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Effect of Nitrogen Management and Biofertilizers on Growth and Yield of Rapeseed (*Brassica campestris* var. toria)

Lakhan Bharti Saini*, P.J. George and Swai Singh Bhadana

Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agricultural, Technology and Sciences (Formerly Allahabad Agricultural Institute), Allahabad - 211007 Uttar Pradesh, India
**Corresponding author*

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A B S T R A C T

A field experiment was conducted during *Rabi* season, 2016 at the Crop Research Farm, Department of Agronomy, SHUATS, and Allahabad (U.P.) to study the Effect of Biofertilizers and Nitrogen Management on Growth and Yield of Rapeseed (*Brassica campestris var*. toria) in Randomized Block Design with Nine treatments replicated thrice. The results showed under treatment T_9 (Azotobacter + PSB + 30 kg ha^{-1} N through inorganic Fertilizer + 30 kg ha^{-1} N through Organic manure poultry manure (PM) produced significantly higher plant height 75 Days (95.53 cm), number of branch $plant^{-1}$ (8.37), dry weight (15.58 g). The significantly higher yield under treatment T_9 (Azotobacter + PSB + 30 kg ha^{-1} N through inorganic Fertilizer + 30 kg ha^{-1} N through poultry manure (PM)) with No. of siliqua $plant^{-1}$ (235.33), No. of seed siliqua $plant^{-1}$ (20.40), Test Weight (4.17 g), seed yield (1500 kg ha^{-1}), Stover yield (3790 kg ha^{-1}), harvest index (28.36%) and oil content (42.03%) was recorded in treatment T_9 (Azotobacter + PSB + 30 kg ha^{-1} N through inorganic Fertilizer + 30 kg ha^{-1} N through poultry manure (PM). Treatment T_9 (Azotobacter + PSB + 30 kg ha^{-1} N through inorganic Fertilizer + 30 kg ha^{-1} N through poultry manure (PM) also recorded the highest gross return (67740 ₹ ha^{-1}), net return (33265 ₹ ha^{-1}) and benefit cost ratio (1.96).

Introduction

Rapeseed (*Brassica campestris var*. toria) commonly known as raya, rai or lahi is an important oilseed crop among the Brassica group of oilseed in India. It's the second most important edible oilseed crop in India after groundnut and accounts for nearly 30% of the total oilseeds produced in the country. Rapeseed-mustard is an important group of edible oil seed crops and contributes around 26.1% of the total oil seed production and contributes about 85% of the total rapeseed–mustard produced in India (Meena *et al.*, 2011). The first position in area and second position in Production after China (Anonymous, 2009). Rapeseed and mustard crops are being cultivated in 53 countries spreading over the six continents across the globe covering an area of 24.2 million hectare. Indians contribution to world hectare and production is 28.3 and 19.8 percent respectively.

In India, Toria is cultivated on 6.86 million hectares in Rabi season. Rapeseed-Mustard is the most important oil seed crop accounting around production 6.31(million tonnes) of

total oilseed production in India (Directorate of Economics and Statistics, Department of Agriculture 2015). Nitrogen is the most important nutrient, which determines the growth of the mustard crop and increases the amount of protein and the yield.

Phosphorus and potash are known to be efficiently utilized in the presence of nitrogen. It promotes flowering, setting of siliqua and in increase the size of siliqua and yield (Bharose *et al.*, 2010). Poultry manure is relaitively resistant to microbial degradation.

However it is essential for establishing and maintaining the optimum soil physical condition for plant growth. Poultry manure is also very cheap and effective as a good source of N for sustainable crop production, but its availability remains an important issue due to its bulky nature, while inorganic fertilizer is no longer within the reach of resource-poor farmers due to its high cost (Rahman, 2004).

Azotobactor is nonsymbiotic nitrogen fixing agro- microbe having potential to fix considerable quantities of atmospheric nitrogen in the rhizosphere of non-legumes.

Besides nitrogen fixation, *Azotobactor* synthesizes various growth promoting substances such as vitamins of B group, nicotinic acid, biotic, gibberellins and antifungal compounds. *Azotobactor* inoculation an improved the crop productivity 0-25 % over the control in the absence of any amendment and by 8.75 % in the presence of NPK (Narula, 2000).

Seed treatment, seedling dipping and soil application methods are used for Azotobacter application. For seed treatment 200 g Azotobacter used for 10 kg seed. Phosphate solubilizing bacterium (PSB) has a capacity to render the insoluble soil phosphorus into plant available form because of their ability to secrete various organic acids (Ram *et al.*, 1999 and Gautam and Pant 2002).

Materials and Methods

A field Experiment was conducted on research farm of department of Agronomy Naini Agricultural Institute, Sam Higginbottom University of Agricultural, Technology and Sciences Allahabad, (U.P.), which is located at 250 24' 42" N latitude, 810 50' 56" E longitude and 98 m altitude above the mean sea level. The soil was sandy loam in texture having pH (7.80), low in soluble salt (0.13dSm^{-1}), organic carbon (0.33%), available P_2O_5 (8.0 kg ha^{-1}) and K_2O (228.0 kg ha^{-1}), respectively.

The experiments were laid out in randomized block design (RBD) with three replications on a plot size of 4.0×2.5 m.

The design applied for statistical analysis was carried out with randomized block design having two factors with Integrated Nitrogen management (INM) and Biofertilizers.

The treatment consisted of nine combination sources of Nitrogen inorganic fertilizers and poultry manure respectively. Biofertilizers are used *Azotobacter* and *Phosphate solubilizing bacterium (PSB)* (200g/10kg seed) for seed treatment. T_1 (Azotobacter + 60 kg ha^{-1} N inorganic Fertilizer), T_2 (*Azotobacter* + 45 kg ha^{-1} N inorganic Fertilizer + 15 kg ha^{-1} N poultry manure), T_3 (*Azotobacter* + 30 kg ha^{-1} N inorganic Fertilizer + 30 kg ha^{-1} N poultry manure), T_4

(PSB + 60 kg ha^{-1} N inorganic Fertilizer), T_5 (PSB + 45 kg ha^{-1} N inorganic Fertilizer + 15 kg ha^{-1} N poultry manure), T_6 (PSB + 30 kg ha^{-1} N inorganic Fertilizer + 30 kg ha^{-1} N poultry manure), T_7 (*Azotobacter* + PSB + 60 kg ha^{-1} N inorganic Fertilizer), T_8 (*Azotobacter* + PSB + 45 kg ha^{-1} N inorganic

Fertilizer + 15 kg ha^{-1} N poultry manure), T_9 (*Azotobacter* + PSB + 30 kg ha^{1} N inorganic Fertilizer + 30 kg ha^{-1} N poultry manure), having the treatments was replicated thrice. Nutrient management through Urea, SSP and MoP and organic nutrients sources as Poultry manure respectively to supply the required NPK The source.

Basal dose of fertilizer was applied in respective plots according to treatment allocation unfurrows opened by about 5cm. depth before sowing seeds in soil at the same time sowing of seeds was shown on well prepared beds in shallow furrows, at the depth of 5cm, row to row distance was maintained at 30cm and plant to plant distance was 10cm, during the course of experiment, To record the various yield observations on rapeseed, a sample consisting of ten plants were selected at random observations were recorded as mean values of the data.

Results and Discussion

Growth parameters

The data presented in table 1 clearly shows that the plant height increased with the age of plants and it was maximum at 75 DAS.

The maximum plant height, number of branches per plant, dry weight per plant was significant increase at 75 DAS, the maximum plant height of 95.53 cm, number of branches per plant 8.37, dry weight (g) 15.58 was recorded in T_9 (*Azotobacter* + PSB + 30 kg ha^{-1} N inorganic Fertilizer + 30 kg ha^{-1} N poultry manure) which was significantly higher than other treatment. The minimum plant height was 89.80 cm, number of branches per plant 7.07, dry weight (g) per plant 10.45 was recorded in T_7 (*Azotobacter* + 60 kg ha^{-1} N inorganic fertilizer (control)) at 75 DAS respectively. Similar results have also been recorded by Tetarwal and Rana (2006) and Singh and Singh (2006).

Yield attributes and oil quality of mustard

The results of yield attributes and oil quality of seeds given in table 2 indicate some of the important parameters of number of siliqua plant^{-1}, number of seed siliqua^{-1}, test weight (g) of seeds, seed yield, straw yield, harvest index, oil content of seeds of mustard crop increased significantly.

The factor of INM and Biofertilizers effect on number of siliqua plant^{-1}, number of seed siliqua^{-1}, test weight of seeds, seed yield, straw yield, harvest index, oil content of seeds was significantly increased due to combined use of inorganic fertilizers, poultry manure and biofertilizer.

The maximum number of siliqua plant^{-1} 235.33 was non-significantly and number of seed siliqua^{1} 20.40, test weight of seeds 4.17 g, seed yield 1500 kg ha^{-1}, straw yield 3790 kg ha^{-1}, harvest index (%) 28.36, oil content 42.03 % was recorded in T_9 (*Azotobacter* + PSB + 30 kg ha^{-1} N inorganic Fertilizer + 30 kg ha^{-1} N poultry manure), which was significantly higher than other treatment Meena *et al.*, (2013).

The minimum number of siliqua plant^{-1} 187.33 was non-significantly and number of seed siliqua^{1} 15.87, test weight of seeds 3.51 g, seed yield 926 kg ha^{-1}, straw yield 2886 kg ha^{-1}, harvest index (%) 24.29, oil content (%) 34.87, was recorded in T_7 (*Azotobacter* + 60 kg ha^{-1} N inorganic fertilizer (control)) at 75 DAS respectively.

Among the different treatments studied with respect of maximum B:C ratio, The maximum B:C ratio was recorded (1.96) in T_9 and the minimum was recorded in T_1 (1.36).Similar results were reported by Rundala *et al.*, (2013), Tripathi *et al.*, (2011), Das and Sinha (2014) and Singh and Pal (2011).

Table.1 Plant growth parameter

	Treatments	Plant height $^{-1}$	Branches plant $^{-1}$	Dry weight (g)
T_1	Azoto. + 60kg ha^{-1} N through inorganic Fertilizer	89.80	7.07	10.45
T_2	Azoto. + 45kg ha^{-1} N through inorganic Fertilizer + 15kg ha $^{-1}$ N through (PM)	91.33	7.27	12.60
T_3	Azoto. + 30kg ha^{-1} N through inorganic Fertilizer + 30kg ha $^{-1}$ N through (PM)	90.97	7.27	12.37
T_4	PSB + 60kg ha^{-1} N through inorganic Fertilizer	90.38	7.37	12.27
T_5	PSB + 45kg ha^{-1} N through inorganic Fertilizer + 15kg ha^{-1} N through (PM)	91.93	7.20	11.89
T_6	PSB + 30kg ha^{-1} N through inorganic Fertilizer + 30kg ha^{-1} N through (PM)	92.15	7.37	13.43
T_7	Azoto. + PSB + 60kg ha^{-1} N through inorganic Fertilizer	94.37	8.10	14.26
T_8	Azoto. + PSB + 45kg ha^{-1} N through inorganic Fertilizer + 15 kg ha $^{-1}$ N through (PM)	93.89	7.90	14.09
T_9	Azoto. + PSB + 30kg ha^{-1} N through inorganic Fertilizer + 30 kg ha $^{-1}$ N through (PM)	95.53	8.37	15.58
	F- test	S	S	S
	S. Ed. (±)	1.220	0.127	0.196
	C. D. (P = 0.05)	2.517	0.261	0.404

Azoto: Azotobacter, PSB: Phosphate-solubilizing bacteria, PM: poultry Manure.

Table.2 Plant yield attributes parameter

Treatments		Seeds siliqua^{-1}	Siliqua plant^{-1}	Test weight (g)	Grain yield (t ha^{-1})	Stover yield (t ha^{-1})	Oil content (%)	Harvest Index (%)	B:C ratio
T1	Azoto.+ 60kg ha^{-1} N through inorganic Fertilizer	15.87	187.33	3.51	926.67	2886.67	34.87	24.29	1.36
T_2	Azoto. + 45kg ha^{-1} N through inorganic Fertilizer + 15 kg ha^{-1} N through (PM)	16.40	224.00	3.74	1126.67	3130.00	35.93	26.39	1.55
T3	Azoto. + 30 kg ha^{-1} N through inorganic Fertilizer + 30 kg ha^{-1} N through (PM)	16.07	206.33	3.78	1116.67	3123.33	37.23	26.31	1.51
T_4	PSB + 60kg ha^{-1} N through inorganic Fertilizer	16.51	195.67	3.68	1056.67	3046.67	36.23	25.76	1.51
T5	PSB + 45kg ha^{-1} N through inorganic Fertilizer + 15 kg ha^{-1} N through (PM)	15.93	226.33	3.58	1053.33	2946.67	36.03	26.33	1.46
T6	PSB + 30kg ha^{-1} N through inorganic Fertilizer + 30 kg ha^{-1} N through (PM)	17.20	225.33	3.89	1086.67	2900.00	37.17	27.27	1.45
T_7	Azoto. + PSB + 60 kg ha^{-1} N through inorganic Fertilizer	19.07	232.00	3.98	1326.67	3506.67	39.00	27.42	1.84
T8	Azoto. + PSB + 45 kg ha^{-1} N through inorganic Fertilizer+ 15 kg ha^{-1} N through (PM)	17.87	229.33	3.97	1173.33	3326.67	38.77	26.08	1.63
T9	Azoto. + PSB + 30 kg ha^{-1} N through inorganic Fertilizer+ 30 kg ha^{-1} N through (PM)	20.40	235.33	4.17	1500.00	3790.00	42.03	28.36	1.96
	F-test	S	S	S	S	S	S	S	
	S.Ed. (±)	0.973	1.655	0.084	73.678	101.735	1.125	0.963	
	C. D. (P = 0.05)	2.009	3.415	0.174	152.071	209.98	2.321	1.988	

It is concluded that the best yield attributes characters in treatment T_9 in respect to different day's intervals**.** The highest plant height (95.53 cm), number of branches (8.37), dry weight plant^{-1} (15.58 g) were recorded in treatment T_9 (*Azotobacter* + PSB + 30 kg ha^{-1} N through inorganic Fertilizer + 30 kg ha^{-1} N through poultry Manure (PM).Growth and yield, treatment T_9 (*Azotobacter* + PSB + 30 kg ha^{-1} N through inorganic Fertilizer + 30 kg ha^{-1} N through poultry Manure (PM) produced highest Number of siliqua plant^{-1} (235.33), Number of seed siliqua^{-1} (20.40), seed Test weight (4.17 g), seed yield (1500 kg ha^{-1}), Stover yield (3790 kg ha^{-1}), harvest index (28.36%), and oil content (42.03%) respectively. Treatment T9 *(Azotobacter* + PSB + 30 kg ha^{-1} N through inorganic Fertilizer + 30 kg ha^{-1} N through poultry Manure (PM)) also recorded the highest gross return (67740 ₹ ha^{-1}), net return (33264.2 ₹ ha^{-1}) and benefit cost ratio (1.96). It may be concluded that among the combination of T_9 (*Azotobacter* + PSB + 30 kg ha^{-1} N through inorganic Fertilizer + 30 kg ha^{-1} N through poultry Manure (PM) was found to be best for obtaining the highest seed yield, oil content in Rapeseed *var*. Toria.

Since, the finding is based on the research done in one season it may be repeated for confirmation.

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