Effect of Nitrogen fixing Endophytes on Biomass of Soybean Crop

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Abstract

Plant associated bacteria that live inside plant tissues without causing any harm to plants are termed as endophytic bacteria. Experiments were conducted in earthen pots to study the effect of endophytic Nitrogen fixers on Soybean crop. Soybean variety JS-335 was used in the present investigation. Soybean seeds were treated with fresh inoculum of *Bradyrhizobium japonicum, Rhizobium phaseoli, and Rhizobium leguminosarum* and sowed in earthen pots. After 20 days of sowing the nodule count, nodule biomass and root biomass (wet and dry) were determined. The Nitrogen fixing endophytes enhance the nodulation and nodulation was greater as compared to control. The total nodule count and biomass of root was increased in test when compared with control.

INTRODUCTION

Endophytes was recognized as early as by De Bary (1887), Freeman (1903), McLennan (1920), Sampson (1937) and Neill (1941) observed them many years ago. The mechanisms by which PGPR promote plant growth are not fully understood, but are thought to include: (i) the ability to produce the plant hormones Indoleacetic acid , Gibberellic acid (Mahmoud et al., 1984), Cytokinins (Tien et al., 1979), and Ethylene (Arshad and Frankenberger, 1991. In addition to the previously described PGPR traits, some rhizobacteria can promote plant growth indirectly by affecting symbiotic N2 fixation. In a study where soybean was inoculated with *Bradyrhizobium japonicum* increased the weights and number of nodules. The objective of this work was to test potential ability of endophytic Nitrogen fixers to enhance growth of soybean.

MATERIALS AND METHODS

Total 60 isolates representing 9 different species from 5 different genera were isolated from root nodules of soybeans. Out of 60 isolates only three namely *Bradyrhizobium japonicum*, *Rhizobium phaseoli*, and *Rhizobium leguminosarum* were screened. Each test was replicated three times. Experiment was conducted in pots with sterilized soil to study the effects of the isolates on the yield, biomass production and nutrient uptake in soybean plants. **Filling of Pots :** sterilized soil was taken in one pot and 12 such pots were prepared Surface of the pots was leveled. Per pot 10 inoculated and un-inoculated (control) seeds were sown in all the treatments.

Inoculation of Seeds **:** The soybean seeds (30 seeds) were soaked for 1 hour in 100ml of 48 hrs. old respective broth culture, the seeds were shaken to mix the culture well. These coated seed were then sown at 10 seeds per pot.

Maintenance of Pots: One week after germination, the plants were thinned to 6 plants/pot and allowed to grow up to 60 days. Enough moisture was maintained in the pots by watering at regular intervals.

OBSERVATIONS**:** The plant samples were collected at the interval of 20 days and at harvesting. Observation were recorded on Nodule Number Nodule size. Dry weight of nodules, roots Pod number and dry weight of Pods, Dry weight of plant samples.

RESULT AND DISCUSSION

Table:1 Fresh Plant weight in gm

Treatments	Fresh Plant Weight after 20 days intervals		
	20 DAS	**40 DAS**	**60 DAS**
Bradyrhizobium japonicum	22.9	50.8	179.6
Rhizobium phaseoli	22.4	38.9	149.6
Rhizobium leguminosarum	18.8	35.6	143.6
Control	17.8	22.8	93.8

Table : 2 Fresh Root Weight (gm)

Treatments	Fresh root Weight after 20 days intervals		
	20 DAS	**40 DAS**	**60 DAS**
Bradyrhizobium japonicum	3.9	4.9	10.2
Rhizobium phaseoli	4.4	4.8	9.8
Rhizobium leguminosarum	3.7	4.6	8.6
Control	3.1	3.6	5.6

Table : 3 Root Length (cm)

Treatments	Fresh root length after 20 days intervals		
	20 DAS	**40 DAS**	**60 DAS**
Bradyrhizobium japonicum	15.0	26.2	31.41
Rhizobium phaseoli	10.5	23.4	27.92
Rhizobium leguminosarum	9.6	22.5	24.21
Control	8.4	11.6	18.2

Table : 4 Number of pods per plants

Treatments	Number of pods per plants	
	Mature	**Immature**
Bradyrhizobium japonicum	46	8
Rhizobium phaseoli	39	6
Rhizobium leguminosarum	37	7
Control	22	6

Table : 5 Weight of Fresh Pods per 3 plants (gm)

Treatments	Weight of Fresh Pods	
	Mature	Immature
Bradyrhizobium japonicum	404	63.1
Rhizobium phaseoli	318	50.6
Rhizobium leguminosarum	271	62.5
Control	172	60.1

Table :6. Weight of Dry Pods per 3 plants (gm)

Treatments	Weight of Dry Pods	
	Mature	Immature
Bradyrhizobium japonicum	134	8.6
Rhizobium phaseoli	113	7.4
Rhizobium leguminosarum	107	9.2
Control	89	15.8

Table :7. Root nodules, length and width of Pods per Plants (gm)

Treatments	No. of Root Nodules	Pod Length (cm)	Pod width (cm)
Bradyrhizobium japonicum	44	5.2	1.5
Rhizobium phaseoli	38	4.8	1.4
Rhizobium leguminosarum	36	4.7	1.3
Control	20	3.6	0.9

DISCUSSION

All the three isolates selected for the plant-growth experiments significantly increased nodule number, root weight, root length, pod weight, pod length, pod width. This may be due to siderophore production, P solubilization, symbiotic N2 fixation, IAA, gibberellins, cytokinnins, and inhibition of fungal pathogens. Similarly, inoculation of soybean seed with a siderophore-producing fluorescent pseudomonad resulted in increased seed germination, growth, and yield of the plants (Kumar and Dube, 1992). Some P-solubilizing organisms have been reported as plant growth promoters, (1997; Whitelaw et al., 1997). The inhibition of F. *oxysporum* was observed by Hurek and Jaroszuk (1997). Inhibition of S. rolfsii and S. sclerotiorum was observed by (Cattelan, 1994).Applying nitrogen as starter is necessary to increase Soybean yield in Sangjiang river plane in China (2017). Nitrogen is one of the most important nutrients affecting Soybean grain yield (2010)

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