EFFECT OF DIFFERENT FORMULATION OF SILICATE SOLUBILIZING BACTERIAL ISOLATE ON INCIDENCE OF BLAST DISEASE *(PYRICULARIA ORYZAE)*

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Abstract

Silicon is largely available in earth crust in second only to oxygen. Few organism and accumulate silicon plants take up various quantities of silicon in certain species. The silica accumulates were found in monocotyledonous plant families. Rice accumulates about 4-20% of silica in paddy straw as well as every part of rice plant. Mineralization of silicate in soil take place by numerous bacteria particularly *Bacillus muciloginosus.* Silicate solubilizing bacteria was isolated from twenty rhizosphere soil of rice in various locations of Cuddalore district. All the twenty isolate were screened for the ability of silicate solubilization and antagonistic activity against *pyricularia oryzae*. The isolates *viz.*, SSB-8, SSB-11, and SSB-17 was recorded a maximum response to silicate solubilization and biocontrol characteristics. The effect of different formulations of silicate solubilizing bacterial strains, natural and artificial biofloc of SSB cells on incidence of *pyricularia oryzae* was studied. Among the different formulations of silicate solubilizing bacteria reduced the incidence of *pyricularia oryzae* to a higher level when compared to the vegetative cells forms of the same.

Key words: Silicate solubilizing, pyricularia oryzae, monocotyledonous, antagonistic activity, etc.

1. Introduction

Silicate minerals are most imperative rock forming substances in earth crust and it is acknowledged so as to micronutrients play a crucial role in process of silicate minerals. The mineralization of silicate in soil takes place by numerous bacteria particularly by Bacillus mucilaginosus reported by several authors. Silicon deposition in cell wall of root endodermal cells may contribute to the maintenance of an effective apoplastic barrier and there by improve the plant resistance as well as disease the drought stresses reported that heterotrophic microorganisms could increase the mobilization of silicates from rock forming minerals. Rezza, et al. reported the interaction effect of incubation time on dissolution of metals from an alumino silicate by heterotrophic microorganisms. Dissimilatory iron-reducing bacteria produced siderophores and the same react with iron oxyhydroxides and dissolve Fe-bearing silicate minerals. ISR does not involve the accumulation of pathogenesis-related proteins or salicylic acid, but instead, relies on pathways regulated by jasmonate and ethylene. Two mechanisms for Si-enhanced resistance to diseases have

been proposed. Si acts as physical barrier and forms a cuticle - Si double layer. This layer can mechanically encumber penetration by fungi, thereby disrupt to infection process.

2. Materials and methods

The survey was conducted at twenty different locations in Cuddalore district, Tamil Nadu, where rice is a predominant cereal food crop grown under lowland condition. Random selection of locations was made so that each and every sector of the experimental area would get a representation in the survey. A total number of eight soil samples from various places and at each depth of a particular location, pooled and a quantity of half kg was taken as representative soil sample of appropriate location. Soil samples were air-dried thoroughly and transported to laboratory under aseptic condition for further analysis. The enumeration of total heterotrophic population from the rhizosphere of rice was carried out on nutrient agar medium as described by Malik, et al. All the twenty isolates of SSB were graded into three categories on the basis of their solubilizing efficacy in SSB medium in the form of clear zone.

I category - <10

II category - 10-14.99

III category - 15 and above

3. Effect of different formulations of silicate solubilizing bacterial cells on incidence of blast disease (*Pyricularia oryzae*) in rice

Rice (*Oryza sativa*) var. IR 50 seeds were surface sterilized, germinated as detailed in 3.10.2 and transferred onto a steel wire mesh (3 mm dia) in a growth chamber filled with 100 ml weaver's medium. One ml of inoculums of silicate solubilizing bacterial isolates in different formulations *viz*. vegetative cells of silicate solubilizing bacteria, natural biofloc of bacteria cells, and artificial biofloc of bacteria cells was prepared as and maintained to evaluate the biocontrol response of silicate solubilizing bacterial isolates, against *Pyricularia oryzae*, whereas following treatments were tested.

1. Control (No inoculation)
2. SSB-8
3. SSB-11
4. SSB-17
5. Co-inoculation 8 + 11 + 17
6. Natural biofloc of SSB

Artificial biofloc of SSB twenty soil samples from various locations of the experimental area and their physico-chemical properties were analysed. Regarding the texture of soil, four textural types, *viz*. loamy, clay loam was found. The organic matter content of soil sample collected from Kanakarapattu village recorded the minimum percentage of organic carbon *viz*. 0.4 g kg^{-1} while the soil sample collected from Kavarapattu Vilagam recorded the maximum percentage *viz*., 0.78 g kg^{-1}. The organic matter content of the remaining samples was intermediary to these two levels. The soil pH of twenty samples ranged from 6.2 to 7.9 whereas the electrical conductivity of the same ranged from 0.1 to 1.2.

4. Experimental results

4.1. Characterization of Silicate Solubilizing Bacterial Isolates – *Bacillus*

In the present research, twenty isolates were subjected to various tests for the characterization and identification of silicate solubilizing bacteria. The results are presented in Table 1 and compared with the general characteristics of *Bacillus mucilaginosus* as described by Gerherdt, et al. Based on the studies all the isolates of SSB are identified as *B.mucilaginosus*

TABLE 1

General Characteristics of *Bacillus* sp

Character	Response of *Bacillus mucilaginosus*
Swollen sporangia	+
Motility	-
Capsule	+
Gram stain	-
Voges-Proskauer reaction	-
Oxidase	-
Nitrate reduction	-
Gelatin hydrolysis	-
Growth at 50°C	-
Growth in NaCl (%)	
1.0	+
1.5	+
2.0	+
2.5	-

4.2. Grading the SSB isolates based on silicate solubilization

All the twenty isolates recorded appreciable value in silicate solubilization. Out of twenty isolates, about three isolates namely SSB-8, SSB-11 and SSB-17 were more efficient in silicate solubilization and recorded clear zone about 15 mm and thirteen SSB isolates were showed medium silicate solubilizing efficiency are recorded 10 to 14.99 mm clear zones and remaining four isolates are recorded below 10 mm clear zones the values were presented in Table 2.

TABLE 2

Grading the SSB isolates on the basis of silicate solubilizing efficiency and biocontrol ability against *Pyricularia oryzae* under *in vitro* condition

Silicate solubilization zone (mm)	No. of isolates	Designation of the isolate	Percentage of isolates
15 and above	3	SSB-8, SSB-11, SSB-17	15
10-14.99	13	SSB-7, SSB-14, SSB-16, SSB-20, SSB-5, SSB-3, SSB-6, SSB-9, SSB-10, SSB-12, SSB-13, SSB-15	65
Below 10	4	SSB-1, SSB-18, SSB-19, SSB-4	20

4.3. Effect of different formulation of silicate solubilizing bacterial cells on rice blast disease incidence (*Pyricularia oryzae*) in rice under *in vitro* condition

The application effect of the different formulations of silicate solubilizing bacterial cells, namely the vegetative cells of silicate solubilizing bacteria and the natural and artificial biofloc of silicate solubilizing bacteria on the incidence of *Pyricularia oryzae* was studied *in vitro* and the results are presented in Table 3. Among the different formulations of silicate solubilizing bacterial cells, the natural and artificial biofloc of silicate solubilizing bacteria reduced the incidence of *Pyricularia oryzae* to a higher level when compared to the vegetative cell forms of the same. Between the two vegetative cell forms, silicate solubilizing bacterial vegetative cells was found to record the high incidence of *Pyricularia oryzae* (42.40±0.83, 36.80±0.30 and 44.60±0.85) when compared to control. Between the natural and artificial biofloc of co-inoculation of silicate solubilizing bacterial cells, the natural biofloc of silicate.

TABLE 3

Application Effect of different formulations of SSB isolates on blast disease incidence in lowland rice cv. IR-50

Sl. No.	Treatments[a]	Percentage of disease incidence[b]	Statistics[c]
1.	Control (uninoculated)	88.10±1.81	g
2.	*B. mucilaginosus* vegetative cells+ SSB-8	42.40±0.83	e
3.	SSB-11	36.80±0.30	d
4.	SSB-17	44.60±0.85	f
5.	Co-inoculation of 8+11+17[++]	21.10±0.24	c
6.	Biofloc (Natural) [+++]	17.11±0.45	a
7.	Biofloc (Artificial) [+++]	20.60±0.56	b

[a] At $1x10^7$ cfu ml^{-1}

[b]Values are mean of three replications ± SD.

[c]Values followed by different letters are significantly differed at 5% level according to student't' test.

Solubilizing bacterial cells + rice straw was found to reduce the incidence of *Pyricularia oryzae* of rice to a higher level than the artificial biofloc of the same. The study clearly indicated the efficiency of silicate solubilizing bacteria natural biofloc on the enhancement of incidence of *Pyricularia oryzae* than any other formulations of the same.

5. Discussion

In the present study on twenty isolates of silicate solubilizing bacteria (SSB-1 to SSB-20) were isolated from the rhizosphere of lowland rice grown at 20 different locations of Cuddalore district, Tamil Nadu and the isolates were identified based upon the morphological and physiological characteristics as reported by Gerherdt (1981) and Awad Galal Osman (2009). On the basis of the above parameters, it was found that all the SSB isolates were belonging to *Bacillus mucilaginosus*. The silicate solubilizing ability of *Bacillus mucilaginosus* has already has been reported. In the present investigation, all the twenty isolates were screened for their silicate solubilizing ability and antagonistic activity against *Pyricularia oryzae* under *in vitro* condition. The present results revealed that a marked variation existed among SSB isolates on silicate solubilization. Exopolysaccharides productions of the SSB isolates and EPS mediated silicate solubilization through organic acid have been proposed by Malinovskaya, et al. and Welch, et al. The results of the present study clearly revealed the silicate solubilizing ability of the isolates and

the microbially solubilized silicon might elicit the biochemical defense reaction against *Pyricularia oryzae* under *in vitro* condition.

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