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Effects of bio priming of rice seeds with native *Trichoderma* spp. isolated from rice rhizospheric soil

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Abstract

Rice seeds were bio primed with native *Trichoderma* isolates for their efficacy of biocontrol and enhancing seedling vigour of the plant. In the investigation fifteen treatments were carried out using native *Trichoderma* isolates including the control. Among the fifteen treatments tested including the control, the treatment of *T. harzianum* isolate WAI-D has shown the best performance giving highest seed germination of 92.00 per cent and seedling vigour index of 944.84 which was statistically superior over other treatments and nonetheless *Trichoderma viride* isolate CHK-I has shown good performance which comes next to the best with germination percentage of 86.33 and seedling vigour index of 661.28 and the least per cent seed germination were observed in the control. The difference in results observed may be due to the presence of variable level of enzymatic activity of the different isolates of native *Trichoderma* isolates and also the difference in the ease of substantial multiplication of the biocontrol agents on seed in the process of bio priming.

Keywords: Bio priming, seed vigour, rice seed, native *Trichoderma*

Introduction

Rice (*Oryza sativa* L.), is an important cereal crop that provides staple food for more than half of the world's population. It has been reported that about 165.00 million ha with a net output of 496.6 million tons of rice with an average yield of 3.01 tons per ha (FAO, 2014) [3]. Asia is the largest consumer of rice housing more than 95% of the 2.7 billion *i.e.*, total rice consuming population (FAO, 2014) [3]. India is an important centre of rice cultivation with an area of 44 million ha annually with a production of 103 mt, with an average productivity of 2.3 t/ha (Parthipan *et al.*, 2013) [8].

Seed treatment with bio-control agents as priming agents may serve as an important means of managing many of the soil and seed borne diseases, the process often known as 'bio-priming'. Bio-priming is the seed treatment that integrates the biological and physiological aspects of disease control, is recently used as alternative method for controlling many seed and soil borne pathogens (Begum *et al.*, 2010) [1]. It is an eco-friendly seed treatment which can be used as a substitute of chemical fungicides in seed treatment. Seed bio priming involves seed coating with a myriad of beneficial agriculturally important microbes leading to rapid and uniform seed colonization (Challan *et al.* 1997) [2]. *Trichoderma* spp. is one of the most common free living saprophytic fungi in rhizosphere which widely occupy the major share of fungal biocontrol agents in bio pesticide industry (Woo *et al.* 2014) [13]. The effects of seed treatment examined with *Trichoderma* isolate on germination of seed exposed to biotic stress and abiotic stresses and evaluated the ability of the beneficial fungus to overcome physiological stress. They found under stress condition *Trichoderma* isolate treated seed germinated consistently faster and more uniformly than untreated seeds (Mastouri *et al.*, 2010) [7]. Biological seed treatment is the most effective method to protect seeds from soil-borne pathogens at early stage of plant development (Singh *et al.* 2013a; Jain *et al.* 2013) [10, 13] and also effectively reduce the dependence on chemical fungicide for diseases management (Challan *et al.* 1997; Pill *et al.* 2009) [2, 9]. *Trichoderma* spp. not only promotes plant growth and development but also have broad-spectrum antagonistic activities against various soil borne phytopathogens (Singh *et al.* 2013b, Keswani *et al.*, 2014) [11, 6]. Due to above reasons, *Trichoderma* has been widely used for seed treatment (Taylor *et al.* 1991; Pill *et al.* 2009; Jain *et al.* 2014) [12, 9, 5]. Thus, with this background, the present study on the effect of seed bio priming with 14 native isolates of *Trichoderma* isolated from rice rhizosphere has been carried out to evaluate the probable biocontrol activity and bio fertilizer action of some native *Trichoderma* to enhance

the production and productivity of rice. The results showed that seed priming with the above treatments significantly increased seed germination and seedling vigour against the control.

Materials and methods

Experimental site

The laboratory experiment was carried out at Department of Plant Pathology, College of Agriculture, Central Agricultural University, Imphal.

The Biocontrol Agents

The native *Trichoderma* isolates have been obtained from the rhizospheric soils of rice collected from different valley regions of Manipur.

In vitro evaluation of biocontrol agents for its bio-priming activity.

The bio priming of seeds of rice has been done by using the potent isolates of *Trichoderma* spp. The mycelial inoculum of *Trichoderma* isolate from the broth culture were prepared. Seeds of test crop were washed with distilled water, air dried and finally dipped into the suspension of bio agents for few minutes, and stirred thoroughly to ensure uniform coverage of seeds with suspension of bio agents. Separate treatment were carried out for all the fourteen native *Trichoderma* isolates. The treated seeds were spread on a cleaned blotter paper and allowed to shade dry. Then the treated seeds were seeded into petriplates lined with double layered moist blotter paper

which were covered with upper lid of petriplates with moist blotter paper. The setup has been incubated for one week at 25 ± 2 °C. The germination of seeds were then observed and the root and shoot length has been measured. The variety of rice used for the experiment is CAU-R1 (Tamphaphou) which were primed in the *Trichoderma* isolates and seeds treated in sterile distilled water were used as control treatment. The vigour index of respective crop seedlings has been calculated on the basis of root and shoot length as follows:

Vigour index of seedlings = [Root length (cm) + shoot length (cm)] x germination (%).

Results and Discussion

Seed bio priming with native *Trichoderma* isolates that were obtained from the rhizospheric soils of rice has been done. List of treatments is enlisted in Table 1. The highest root length was observed in treatment with isolate WAI-D, *Trichoderma harzianum* followed by CHK-I, *Trichoderma viride*. Highest per cent germination of 92.00% was recorded in treatment with isolate WAI-D, *Trichoderma harzianum* and followed by CHK-I, *Trichoderma viride* @ 86.33% and the least per cent seed germination were observed in the control. Bio priming of rice seeds with *Trichoderma* isolates showed considerable increase in seedling vigour index over control. All the isolates showed significant differences among them as listed in table 2.

Table 1: List of treatments used in the bio priming experiment

S. No.	Treatments	Native <i>Trichoderma</i> isolate	Places of rice rhizospheric soil collection
1	T1 TAN-A	<i>Trichoderma koningii</i>	Tangjeng, Thoubal
2	T2 LAM-B	<i>Trichoderma brevicompactum</i>	Lamsang, Imphal West
3	T3 WAI-D	<i>Trichoderma harzianum</i>	Waiton, Imphal East
4	T4 LIL-E	<i>Trichoderma harzianum</i>	Lilong, Thoubal
5	T5 KWS-F	<i>Trichoderma harzianum</i>	Kwasiphai, Bishnupur
6	T6 NAM-G	<i>Trichoderma harzianum</i>	Nambol Oinam, Imphal West
7	T7 TKS-H	<i>Trichoderma asperellum</i>	Thongahanbi Kiyamsiphai, Thoubal,
8	T8 CHK-I	<i>Trichoderma viride</i>	Chingkhui, Imphal East
9	T9 THML-J	<i>Trichoderma asperellum</i>	Thinungei maning leikai, Bishnupur
10	T10 WAN-K	<i>Trichoderma harzianum</i>	Wangbal Canal, Thoubal
11	T11 WANJ-L	<i>Trichoderma harzianum</i>	Wangjing Thongthak, Thoubal
12	T12 NAR-M	<i>Trichoderma harzianum</i>	Naran Seinya, Bishnupur
13	T13 KSS-O	<i>Trichoderma harzianum</i>	Kangla Sangom Sang, Imphal East
14	T14 SAI-C	<i>Trichoderma koningiopsis</i>	Sairemkhul, Imphal West
15	T15 Control	Treatment with sterile distilled water	

Table 2: The effects of bio priming on shoot length, root length, Germination per cent and seedling vigour index

Treatment	Shoot length* (cm)	Root length* (cm)	Germination* per cent	Seedling Vigour index*
T1	3.90	4.03	83.33	660.80
T2	2.50	5.23	85.00	657.05
T3	2.86	1.09	71.67	283.09
T4	5.81	4.46	92.00	944.84
T5	3.83	3.83	86.33	661.28
T6	4.34	3.16	66.67	500.02
T7	3.53	3.73	83.00	602.58
T8	4.76	3.36	80.00	649.60
T9	4.76	2.96	77.67	599.61
T10	4.06	3.33	81.33	601.02
T11	3.30	2.65	73.33	436.31
T12	3.83	3.33	80.00	572.80
T13	4.03	3.16	80.00	575.20
T14	3.83	3.33	75.00	537.00
T15 (control)	2.89	1.66	51.67	235.09
SEd	0.91	0.79	18.08	136.27
CD 5%	1.81	1.56	35.75	269.45
CD 1%	2.39	2.06	47.22	355.93

* mean values of the three replications in the experiment

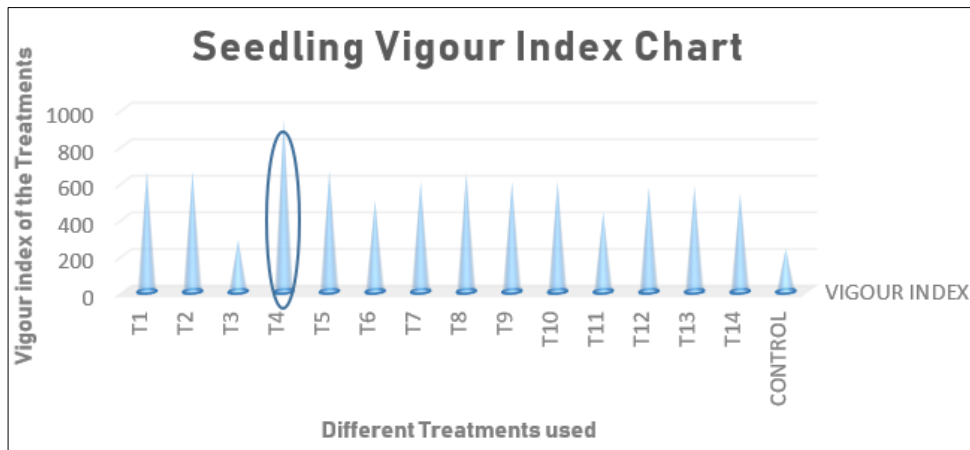


Fig 1: Graphical representation of effects of bio priming on seedling vigour of Rice

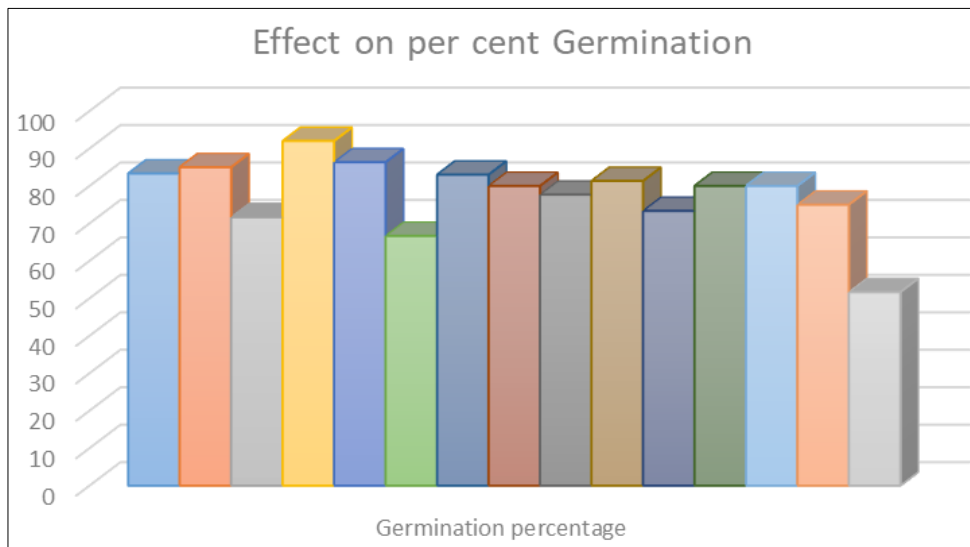


Fig 2: Graphical representation of effects of bio priming of rice seed with native *Trichoderma* isolates on the germination percentage

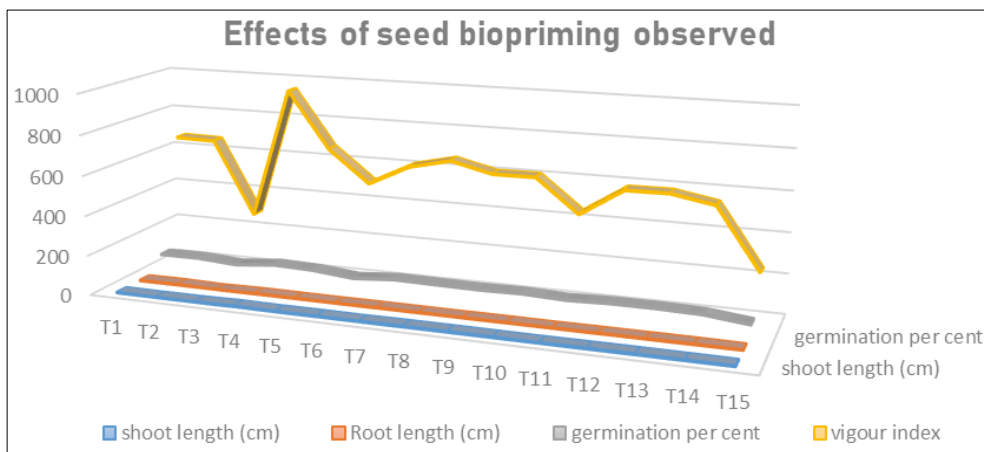


Fig 3: An overall graphical representation of the effects of Bio priming of rice seed using native *Trichoderma* isolates (effects on shoot length, root length, germination per cent and seedling vigour index)

Conclusion

The results showed that seed bio priming with the above treatments significantly increased seed germination and seedling vigour against the control. The highest root & shoot length was observed in T4, treatment with isolate WAI-D, *Trichoderma harzianum*. Highest per cent germination of 92% was recorded in treatment with isolate WAI-D, *Trichoderma harzianum* and the least per cent seed germination were observed in the control. Bio priming of rice seeds with *Trichoderma* isolates showed considerable increase

in seedling vigour index over control which may be accorded to the presence of variable level of enzymatic activity of the different isolates of native *Trichoderma* isolates and also the difference in the ease of substantial multiplication of the biocontrol agents on seed in the process of bio priming.

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