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REGULAR ARTICLE

EFFECT OF NITROGEN FIXING BACTERIA ON PLANT GROWTH AND YIELD OF *BRASSICA JUNCEA*

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SUMMARY

Brassica juncea (L.) Czern & Coss. is one of the major oilseed crops cultivated in India and around the world. The aim of this study was to evaluate the efficiency of *Azotobacter*, *Azospirillum* and their combination on plant growth and yield parameters of *Brassica juncea* cv. Varuna. A pot experiment was conducted in the net house of Department of Botany, G.F. (P.G.) College, Shahjahanpur (U.P.) to study the effect of two bacterial inoculations *Azotobater*, *Azospirillun* and their combination on growth and yield of *Brassica juncea*. *Azotobacter* and *Azospirillum* were applied separately and combination of both the bacteria in half doses. Application of both the bacteria recorded higher plant growth and yield in *Brassica juncea*. *Azospirillum* inoculation resulted in higher growth and yield parameters in comparison to *Azotobacter* inoculation. However, the combination of half dose of both the bacteria proved best in improving plant growth and yield in comparison to individual inoculation.

Key words: *Brassica juncea*, Nitrogen fixing bacteria

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1. Introduction

Brassica juncea (L.) Czern & Coss. is the principle *rabi* oilseed crop in India which covers 22% of area and contributes 25% of production of total oil seed crops. The average productivity of the crop in India is nearly 1 tone/ha (Godika *et al.*, 2001). Soil nutrient supply system provides basic input for growth and development of plant. The demand for fertilizer also increases with increased production. For quite some time biofertilizers, have been mooted as ecofriendly potential fertilizer source for maintenance of soil health and sustainable crop production system (Subba Rao, 1993; Gehlot and Bohra, 2001).

Free living nitrogen fixing bacteria *Azotobacter* has been considered as low cost biofertilizer in the agricultural production. Worldwide inoculation experiments carried out with strains of *Azotobacter chroococcum* have demonstrated the potential of the bacteria to promote plant growth and enhance the yield of crops in different soils and in different climatological conditions (Pandey and Kumar, 1998). The beneficial effect of *Azotobacter* is attributed to production of plant growth hormones, improved nutrient uptake and antagonistic effect on plant pathogens (Parmar and Dadarwal, 1997).

Azospirillum assimilates atmospheric nitrogen and fix it in soil and helps to save nitrogen. *Azospirillum* also secretes phytohormones in the plant root region, which in turn enhance the root growth. The results of the various experiments conducted throughout India have clearly shown that *Azospirillum* can be used as a potential biofertilizer in both extensive and intensive agriculture (Dey, 1988; Banger and Sharma, 1993; Govindan *et al.*, 2009).

Thus, *Azotobacter* and *Azospirillum* are potential biofertilizers and are capable to contribute nitrogen to a number of non-leguminous crops. Biofertilizers application is an important key for maximizing the yield of a crop. In view of this, it was considered imperative to study the growth and yield of *Brassica juncea* by the application of

Azotobacter, Azospirillum and their combination.

2. Materials and Methods

The experiment was laid out in clay pots with four different treatments viz. control (T_0), *Azotobacter* (T_1), *Azospirillum* (T_2) and a combination of *Azotobacter* and *Azospirillum* (T_3). For the application of *Azotobacter* and *Azospirillum* alone 2.5 g jaggery was dissolved in 50 ml water (Mahale *et al.,* 2003). Culture of each bacterium @ 250 mg/10 g seeds were mixed separately with jaggery solution. In T_3treatment both the bacterial culture were mixed in half quantity and this mixture was also applied @ 250 mg/10 g seeds in the similar manner. 10 g seeds of *Brassica juncea* cv. Varuna were dipped in the bacterial culture for one hour for coating the bacteria on them. Seeds were then dried under shade for thirty minutes before sowing. Ten seeds were sown in each pot in three replicates. Ten uninoculated seeds were also sown in separate pots to run control. The crop was thinned 20 days after sowing (DAS) and only three plants were left in each pot to maintain plant to plant spacing of 15 cm. Plants were uprooted from each pot after 120 DAS. Different parameters in terms of plant height, fresh and dry weights of shoot and roots and seed yield were recorded separately. Seed yield was determined by taking the weight of seeds produced by each plant.

Mean values of data were calculated. Data was analyzed statistically and the values of C.D. were calculated for the comparison of results.

3. Results and Discussion

The results indicate that the seed inoculated with biofertilizers significantly increased growth and yield attributes viz. the plant height, fresh and dry weights of shoot and root and seed yield over uninoculated one.

Results presented in Table-1 showed growth and yield of *Brassica juncea,* was significantly influenced by the application of T_1 which obtained a maximum increase of 7.60 and 25.83 % in shoot and root length, 7.71 and 20.55 % in fresh weights of shoot and root, 8.99 and 16.96 % in dry weights of shoot and root, respectively and seed yield was increased by 16.72 % over the control (T_0).

The plants under T_2 inoculation resulted in an increase of 7.77 and 33.33 % in shoot and root length, 10.04 and 25.69 % in fresh weights of shoot and root, 10.96 and 20.53 % in dry weights of shoot and root, respectively and seed yield was increased by 24.65 % over T_0.

Combination of half dose of both the bacteria *Azotobacter* and *Azospirillum* (T_3) caused significant effect and resulted in higher growth and yield in comparison to all other treatments. The plants under T_3 inoculation resulted in an increase of the shoot length by 13.56 %, root length by 58.33 %, shoot fresh weight by 16.28 %, root fresh weight by 40.31 %, shoot dry weight by 15.24 % and root dry weight by 60.71 %, and seed yield was increased by 41.37 % over T_0.

When T_2 was compared with T_1, T_2 showed an increase of 20.15 and 5.96 % in shoot and root length, 2.16 and 4.26 % in fresh weights of shoot and root, 1.80 and 3.05 % in dry weight of shoot and root respectively and seed yield was increased by 6.79 % over T_1. When T_3 was compared with T_1, T_3 resulted 5.53 and 25.82 % in shoot and root length, 7.95 and 16.39 % in fresh weights of shoot and root, 5.73 and 35.33 % in dry weight of shoot and root respectively and seed yield was increased by 21.12 % over T_1. Therefore treatment T_3 proved the best in improving plant growth and yield in comparison to T_0, T_1 and T_2 on the basis of all the parameters studied.

Improvement in different parameters due to use of *Azotobacter* may be because of the ability of the inoculants to produce some biological active compounds such as gibberellins and vitamins which can stimulate plant growth directly (Martinez-teledo *et al.,* 1988; Pandey *et al.,* 1989).

Azospirillum also produces plant growth factors (auxins) that cause the plant to produce more roots. The better root system and stronger plants produce more food (Chamberlain, 2006). *Azospirillum* a diazotroph is capable of fixing nitrogen and therefore serves as an efficient biofertilizer in

nourishing crop plants with nitrogen and in producing phytohormones such as IAA and GA.

Govindan *et al;* (2009) reported that the *Azospirillum,* has been found associated with the rhizosphere of ginger. They reported that inoculated as well as uninoculated treatment recorded the stimulation in root growth but with a great difference as evident from the fact that the mean root length for inoculated plants was 16.9 cm only while the corresponding figures for non-inoculated plants was 2.1 cm. Our results confirm the findings of these workers.

Table-1: Effect of nitrogen fixing bacteria on plant growth and seed yield of *Brassica juncea*

Treatment	Plant length (cm)		Fresh weight (g)		Dry weight (g)		Seed yield/ plant (g)
	Shoot	Root	Shoot	Root	Shoot	Root	
Control (T_0)	78.37	12.00	50.16	2.53	20.80	1.12	5.80
Azotobacter (T_1)	84.33	15.10	54.03	3.05	22.67	1.31	6.77
Azospirillum (T_2)	86.03	16.00	55.20	3.18	23.08	1.35	7.23
Azotobacter + *Azospirillum* (T_3)	89.00	19.00	58.33	3.55	23.97	1.80	8.20
C.D. at 5%	2.23	1.47	1.18	0.21	0.97	0.13	0.44

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