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Original Research Article

Response of Nitrogen and *Azotobactor* on Yield of Mustard (*Brassica juncea* L.)

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Keywords

Nitrogen, *Azotobactor*, on Yield, Mustard (*Brassica Juncea* L.)

A B S T R A C T

The experiment was conducted at the instructional Farm of Acharya Narendra Deva University of Agriculture & technology, Kumarganj, Ayodhya (U.P.) during *Rabi* seasons of 2017-18. The experiment was conducted in randomized bloc design with three replication and ten treatments. The treatments were included, T_1- Control ($N_0P_{60}K_{40}S_{35}$ kg ha^{-1}) T_2- Control + *Azotobacter*, T_3- 20 kg N ha^{-1}, T_4- 20 kg N ha^{-1}+ *Azotobacter*, T_5- 40 kg N ha^{-1}, T_6 - 40 kg N ha^{-1}+ *Azotobacter*, T_7 – 60 kg N ha^{-1}, T_8 – 60 kg N ha^{-1} + *Azotobacter*, T_9- 80 kg N ha^{-1}, T_{10}- 80 kg N ha^{-1}. The soil of experimental field was silty loam in texture, having pH 8.2, EC 0.24 dSm^{-1}, organic carbon 0.32%, low available nitrogen (175.18 kg ha^{-1}), medium in available phosphorus (14.80 kg ha^{-1}) and potassium (255.20 kg ha^{-1}) and low in available sulphur (10.21 kg ha^{-1}) with pH of the soil. Application of 80 kg N ha^{-1} with and without *Azotobacter* inoculation was found better result on growth, yield attributes and yield of mustard. 80 kg N ha^{-1} following 6 kg P_2O_5 ha^{-1} was also found better results on nutrient content (N, P, K, S) with without *Azotobacter* inoculation. The maximum benefit-cost ratio (1.5) was recorded with T_{10} (80 kg N ha^{-1} + *Azotobacter*). On the basis of above findings application of 80 kg N ha^{-1} was found better dose to obtained grain yield and its attributes in mustard crop. However economically the same treatments give better response.

Introduction

India is the third largest producer of rapeseed mustard (*Brasica juncea* L.) in world after China and Canada. The producer of rapeseed and mustard in India is around 16.2 million tonnes which accounts for 18% of total oilseed production of country. Total production of oilseed crop was 50.8 lakh tonnes in 1950-51 which has increased to 31.31 million tonnes in 2017-18 which is marginally higher than the production of 31.28 million tonnes than the average oilseed production of oilseed during 2017-18 is higher by 1.76 million tonnes that the average oilseed production. The total rapeseed and mustard production in 2016-17 is 7.98 million tonnes which is increased 8.32 million tonnes hectares (33.8%) for mustard cultivation in India (Anonymous, 2017). Mustard is the main oilseed crop for the *rabi* season which is planted on more that 80 per cent area covered under oilseeds. Rajasthan, Uttar Pradesh, Madhya Pradesh, Haryana and

Gujarat are highest sown states of mustard seed accounting for more that 70 per cent of total mustard acreage in the country. New yielding varieties of mustard are responsive to various management practices including higher dose of fertilizer. Out of rapeseed and mustard group of crop, mustard is most responsive to fertilizer and other agronomic practices. The information available on response of high yielding newly evolved mustard variety to *Azotobacter* and nitrogen in meagre. Nitrogen is the most important nutrient and being a constituent protoplasm and protein, it is involved in several metabolic process that strongly influence growth, productivity and quality of crop.

Materials and Methods

The field experiments was conducted at instructional Form of ANDUAT, Kumarganj, Ayodhya U.P. during *rabi* season of 2017-18. The experiment was conducted in randomized block design with three replication and ten treatments. The treatments were included, T_1- Control ($N_0P_{60}K_{40}S_{35}$ kg ha^{-1}) T_2- Control + *Azotobacter*, T_3- 20 kg N ha^{-1}, T_4- 20 kg N ha^{-1}+ *Azotobacter*, T_5- 40 kg N ha^{-1}, T_6 - 40 kg N ha^{-1}+ *Azotobacter*, T_7 – 60 kg N ha^{-1}, T_8 – 60 kg N ha^{-1} + *Azotobacter*, T_9- 80 kg N ha^{-1}, T_{10}- 80 kg N ha^{-1}. The soil of experimental field was silty loam in texture, having pH 8.2, EC 0.24 dSm^{-1}, organic carbon 0.32%, low available nitrogen (175.18 kg ha^{-1}), medium in available phosphorus (14.80 kg ha^{-1}) and potassium (255.20 kg ha^{-1}) and low in available sulphur (10.21 kg ha^{-1}). Half dose of nitrogen and full dose of phosphorus, potash and sulphur were applied at the time of mustard sowing and remaining dose of nitrogen was applied at top dressing at 30 DAS. Seeds were also treated as per treatments before sowing with biofertilizer (*Azotobacter*). The mustard variety Varuna was raised follow the GAP of the region soil parameter was analysed by standard laboratory methods.

Results and Discussion

Growth and yield of mustard increased with increasing dose of nitrogen upto 80 kg ha^{-1} with and without *Azotobacter* as compared with control. Treatment T_{10} (80 kg N ha^{-1} + *Azotobacter*) was found better (Plant height, stover yield, seed yield and oil content) over rest of the treatments. Maximum plant height (148.80 cm), stover yield (44.30 qha^{-1}), seed yield (18.80 q ha^{-1}), oil yield (7.82 q ha^{-1}) and B:C ratio (1.5) were recorded with T_{10} (80 kg N ha^{-1} + *Azotobacter*) treatment. This was mainly due to higher concentration and fast solubilisation of nutrients. This result was conformity with the finding of (Singh and Kumar, 2014).

Further results revealed that increasing dose of nitrogen significantly increase the nutrients contents in grain. Maximum nutrients contents i.e. N (3.38%), P (0.44%), K (0.55%) and S (0.71%) were found in T_{10} treatment where nitrogen was applied @ 80 kg N ha^{-1} along with *Azotobacter*. This was mainly due to better utilization of nutrients to mustard crop. The finding is closely supported with (Sahoo *et al.*, 2010).

Soil properties of experimental field not affected significantly with the various treatments except nitrogen content. Non significant variation was recorded on pH, EC, available P, available K and available S. However in available N significant variation was recorded under T_{10} treatment as compared to control plot. Maximum availability of nutrients was found under T_{10} treatment (80 kg N ha^{-1} + *Azotobacter*). This was mainly due to nitrogen and *Azotobacter* application. *Azotobacter* increases the nitrogen status in soil due to addition of atmospheric N in soil. These results confirmed by Gopal *et al.*, (2018).

Table.1 Response of nitrogen and *Azotobacter* on the plant height, stover yield, grain yield, oil yield and B:C ratio in mustard\

Treatments		Plant height at 90 DAS (cm)	Stover yield (q ha^{-1})	Seed yield (q ha^{-1})	Oil yield (q ha^{-1})	B:C ratio
T_1	Control ($N_0P_{60}K_{40}S_{35}$ kg ha^{-1})	94.18	28.50	9.60	3.61	0.3
T_2	Control + *Azotobacter*	102.90	29.41	10.50	4.04	0.4
T_3	20 kg N ha^{-1}	115.33	35.33	13.20	5.14	0.8
T_4	20 kg N ha^{-1}+ *Azotobacter*	119.00	37.20	14.00	5.52	0.9
T_5	40 kg N ha^{-1}	127.05	39.30	15.50	6.16	1.1
T_6	40 kg N ha^{-1}+ *Azotobacter*	132.13	40.40	16.10	6.47	1.2
T_7	60 kg N ha^{-1}	138.25	41.60	17.60	6.91	1.3
T_8	60 kg N ha^{-1} + *Azotobacter*	141.58	43.20	17.90	7.36	1.4
T_9	80 kg N ha^{-1}	143.50	44.10	18.40	7.62	1.4
T_{10}	80 kg N ha^{-1}+ *Azotobacter*	148.05	44.30	18.80	7.82	1.5
	SEm±	5.08	1.82	0.67	0.25	-
	CD at 5%	15.11	5.40	2.00	0.75	-

Table.2 Response of nitrogen and *Azotobacter* on N, P, K, S content (%) in grain of mustard

Treatments		N content in grain	P content in grain	K content in grain	S content in grain
T_1	Control ($N_0P_{60}K_{40}S_{35}$ kg ha^{-1})	2.80	0.29	0.37	0.48
T_2	Control + *Azotobacter*	2.88	0.32	0.40	0.51
T_3	20 kg N ha^{-1}	3.01	0.30	0.38	0.49
T_4	20 kg N ha^{-1}+ *Azotobacter*	3.05	0.31	0.38	0.50
T_5	40 kg N ha^{-1}	3.09	0.37	0.46	0.60
T_6	40 kg N ha^{-1}+ *Azotobacter*	3.12	0.37	0.47	0.61
T_7	60 kg N ha^{-1}	3.18	0.40	0.50	0.65
T_8	60 kg N ha^{-1} + *Azotobacter*	3.21	0.40	0.50	0.65
T_9	80 kg N ha^{-1}	3.35	0.44	0.54	0.71
T_{10}	80 kg N ha^{-1}+ *Azotobacter*	3.38	0.44	0.55	0.71
	SEm±	0.13	0.01	0.02	0.02
	CD at 5%	0.38	0.02	0.05	0.06

Table.3 Response of nitrogen and *Azotobacter* on physic-chemical properties of soil after harvesting the mustard crop

Treatments		pH	EC (dSm^{-1})	Av. N (Kg ha^{-1})	Av. P (Kg ha^{-1})	Av. K (Kg ha^{-1})	Av. S(Kg ha^{-1})
T_1	Control ($N_0P_{60}K_{40}S_{35}$ kg ha^{-1})	8.32	0.34	175.18	14.80	255.20	10.21
T_2	Control + *Azotobacter*	8.30	0.33	176.07	15.10	256.77	10.23
T_3	20 kg N ha^{-1}	8.30	0.33	178.96	15.30	258.35	10.24
T_4	20 kg N ha^{-1}+ *Azotobacter*	8.40	0.30	178.85	15.50	259.92	10.23
T_5	40 kg N ha^{-1}	8.30	0.30	181.03	15.60	260.24	10.32
T_6	40 kg N ha^{-1}+ *Azotobacter*	8.26	0.32	181.74	15.70	261.50	10.36
T_7	60 kg N ha^{-1}	8.25	0.31	184.52	15.75	264.65	10.39
T_8	60 kg N ha^{-1} + *Azotobacter*	8.20	0.31	184.62	15.80	264.65	10.42
T_9	80 kg N ha^{-1}	8.15	0.30	191.08	15.85	267.80	10.42
T_{10}	80 kg N ha^{-1}+ *Azotobacter*	8.10	0.30	192.04	15.90	270.95	10.45
	SEm±	0.32	0.02	2.37	0.26	4.07	0.17
	CD at 5%	NS	NS	7.04	NS	NS	NS

On the basis of results it may be concluded that the application of 80 kg N ha^{-1} + *Azotobacter* was found better dose to obtained maximum yield in mustard crop.

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