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Influence of Bio-fertilizer and Fertility Levels on Growth and Yield of Indian Mustard (*Brassica juncea* L.)

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ABSTRACT: The field experiment was driven during *Rabi* 2018 at Research Farm, Selakui, Dehradun, Uttarakhand. The treatment consists of two different bio-fertilizers (Azotobacter and Phosforus solubilizing bacteria) and three different nutrient level 75% RDNP, 100% RDNP and 125% RDNP, whose effect was perceive on Indian mustard. The trial was laid out in Randomized Block Design in which consist of eight treatments which are replicated thrice. The outcome manifest that utilization azotobacter + PSB with 125% RDNP (N 112.5 7 P 50 kg/ha) remarkably increased the growth variables of Indian mustard viz, plant extent (174.76 cm), Dry matter accumulation (47.90 g/ plant), number of primary branches (7.67), no. of functional leaves (18.40). Application of Azotobacter + PSB in crop with 125% fertility level significantly lofty Leaf area index (4.42 per plant) at 90 DAS. Using of Azotobacter + PSB with 112.5 nitrogen & 50 kg phosforus per ha showed significantly higher the yield parameters *viz,* siliqua per plant (140.75), total size of siliqua (4.78 cm), mean seed per siliqua (12.12), total seed weight (1717 kg/ha), Stover yield (4355 kg/ ha). However, Harvest index (28.28 %) was notably recorded in treatment Azotobacter + PSB + N 112.5 kg/ ha + P 50 kg/ha. So, the combined effect of growth and yield traits were ultimate review in production of highest seed yield by sowing of Indian mustard with utilization of Azotobactor + PSB + N 112.5 & P 50 kg per ha and only N 112.5 & P 50 application should be put forwarded for farmers of that locality of Uttarakhand.

Keywords: Indian mustard, Azotobacter, PSB, Nitrogen, Growth.

INTRODUCTION

Oilseeds have prestigious place in Indian agriculture next to cereals. Oilseeds are the most important crops in India both in respect of remunerative return per unit area and wider adaptability under constrained agro-climatic conditions. India is world's fourth largest edible oil economy after the U.S., China and Brazil, and is the second largest importer after China. India accounts for seven per cent of global oilseeds output; seven per cent of global oil meal production; six per cent of global oil meal exports; six per cent of global vegetable oil production; 14 per cent of global vegetable oil imports; and 10 per cent of global edible oils. India is the largest rapeseed-mustard growing country in the world, occupying the first position in area and second position in production after China. The estimated area, production and yield of rapeseed-mustard in the world was 355.20 lakh ha, 714.50 lakh t and 2010 kg ha^{-1}, respectively, during 2015-16. Rapeseed-mustard seed cultivation is carried out widely in 13 states of India. However, most production takes place in the states of Rajasthan (48.6 per cent); Uttar Pradesh (13.4 per cent), Haryana (11.4 per cent), Madhya Pradesh (9 per cent), Gujarat (6 per cent) and West Bengal (5 per cent), Assam (1.7 per cent), Bihar (1.1 per cent), Punjab (0.6 per cent) and other states (2.4 per cent) (krishikosh.egranth.ac.in). During 2016-17, rapeseed-mustard contributed 25.9% and 22.0% to the total oilseeds production and acreage, respectively (Anonymous, 2017). Indian mustard accounts over area of 6.412 m ha with an annual production of 6.33 mt and productivity of 1184 kg ha^{-1} (AICRP- 2017).

Bio-fertilizers are known to play a number of vital roles in soil fertility, crop productivity and production in agriculture as they are ecofriendly but cannot at any cost replace chemical fertilizers that are indispensable for getting maximum crop yields. They supplement chemical fertilizers for meeting the integrated nutrient demand of the crops. Application of bio-fertilizers results in increased mineral and water uptake, root development, vegetative growth and nitrogen fixation (Kumar *et al*., 1999).

Azotobacter inoculants when applied to many non-leguminous crop plants, promote seed germination and initial vigor of plants by producing growth promoting substances. Bacterial rot and sclerotina rot of mustard significantly reduced with application of Azotobacter (Suneja *et al.,* 1994). Azotobacter showed maximum response to various yield variables as well disease intensity for Alternaria blight, white rust and stage head formation (mafiadoc.com)

Besides bio fertilizers, all the major nutrients *viz*., nitrogen, phosforus and potassium play important role in increasing the quality of mustard. Nitrogen is known to activate most of metabolic activities and transformation of energy. Phosforus is essential for cell division and meristematic growth of tissue. It also helps in seed and fruit development and in stimulates flowering as well (Dubey *et al.*, 2000).

Although chemical fertilizers are scarce and costly, it is necessary to use them thrifty in merger with bio fertilizers. In view of above outline, a field trail was laid out to study the effect of Bio fertilizer and fertility levels on growth and yield of Indian mustard.

MATERIALS AND METHODS

The experiment was conducted during the *Rabi* season 2018, at the Research Farm, Selakui, Dehradun, Uttarakhand, India which is located at geographical coordinate's 30°19'59"N latitude, 77°57' 39" E longitude and 648 m altitude above the mean sea level. Location of Farm is about 10 Km towards west from District head quarters Dehradun 11 Km from State capital Dehradun. The annual rainfall is 2073.3 mm. The experimental soil contained organic carbon 0.91%, available phosforus 36.34 kg ha^{-1}, available nitrogen 228.6 kg ha^{-1} with p^H 6.67 and electrical conductivity of 0.38 (dS m^{-1}). Experiment was laid out in randomized block design, in which eight treatments which is replicated thrice. The treatment consists of two different Bio fertilizer (Azotobacter and PSB) and three different nutrient levels 75% RDNP, 100% RDNP and 125% RDNP, whose effect was observed on Indian mustard. The recommended dose of fertilizer is nitrogen 90 kg, phosforus 40 kg and sulfur 40 kg which were given as a basal dose at time of sowing and top dressing Nitrogen, phosforus and potash used in form of urea, diammonium phosphate and muraite of potash respectively (www.researchtrend.net). Seed was treated with Azotobacter and PSB. For plant protection purpose Imidacloprid and chlorpyriphos were used. In all plots 5 plants were tagged for observation recording and yield recording from net plot. Under growth variables plant height, average primary branches, mean number of leaves, average number of siliquae, length of siliquae were recorded from tagged plants at consistent meantime. Wherever, anhydrous basis, leaf area and leaf area index (LAI) different sampling method were workout observation for 5 uprooted plants from outer line up of each and every plots.

The details assembled were set out in appropriate tables and analyzed statistically by applying analysis of variance technique (ANOVA) (Gomez and Gomez1984). The significance of variance was tested by error mean square method of Fisher Snedecor's F-test at the probability level of 0.05 for appropriate degree of freedom ($p<0.05$). Standard error of mean *i.e.* S.Em (+) were used in all cases.

RESULTS AND DISCUSSION

The results of recorded observation were discussed below:

Effect on growth variables. The plant vertical extension plays a vital in outstanding yield production. During research trial growth parameter of Indian mustard indicate that the treatment Azotobacter + PSB + N 112.5, P 50 Kg/ha respectively recorded crucially plant height (174.76 cm), mean functional number of leaves (18.40 cm), dry matter accumulation (47.90) & average primary branches (7.67) followed by treatment N 112.5, P 50 kg/ha respectively (125% RDNP) in which plant vertical growth (172.80 cm), average number of leaves (18.07) recorded. Application of azotobacter, PSB & nitrogen 112.5 kg/ha gained much more growing in vertical direction as compare to only application of nitrogen and phosforus, this happened due to competitive deportment of plants for more nitrogen (Janaki *et al.*, 2022).

The total higher average primary branches (7.67) recorded in application of Azotobacter + PSB + N 112.5, P 50 Kg/ha. However, application nitrogen 112.5 kg/ha, phosforus 50 kg/ha recorded branches (7.17).

Using of Azotobacter, PSB & nitrogen 112.5, phosforus 50 kg/ha in field recorded significantly higher anhydrous basis (47.90 g) per plant. Where, application of nitrogen 112.5 kg/ ha and phosforus 50 kg/ha (45.53 g) found to be just at par to higher combination. This might be due to bona fide adjustment of plants which clarify more photosynthesis, interception of light and easy aeration.

The inflated leaf area index (4.42) observed in combined nutrient application *i.e.* Azotobacter, PSB & 125% RDNP due to more nitrogen fixation by microbes.

Effect on yield and yield variables. The different yield variables were influenced significantly due to various treatments. Maximum number of siliquae per plant (140.75) and seed yield per hectare (1717 kg/ha) were found in 125 % RDNP + Azotobactor +PSB, followed by 125 % RDNP treatment. The highest stover yield 4355 kg/ha was recorded in Azotobactor +PSB +125 % RDNP which was at par with 125 % RDNP. Similar trend was seen in figure of seeds siliquae per plant. 1000 seed weight was found non-significant showing

that seed size was not much inveigled by various treatments. The stunted figure of siliquae per plant (108.68), seed yield per hectare (910 kg) & stover yield per hectare (2567 kg) were take down in control. Above findings comply with the findings of Gudadhe *et al*. (2005).

Thus, insertion of azotobactor and PSB with 125 % RDNP as well as 100 % RDNP gave significantly more value or at par value.

Table 1: Influence of Bio-fertilizer and Fertility levels on Growth variables of Indian mustard.

Treatments	At 90 DAS				
	Plant extent (cm)	Primary Branches (No.)	Leaves per plant (No.)	Plant dry weight (g)	Leaf Area Index (LAI)
Control	114.53	5.17	14.30	34.03	3.01
$N_{67.5}$ P_{30} (75% RDNP)	158.00	5.70	15.97	37.70	3.45
N_{90} P_{40} (100% RDNP)*	165.60	6.23	16.40	40.67	3.86
$N_{112.5}$ P_{50} (125% RDNP)	172.80	7.17	18.07	45.53	4.37
Azotobacter + PSB	129.33	5.47	14.80	35.53	3.17
Azotobacter + PSB + $N_{67.5}$ P_{30} (75% RDNP)	162.33	5.93	16.17	40.00	3.63
Azotobacter + PSB + N_{90} P_{40} (100% RDNP)	168.97	6.87	17.96	45.23	4.32
Azotobacter + PSB + $N_{112.5}$ P_{50} (125% RDNP)	174.76	7.67	18.40	47.90	4.42
S.Em(±)	2.76	0.40	0.38	1.04	0.05
CD (P=0.05)	8.37	1.20	1.15	3.15	0.16

*100% Recommended Dose of Nitrogen &Phosforus (RDNP): 90 kg N & 40 kg P_2O_5 per ha.

Table 2: Influence of Bio-fertilizer and Fertility levels on Yield variables of Indian mustard.

Treatments	At harvest			
	Siliqua per plant (No.)	Length of siliqua (cm)	Seeds per siliqua (No.)	1000-seed weight (g)
Control	108.68	4.08	9.69	3.75
$N_{67.5}$ P_{30} (75% RDNP)	116.40	4.28	10.80	4.28
N_{90} P_{40} (100% RDNP)*	121.34	4.34	10.28	4.62
$N_{112.5}$ P_{50} (125% RDNP)	138.33	4.76	11.70	4.81
Azotobacter + PSB	111.76	4.20	9.76	4.00
Azotobacter + PSB + $N_{67.5}$ P_{30} (75% RDNP)	117.79	4.37	10.17	4.61
Azotobacter + PSB + N_{90} P_{40} (100% RDNP)	136.83	4.52	11.64	4.78
Azotobacter + PSB + $N_{112.5}$ P_{50} (125% RDNP)	140.75	4.78	12.12	4.89
S.Em(±)	2.06	0.12	0.48	0.07
CD (P= 0.05)	6.27	0.36	1.47	0.21

*100% Recommended Dose of Nitrogen & Phosforus (RDNP): 90 kg N & 40 kg P_2O_5 per ha.

Table 3: Influence of Bio-fertilizer and Fertility levels on Yield of Indian mustard.

Treatments	Yield (kg per ha)		Harvest index (%)
	Seed	Stover	
Control	910	2567	26.14
$N_{67.5}$ P_{30} (75% RDNP)	1166	3590	24.48
N_{90} P_{40} (100% RDNP)*	1458	4074	26.29
$N_{112.5}$ P_{50} (125% RDNP)	1714	4267	28.43
Azotobacter + PSB	967	2714	26.27
Azotobacter + PSB + $N_{67.5}$ P_{30} (75% RDNP)	1399	3944	26.19
Azotobacter + PSB + N_{90} P_{40} (100% RDNP)	1681	4240	28.40
Azotobacter + PSB + $N_{112.5}$ P_{50} (125% RDNP)	1717	4355	28.28
S.Em(±)	34	70	0.60
CD (P= 0.05)	104	211	1.82

*100% Recommended Dose of Nitrogen & Phosforus (RDNP): 90 kg N & 40 kg P_2O_5 per ha.

CONCLUSION

Based on result acquired under the study it can be concluded that integrated inoculation of Azotobactor & PSB along with 112.5 kg nitrogen & 50 kg phosforus per hectare gave maximum output production in Indian mustard.

Conflict of Interest. None.

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