @ 5ml kg⁻¹ seed. The seeds were inoculated by Azotobacter and PSB spp. as per treatments. The recommended dose of fertilizer 120:40:40 NPK. Nitrogen fertilizer was applied split dose with phosphatic and potassium fertilizer used in basal dose.

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Urea, DAP and MOP were used as source of fertilizer. Indian mustard variety (Azad Mahak) was sown on dated 31 Oct. 2021 with seed rate 6 kg ha⁻¹ and harvested at 23 March, 2022. The light irrigation was applied after germination and two post irrigations were given to crop. Other management practices were adopted as per recommendation of the crop grown under irrigated conditions.

Results and Discussion

Effect of Nutrient Management

The yield and economics of mustard were significantly with increasing doses of nutrients of 125% RDF in present study in Table. The used of 125% RDF enhanced grain yield by 18.74 Kg ha⁻¹, gross income by Rs. 104725.60 ha⁻¹, net income by Rs. 64388.39 ha⁻¹ and B:C ratio by 2.60, over 0, 75% RDF and 100% RDF, respectively. The percentage increment of 125% RDF over control, 75% RDF and 100% RDF were 38.51%, 19.74% and 10.95% in respect of grain yield, 38.04%, 19.50% and 10.80% in gross return, 57.09%, 29.98% and 16.49% in net return and 19.26%, 13.04% and 8.79% in benefit cost ratio, respectively. This could be attributed to higher seeds yield and stover yield with low cost input these results are in conformity with those reported by Singh and Pal (2011) [11], Chaurasiya *et al.* (2019) [2], Patel *et al.* (2022) [8], Gora *et al.* (2022) [3].

The results showed in Table that quality parameter *viz.*, oil content in seed, oil yield (kg ha⁻¹), protein content in seed and protein yield kg ha⁻¹ were significantly increased with application of 125% recommended dose of fertilizer. The maximum oil content (39.19%) in seed, oil yield (735.05 kg ha⁻¹), protein content (19.99%) in seed and protein yield (374.85 kg ha⁻¹) were observed in 125% RDF while the minimum oil content (38.46%) in seed, oil yield (520.26 kg ha⁻¹), protein content (19.50%) in seed and protein yield (263.97 kg ha⁻¹) were observed in control treatment. The increment evaluated in oil content 1.90%, 1.21% and 0.38%, in oil yield 41.28%, 21.24% and 11.42%, in protein content 2.51%, 1.11% and 1.36% and in protein 42.00%, 21.10% and 12.09% over control, 75% RDF and 100% RDF, respectively. Combined nutrients (NPK) application, recorded in enhancing the oil content leading to higher oil yield as result of enhance seed yield. Similar finding where reported by Mohiuddin *et*

al. (2011) [7], Potdar *et al.* (2019) [9].

Effect of Bio-fertilizer

The different dose of bio-fertilizer affected the yield and economic of mustard. The Azotobacter @5 ml Kg⁻¹ with PSB @5 ml Kg⁻¹ seed enhanced the grain yield of mustard (18.12 q ha⁻¹) over rest treatment, respectively. The maximum gross income (Rs. 101278 ha⁻¹), net income (Rs. 63109.26 ha⁻¹) and B:C ratio (2.63) were significantly recorded in Azotobacter @5 ml + PSB @5 ml kg⁻¹ seed over rest nutrient management of treatment whereas, the minimum gross income (Rs. 78516.63 ha⁻¹), net income (Rs. 40492.75 ha⁻¹) and B:C ratio (2.07) were recorded in control treatment. The percentage gain of seed yield (29.24%, 14.68% and 7.35%), gross income (28.99%, 14.42% and 7.24%), net income (55.85%, 25.42% and 12.38%) and B:C ratio (27.05%, 13.85% and 6.91%) over 0, Azotob. @10 ml kg⁻¹ seed and PSB @10 ml kg⁻¹ seed, respectively. This could be attributed to higher seed yield low cost input. Hence, bio-fertilizer, being a low cost input found economical over no bio-fertilizers where also reported by Meena *et al.* (2013) [6], Reddy *et al.* (2018) [10], Vijayeswarudu *et al.* (2021) [12].

The quality parameter *viz.*, oil content (%) in seed, oil yield (kg ha⁻¹), protein content (%) in seed and protein yield kg ha⁻¹ were significantly increased with application of Azotobacter @5 ml + PSB @5 ml kg⁻¹ seed. The maximum oil content (39.20%) in seed, oil yield (710.92 kg ha⁻¹), protein content (19.99%) in seed and protein yield (361.60 kg ha⁻¹) were observed in Azotobacter @5 ml + PSB @5 ml kg⁻¹ seed while, the minimum oil content (38.45%) in seed, oil yield (539.06 kg ha⁻¹), protein content (19.57%) in seed and protein yield (274.43 kg ha⁻¹) were observed in control treatment. The gain assessment of Azotob. @5 ml + PSB @5 ml kg⁻¹ seed over control, Azotobacter @10 ml kg⁻¹ seed and PSB @10 ml kg⁻¹ seed were 1.95%, 1.21% and 0.48% in oil content, 31.88%, 16.08% and 7.88% in oil yield, 1.73%, 0.86% and 0.75% in protein content and 31.56%, 15.66% and 7.75% in protein yield, respectively. The treatment receiving Azotobacter + PSB inoculation recorded higher oil content as well as oil yield in mustard found significantly superior to no inoculation (control). Similar findings were also reported by, Hadiyal *et al.* (2017) [4], Kumar *et al.* (2019) [5].

Table: Effect of nutrient management and bio-fertilizer on yield, economics and quality of mustard

Treatment	Grain yield (Kg ha ⁻¹)	Economics			Quality parameter			
		Gross income (Rs ha ⁻¹)	Net income (Rs ha ⁻¹)	B:C ratio	Oil content	Oil yield (kg ha ⁻¹)	Protein content	Protein yield (Kg ha ⁻¹)
Nutrient management								
Control	13.53	75866.01	40985.76	2.18	38.46	520.26	19.50	263.97
75% RDF	15.65	87633.00	49534.00	2.30	38.72	606.26	19.77	309.53
100% RDF	16.89	94517.00	55275.88	2.39	39.04	659.71	19.72	334.39
125% RDF	18.74	104725.60	64388.39	2.60	39.19	735.05	19.99	374.85
S.E.(d)±	0.614	2349.192	1383.782	0.062	0.067	7.457	0.064	3.361
C.D. at 5%	1.254	4820.896	2839.729	0.126	0.136	15.234	0.130	6.865
Levels of Bio-fertilizer								
Control	14.02	78516.63	40492.75	2.07	38.45	539.06	19.57	274.43
Azotobacter @10 ml kg ⁻¹ seed	15.80	88510.25	50315.63	2.31	38.73	612.39	19.74	312.15
PSB @10 ml kg ⁻¹ seed	16.88	94435.90	56266.39	2.46	39.01	658.95	19.76	335.09
Azotob. @5 ml + PSB @5 ml kg ⁻¹ seed	18.12	101278.90	63109.26	2.63	39.20	710.92	19.91	361.06
S.D.(d)±	0.614	2349.192	1383.782	0.062	0.067	7.457	0.064	3.361
C.D. at 5%	1.254	4820.896	2839.729	0.126	0.136	15.234	0.130	6.865

Conclusion

On the basis of results from experimentation, it can be concluded that higher production and more net returns with better quality of Indian mustard (var. Azad Mahak) under central plane zone of India can be achieved by application of 125% recommended dose of fertilizer and inoculation with Azotobacter + PSB spp. (each @5 ml kg⁻¹ seed).

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