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REVIEW ARTICLE

STUDIES RELATED TO DIFFERENT RHIZOBACTERIAL CO-AGGREGATION FOR THE EFFECT INDUCED SYSTEMIC RESISTANCE AGAINST RICE BLAST DISEASE OF TANJORE DISTRICT, TAMIL NADU

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ABSTRACT

A study related to different formulations of vegetative cell of *Pseudomonas fluorescence* (Pseu-4) and *Bacillus polymyxa* (B.pol-15) together with challenge inoculation of *pyricularia oryzae* in the enhancement of IRS in Rice. *Pyricularia oryzae* disease patho systems was studied under pot culture with ADT-36. "It was observed that the application of (Pseu-4), (B.pol-15) as co-aggregates altered the biochemical and physiological parameters *viz.,* reducing sugar and non-reducing sugars, Phenol content and defence mechanism by means of producing enzymes such as perocidase, polyphenol oxidase, (PPO) of rice plant to a significant level followed by co-inoculation and vegetative cell applications of PGPR". When compare to that the co-aggregates of PGPR was found to augment all enzymes for the defence enzymes of rice plant, where as reduction and non-reducing sugar level also recorded, there by leads to reduction in *Pyricularia oryzae* incidence in rice grown of Tanjore regions of Tamil Nadu. EPS biosynthesis of PGPR cells during co-aggregation process might act as the defense mechanism of ISR, pathosystem, where as vegetative forms and co-inoculation processes does not produced of EPS and also responded poorly for the ISR pathosystem.

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INTRODUCTION

The Rice blast caused by *Pyricularia oryaze*, one of the most effective disease of alternative paddy and cause a reduction in yield upto 90 percent. The use of PGPR as a biological tool, is an technique to overcome the use of chemical fertilizers. "Rhizosphere bacteria enhanced the plant growth and yield of commercially important crops are denominated as "Plant growth promoting rhizobacteria (PGPR)" (Kloepper *et al,* 1980)". The plant growth promoting rhizobacteria also involved in the biocontrol of phytopathogens, such as siderophore, antibiotics and phytohormone production for plant growth promoting organism such as, *Bacillus polynyxa (Bacillus polymyxa;* Ash *et al.,* 1994). "The appropriate host extract agar media is highly suitable for cultural and morphological study of rice blast fungus P". oryzae Manjunatha and Krishnappa (2019). They also reported that the incidence and severity of the disease vary from low to high on the rice fields depending on the cultivars differences. Rice blast was observed in all assessed locations at variable levels. Mebratu Gebremariam Asfaha (2015).

The present work was aimed on the enhance the induced systemic resistance in Rice *Pyricularia oryzae* disease system.

MATERIALS AND METHODS

A research was conducted on the effect of different formulations of PGPR cells viz., single strain inoculation, coinoculation and coaggregates application in order to control the *Pyricularia oryzae* on the enhancement of growth and yield in lowland rice with special emphasis to indusced systemic resistance mediated biocontrol against Rice blast disease. The study was conducted with rice cultivar ADT-36 in the Department of Agricultural Microbiology, Faculty of Agriculture, Annamalai University, Annamalai Nagar, India. A cement pots size of 18" x 12" x 12" size were filled with 45kg of paddy soil flooded with water for 2 days and brought to fine condition. Seeds of the rice variety ADT 36 were taken in gunny bag and soaked in water for 12 hrs. and then kept under dark condition and the seeds were germinated within 24 hrs. The pre-germinated seeds of rice (cv., ADT 36) was sown in rows in cement pots separately, On the 5th day of sowing, the seedlings were thinned to get 50 numbers per pot and age of the seedlings were noted from the time of sowing.

"The research was conducted with randomized block design (RBD) by using three replications and the following were the treatments. Ti. Control, T_2 *Pseudomonas fluorescens,* T_3 *Bacillus Polymyxa,* T_4 *Pseudomonas fluorescens* + *Pseudomonas fluorescens* + *Bacillus Polymyxa* coaggregates application during, the investigation, annual mean minimum and the maximum temperature of experimental area isaround 25°C and 30°C and the mean humidity were around 96 and 78 a percent, respectively. The average annual rain fall is 1500 mm. K_2O has been applied basally as super phosphate and muriate of potash, respectively". "Rice plants were inoculated by spraying the *P.oryzae* spore suspension at (50,000 spore/ ml inoculums level) on 15 DAS with an atomizer and the control plant was sprayed with sterile water high humidity was created by sprinkling the water frequently in the polyhouse. The crop was given a hand weeding on 30 DAS and well protected against pests and diseases. Five representative samples of plant hills in each pot were pegmarked for periodical observations.'' The plant height, shoot dry weight, root dry weight, chlorophyll content (Mahadevan and Sridhar, 1986), IAA production, phosphorous content, grain and straw yield of lowland rice wsas recorded on 45 DAS. "The reducing and non-reducing sugar was estimated according to (Mahadevan and Sridhar, 1986) whereas, the total phenol content was assayed according to (Malik *et al.,* 1997). "The defense enzyme activities such as peroxidase (PO), "Polyphenol oxidase (PPO) was assayed according to Putter, (1974) and Ester Bauer, (1977) respectively".

RESULTS AND DISCUSSION

"The effect of different types of bioformulations *viz.,* single strain inoculation, co-inoculation and co-aggregates application of PGPR cells. *viz*., *Pseudomonas fluorescens* and *Bacillus polymyxa* on the growth yield parameters *viz*., plant height, root and shoot dry weight, phosphorus, IAA and chlorophy content, grain and straw yield of rice cv. ADT 36 was studied under pot culture condition (Table 1). It was observed that all the formulations of PGPR cells could augment the growth and yield parameters of lowland rice cv. ADT 36 when compared to control (without bioinoculation)". "The Chemical fertilizer schedule for paddy crop 100; 50; 50 NPK ha^{-1} was followed, Regarding the 'N' fertilization, 50 per cent of the same was given as basal dose, while the other 50 per cent was given as top dressing in two split doses.

Regarding the different kinds of formulations of PGPR cells, the application of "Intergeneric PGPR coaggregates" consisting of *Pseudomonas fluorescens and Bacillus polymyxa* could augment the growth and yield parameters of lowland rice to a higher level followed by coinoculation and single strain inoculation treatments *viz*., *Pseudomonas fluorescens* and *Bacillus polymyxa*, the inoculation of *Pseudomonas fluorescens* treatement recorded the higher value for the above parameters than *Bacillus ploymyxa* treatment'. The individual inoculation effect of *Pseudomonas* and *Bacillus* in augmenting the growth and yield parameters of rice has already been reported (Guemouri - Athmani *et al.,* 2000). "The positive coinoculation effect of *Pseudomonas* and *Bacillus* has already been reported by EL - Komy *et al.* (2004) in wheat, Neyra *et al.* (1999) reported increasing positivly effect using the *Azospirillum* and *Rhizobium* coflocs for the enhancement of growth and yield in common bean. Plant height of rice been reported by Agarwal and Singh (2000).

"The studies on the effect of different Bioformulations of PGPR cell on the enhancement of ISR mediates the biocontrol of *P.oryzae* with special Emphasis to biochemical and physiological aspects, revealed the highest performance of PGPR co-aggregates in augmenting the phenol metabolism *viz*., total phenol content and orthodihyroxy phenol, carbohydrate metabolism *viz*., reducing and non reducing sugar level and defense enzyme activities viz., Peroxidase (PO) and Polyphenoloxidase (PPO) of lowland rice plant followed by co-inoculation of PGPR cells." "The PGPR co-aggregates consisting of *Pseudomonas* and *Bacillus* sp. augmented the total phenol, OD phenol PO and PPO activities of lowland rice plant to a higher level whereas a reduction in reducing and non-reducing sugar levels, observed." Mishra *et al.* (2006) reported the *Rhizobium* inoculated of phenolics in rice plant during the challenge inoculation of *P.oryzae.* Nanthakumar (1998) correlated the ISR with two fold increase in peroxidase activity against rice sheath pathosystem *(Rhizoctonia solani)* in rice plant. "Plant tissues containing greater reserves of oxidisable carbohydrates are oftern more prone to pathogenic invasion that tissues containg low reserves. Altered carbohydrate metabolism in response to pathosystem infection was studied by several workers (Bhaskaran and Prasad 1971; Kalyanasundaram 1986)." "The sugar content in healthy and pathogen inoculated plants was very often correlated with resistance mechanism (Horsfal and Diamond 1957).

Table 1. Efficacy of different inoculation of PGPR cells on the enhancement of growth and yeild of rice variety ADT-36 *(Oryza sativa)*

Treatment	Plant height (cm)	Root dry weight (g/plant)	Shoot dry weight (g/plant)	Phosphorous content (%)	Chlorophyll content (mg/g of leaf)	IAA content (%)	Grain yield (tha^{1})	Straw yield ($t\ ha^{4}$)
Control	51.07	0.268	1.039e	0.43	2.40e	11.70e	5.49e	-
Pseudomonas flouorescens	60.36e	0.317e	1.244e	0.66e	2.41e	13.44e	5.79e	11.33
Bacillus polymyxa	62.69d	0.32d	1.176d	0.59d	2.36d	12.82d	5.59d	9.70
Pseudomonas fluorescens+ Bacillus + polymyxa co inoculation	67.11b	0.332b	1.359b	0.74b	2.67b	13.04b	5.86b	14.26
Pseudomonas fluorescens+Bacillus Polymyxa coagg.	70.71a	0.338a	1.489a	0.86a	2.88a	15.26a	5.92	14.39
LSD (P = .05)		0.009	0.188	0.10	0.16	0.13	0.02	

a Average of three replication b Values followed by different letters are significantly differed at 5% level according to student T test

In present research also, the reducing and non reducing sugar levels were found to decrease with PGPR coaggregates application together with challenge inoculation of *P.oryzae* and higher rate of reduction in the native level of reducing sugars, may be one among the vital phenomena contributing resistance to plant." "The results of present research clearly envisaged the positive role of PGPR consisting of *Pseudomonas* (Pseu-4) and *Bacillus polymyxa* (B.pol-15) isolates in augumenting the ISR against *Pyricularia oryzae* in rice crop."

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