

Yield and quality of radish (*Raphanus sativus*) seed as affected by fertility levels and biofertilizers

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ABSTRACT

A field experiment was conducted during 1995–96 and 1996–97 to study the effect of fertility levels (0, 40, 80 and 120 kg N/ha) with or without biofertilizer treatments (uninoculated control, inoculation with *Azotobacter*, *Azospirillum* and both) on seed yield and quality of radish (*Raphanus sativus* L.) seed. The increasing levels of nitrogen application significantly increased the seed yield and values of quality parameters up to 120 kg/ha. When nitrogen levels were integrated with biofertilizer, the results were perceptible and maximum values were observed with the combined inoculation of *Azotobacter* + *Azospirillum* at 120 kg N/ha.

Key words : *Azotobacter*, *Azospirillum*, Radish

In India, cultivation of radish throughout the year necessitates huge quantities of quality seed, for which the application of required amount of nutrients is a prerequisite. In the recent year, the price of inorganic fertilizers has gone up considerably, which in turn has increased the cost of production. The use of biofertilizers (*Azotobacter* and *Azospirillum*) to supplement the nitrogen requirement, therefore, needs investigation. Hence an elaborate study was carried out on the use of *Azotobacter* and *Azospirillum*, alone and together, on cv. 'Pusa Reshmi' of radish

with graded dose of nitrogen.

MATERIALS AND METHODS

The field experiment was carried out at the experimental farm of R.K. College, Shamli, during *rabi* season of 1995–96 and 1996–97 on well-drained sandy-loam soil. The experiment comprising 5 nitrogen levels [N_0 , N_{40} , N_{80} , N_{120} , and N_{160} (0, 40, 80, and 160 kg N/ha)] and 4 biofertilizer treatments (I_0 , I_1 , I_2 , and I_3) was tested using randomized block design with 3 replications. The seedlings of cv. 'Pusa Reshmi' were raised by following package

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of practices for radish root production. At the time of transplanting the radish were uprooted, washed with running water and only true-to-type roots were selected. The steckles were prepared by cutting them 10 cm from the both sides and were divided into 4 lots keeping 1 uninoculated (I_0) while others were inoculated with *Azotobacter* (I_1), *Azospirillum* (I_2) and *Azotobacter* + *Azospirillum* (I_3). Similarly, the soil was inoculated treatment-wise with the respective biofertilizer @ 2 kg/ha by mixing it with FYM @ 40 kg/ha and to maintain uniform FYM, the control plots were also supplied with same quantities of FYM. Half dose of nitrogen through urea along with 50 kg each of P_2O_5 and K_2O through single superphosphate and muriate of potash, respectively, were applied at the time of transplanting and remaining nitrogen was top-dressed at the time of flowering. After harvesting seed yield and quality parameters were recorded. The crude protein content in the seed was

determined by multiplying the nitrogen content with 6.25. The data of both the years were pooled and analysed statistically.

RESULTS AND DISCUSSION

Plant height

Increasing levels of nitrogen application significantly increased the plant height up to 120 kg N/ha, while at 160 kg/ha the plant height decreased slightly (Table 1). The results of Sharma and Kanaujia (1992) and Sharma and Lal (1994) are in dissension with the present findings. Single inoculation with *Azotobacter* (I_1) and *Azospirillum* (I_2) increased the plant height significantly, but when applied together (I_3) the plant height increased perceptibly producing longest plant of 157.8 cm against 147.3 cm long plant in the control. The increase in plant height due to biofertilizer could be ascribed to the fact that the biofertilizers are known to synthesize the growth-promoting substances besides nitrogen fixation

Table 1. Yield and quality of radish seed as affected by different fertility levels and biofertilizer

Treatment	Plant height (cm)	Pods/plant	Pods weight/plant	Seeds/pod	Seed yield (q/ha)
N_0	143.6	390.3	21.5	5.4	5.6
N_{40}	151.3	568.1	43.6	5.6	9.3
N_{80}	154.9	715.4	50.4	5.5	10.9
N_{120}	159.3	867.7	58.3	5.6	12.2
N_{160}	159.1	884.8	56.8	5.5	12.2
CD (P = 0.05)	2.00	10.64	2.48	NS	0.67
I_0	147.3	644.3	40.7	5.4	8.8
I_1	155.5	695.8	47.6	5.5	10.4
I_2	153.9	693.4	46.6	5.5	10.2
I_3	157.8	707.2	49.4	5.6	10.8
CD (P = 0.05)	2.1	8.5	NS	NS	0.6

(Chauhan *et al.*, 1995), as a result of this the plant could have grown luxuriously. The interactions of nitrogen and biofertilizer were significant and the maximum plant height was registered due to inoculation with *Azotobacter* + *Azospirillum* at 120 kg N/ha (Table 3).

Yield parameters

Number of pods and pod weight/plant increased significantly with the increasing levels of nitrogen application (Table 1). Inoculation with *Azotobacter* and *Azospirillum*, alone or together, significantly increased the production of pods and their

Table 2. Seed-quality parameters of radish as affected by nitrogen and biofertilizer application

Treatment	1,000-seed weight (g)	Seed germination (%)	Protein content (%)
N ₀	10.8	90.9	20.9
N ₄₀	11.6	91.8	22.8
N ₈₀	12.5	92.3	24.5
N ₁₂₀	12.8	92.6	24.3
N ₁₆₀	12.8	92.7	24.2
CD (P = 0.05)	0.3	1.5	1.6
I ₀	11.9	91.4	22.3
I ₁	12.2	93.1	23.4
I ₂	12.2	92.2	23.3
I ₃	12.3	92.1	23.8
CD (P = 0.05)	0.3	92.2	1.5

Table 3. Interactions effect of nitrogen and biofertilizer on seed-yield parameters of radish

Treatment	N ₀	N ₄₀	N ₈₀	N ₁₂₀	N ₁₆₀	CD (P=0.05)
Plant height (cm)						
I ₀	137.6	142.8	146.6	152.8	156.4	
I ₁	144.6	154.0	157.5	161.2	160.2	
I ₂	143.7	151.8	155.8	159.5	158.5	
I ₃	148.5	156.3	159.7	163.8	161.2	4.0
Pods/plant						
I ₀	354.5	512.3	650.5	824.4	879.6	
I ₁	399.5	578.4	738.7	878.2	884.4	
I ₂	398.8	580.8	726.9	875.3	885.2	
I ₃	407.3	600.4	745.2	892.9	890.1	21.3
Seed yield (q/ha)						
I ₀	4.4	6.9	9.9	11.5	11.6	
I ₁	6.4	9.9	11.3	12.2	12.4	
I ₂	5.9	9.6	10.9	12.1	12.3	
I ₃	6.7	10.6	11.7	12.7	12.5	1.3

weight/plant compared with uninoculated control. The highest value of these parameters were recorded with combined inoculation of *Azotobacter* and *Azospirillum* (I_3), followed by their single inoculation. The interaction of nitrogen and biofertilizer was significant only for pods/plant where combined inoculation with *Azotobacter* and *Azospirillum* at 120 kg N/ha produced highest number of pods/plant, while lowest was with no nitrogen and biofertilizer application (Table 3).

Seeds/pod were not significantly influenced by nitrogen or biofertilizer treatments. The seed yield/ha increased linearly with the application of N up to 120 kg/ha.

Sharma and Singh (1981) also reported similar findings. Among the different biofertilizer treatments, inoculation with *Azotobacter* + *Azospirillum* (I_3) recorded the highest seed yield, followed by *Azotobacter* (I_1) and *Azospirillum* (I_2) treatments. Seed yield responded significantly up to 80 kg N/ha in the presence of biofertilizer, but the highest seed yield was recorded with combined inoculation with *Azotobacter* and *Azospirillum* at 120 kg N/ha, which was 9.88 and 8.84% higher than the seed yield recorded at 120 and 160 kg N/ha without biofertilizer application, showing a net saving of 40 kg N/ha as well as improvement in yield parameters.

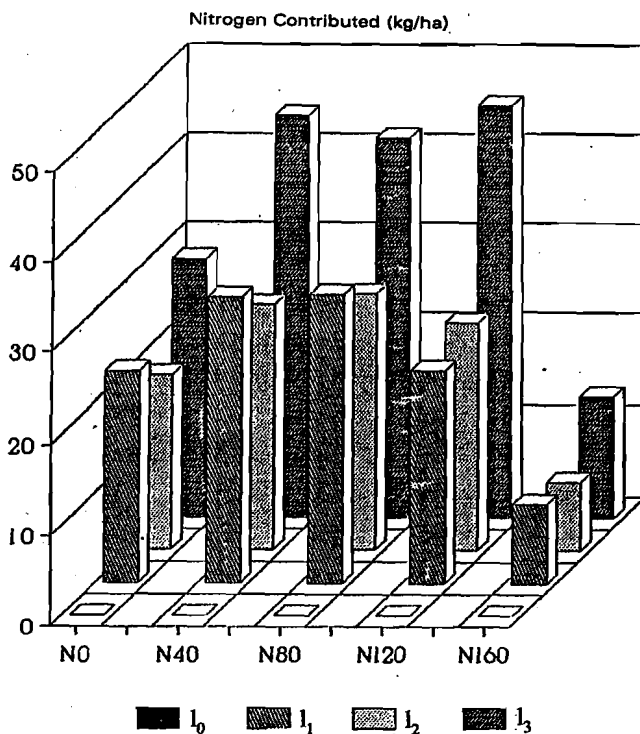


Fig. 1. Amount of nitrogen contributed by biofertilizers in plants over and above the native population

Seed-quality parameters

The application of N at 120 kg/ha significantly improved 1,000-seed weight and seed protein content. The germination of seed though improved with nitrogen doses but the difference between N doses not significant (Table 2). Among the different biofertilizers, combined inoculation with *Azotobacter* and *Azospirillum* increased the 1,000-seed weight and protein content in seed. Single inoculation of seedlings as well as soil with *Azotobacter* or *Azospirillum*, increased the fixation of nitrogen in plant over and above the native population up to 80 kg N/ha, however, their combined inoculation increased the N fixation up to 120 kg N/ha (Fig. 1), thereafter at 160 kg N/ha the amount of N fixation declined. The highest amount of N to the tune of

45.56 kg/ha was fixed due to combined inoculation at 120 kg N/ha, while lowest was at 160 kg N/ha.

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