

Effective of Phosphate Biofertilizer on Reducing Use of Chemical Phosphate Fertilizer and Rice Yield in Amol, Iran

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Abstract: In order to study the effect of phosphate biofertilizer on reducing the use of chemical fertilizer and increasing Rice yield (two varieties called Shafagh and Tarom) was carried out in Amol province Agricultural Rice research in 2009. The experimental design was Split plot in randomized complete block with 3 replications. The main plot was variety in two levels (shafagh and Tarom) and sub plot was (use and not use) of phosphate biofertilizer with different amounts of chemical fertilizer in 4 levels (0, 50, 100 and 150 kg/ha). The data were analyzed statistically and means were compared by Duncan's test. The analysis of variance showed that, there is no significant influence biotic fertilizer and interaction between phosphate biofertilizer and chemical fertilizer on none of trait under examination such as Panicle length, percent of paddy, the percent of full and empty grains, the number of grain in panicle, the weight of 1000 grains, the height of plant, the number of Tiller and Yield. The effect of Phosphate triples fertilizer on the number of teller, the height of plant and yield by %1 was significant. The interaction between biotic fertilizer and chemical fertilizer on the weight of 1000 grains of Shafagh was significant by %5. But in general the effect of biotic fertilizer on yield of two varieties was not significant due to the planting environment.

Key words: Phosphate biofertilizer • Phosphate fertilizer • Rice yield

INTRODUCTION

The appropriate adequate consumption of all kinds of fertilizer (Chemical, Farm yard manure, Compost and Bio fertilizer) is the main way of protection and correction of productivity of soil condition and they increase in the yield of agricultural products. This fertilizer should be able to increase yield and quality of agricultural crops and while not polluting the environment, minimize the aggregation of pollutant substances like Nitrate in consumable parts of crops [1]. Phosphorus is found in the form of organic and mineral phosphors in the soil [2]. To supply required Phosphorus of plant, the use of chemical fertilizer and Biologic fertilizer are available. It is necessary to use phosphate solubilizing microorganisms (PSM) to change insoluble phosphors into soluble form [3].

Eftekhari, *et al.*, (2006) during the research on (*Oriza sativa L.*) find that consume of deferent treatment of super phosphate tripl 75, 150 and 75 (kg/ha) with phosphate solubilizing bacteria respectively cause to

increase Grain yield 7593.7 (kg/ha), T.G.W; 31.13 (gr) and the highest Panicle length 29.7 (cm) [4]. Ghasem Khanloo, *et al.*, (2009) done an experimental on Potato showed that control treatment in comparison with biofertilizer had the lowest number of leaves, plant height, number of branching in plant, biggest and smallest tubular diameter, number of rubber per plant and tuber yield lowest prosper and consumption of 100 gram treatment, Barvar-2 phosphate biofertilizer in the whole of characters in the lower level toward treatment attendance 200 grams barvar-2 phosphate biofertilizer were placed. Control treatment with tuber yield of 29630 (kg/ha) toward treatment levels 100 and 200 grams manure per hectare had respectively reduced function equal to 22 and 31 percent [5]. Baybordi and Malekoti, (2004) during their research find that there is the significant different between the yield of Potato and the levels of fertilizer P0 and P150 [6]. Rahimzade Abyazani, *et al.*, (2006) during their research find that phosphate biofertilizer (P5, P7 and P13) had the significant effect on observation the phosphor, nitrogen and increase yield of Sorgom

forage [7]. Melboobi, (2001) done an experimental on Potato by using bio fertilizer; found that, bio fertilizer has caused the increase of yield to 10 % [8]. Substitution of phosphate biofertilizer has caused the decrease in dangerous effects on production stage and phosphate chemical fertilizer. This kind of fertilizer has caused the reconstruction of soil texture and their productivity [2]. Eftekhari (2003) by using phosphate biofertilizer (A2) and Phosphate Solubilizing Bacteria (A3) on Rice has been found that, bio fertilizer Phosphate (A2) has caused the heights increase of grin yield (7593.7 kg/he) and longest panicle length was Phosphate Solubilizing Bacteria (A3)(29.7 cm) [9]. Darzi (2004) by using treatment of Bio fertilizer effect on the grain yield and the influential amount of medical herb (*Foeniculum vulgare*), it has been concluded that the heights grain yield (1047 kg), amount of essence in grain (3.95%) and essence performance (42.17 kg) were available through inoculation with Micoriza. Phosphate Bio fertilizer didn't have any significant effect on grain yield. But it had an influence on the amount of essence in grin and its yield. The highest amount of essence (3.94%) and essence yield (9.77 kg) gained [10]. Ardakani(2004) mention the effect of inoculation with *Tiobasilus* and Organic Sulphur Fertilizer in soil on forage corn (ksc 400), it has been concluded that phosphate fertilizing with granular Sulphur has increased the height of plant and wet and dry weight of plant [11]. Silspoor (2004) used phosphorus biologic fertilizer and treatment without using phosphorus biologic fertilizer (control) in forage corn, he concluded that the highest yield (92.5 ton/he) in treatment of using phosphorus biologic fertilizer was attained and the highest amount in control treatment without using this fertilizer was (45.7 ton/hc) [12].

MATERIALS AND METHODS

Thy study was performed to decrease the consumption of phosphate chemical and the effect of phosphate bio fertilizer on the yield and components of the yield of two kinds of Rice in Amol province Agricultural Rice Research Center (Longitude=52° 30' Latitude=36° 30' and Elevation=76 m) in 2004, which has the following soil characteristics:

Table 1: The results of soil analysis

Soil texture	Loam (%)	Sand (%)	Clay (%)	Organic (%)	PH	K (ppm)	P (ppm)	EC (ds/m ²)
Clay loam	29	34	37	2	7.5	201	11	1.46

The experimental design was split plot in randomized complete block with 3 replication. The main plot was varieties in two levels (Shafagh and Tarom) and sub plot was (use and not use) of phosphate biofertilizer with different amount of chemical fertilizer in 4 levels [0 (control), 50,100 and 150 kg/ha].

Tarom is a local variety with suitable quality and Shafagh is a breeder variety with high yield and suitable quality.

Phosphate biofertilizer is a kind of bacteria which is recommend to the value of 10 (gr/hc). In order to perform the experiment first Tarom and shafagh seeds were planted separately. When seedling height reached 20-25 cm or 4 leaves stage, seedlings are taken from Nursery and were put in to bio fertilizer bacteria for 2-3 min. Than they were planted in main rows with 25*25 cm distance.

Triple Super Phosphate chemical fertilizer treatment on each rows were used separately, Urea fertilizer (250 and 100 kg/he) and Potassium sulphate fertilizer and Triple Super Phosphate with 50% Urea fertilizer before planting were consumed and the remain of Urea fertilizer in tillering and panicle formation into form of Top dressing was consumed. To determine the component of yield, 10 panicles were collected from sample area characteristics such as panicle the number of grain and the weight of 1000 grains (T.W.G) was identified. In maturity, 5 m² were selected from each plot and its yield was determined on the basis of 14% humidity. After collecting data and Statistical Analysis on the basis of statistical software such as SAS and MSTAT-C were done and comparison of average data was performed by (Duncan multiple rang test 5%) and the charts was drawn with Excel software.

RESULTS AND DISCUSSION

Panicle Length: The effect of phosphate biofertilizer and chemical fertilizer and their interaction effect on panicle Length was not Significant (Table 2).

And statistically the effects of treatment of phosphate biofertilizer on panicle Length in tow varieties were in the same group (Table 3).

Table 2: Analysis of variance (S.O.V) for Shafagh and Tarom characteristics study

		Main squares (M S)													
S.O.V	d.f	Grain yield (kg/ha)		Number of Tiller		Plant height (cm)		T.G.W (gr)		No. of grain in panicle		Percent of Full grains		Panicle Length	
		Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh
Replication	2	438120/67*	540938/17*	20/38**	5/01*	237/12**	21/94*	0/30*	0/55*	258/05*	1037/39*	0/030*	0/7*	2/64*	3/41*
Biophosphot	1	297037/50*	642228/17*	0/04*	7/60*	96/00*	1/81*	1/67*	1/05*	2/31*	11/76*	0/002*	0/008*	0/74*	0/77*
Chemical fertilizer	3	194153/06*	1847312/17**	1/71*	40/88**	39/39*	144/25*	3/89*	4/15*	167/30*	153/70*	0/006*	0/04*	3/54*	1/08*
Chemical fertilizer *Biophosphot	13	218983/28*	35581/95**	3/16*	1/04*	20/34*	2/50*	0/50*	2/49*	169/07*	75/50*	0/019*	0/01*	1/07*	1/53*
Error (C.V)	14	97498/58	255117/21	1/09	2/51	27/08	63/71	0/96	10/91	308/15	304/09	0/01	0/03	1/14	1/10
		7/17	7/70	7/52	8/61	3/40	2/08	3/71	3/15	13/07	10/35	1/04	1/87	4/18	3/79

* and ** : Significant at 5% and 1% probability levels, respectively
 - ns: No - Significant

Table3: Means comparison of interaction effects between Biotic Fertilizer and Non-Biotic Fertilizer for Shafagh and Tarom Characteristics (Duncan multiple rang test 5%)

Treatment	Grain yield (kg/ha)		Number of Tiller		Plant height (cm)		T.G.W (gr)		Number of grain in panicle		Percent of Full grains		Panicle Length	
	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh
Biofertilizer	4245/3*	6400/5*	13/84*	17/84*	154/75*	102/71*	26/35*	27/75*	134/67*	169/05*	95/25*	89/34*	25/38*	27/89*
Non - Biofertilizer	4467/8*	6727/7*	13/92*	18/95*	150/75*	102/17*	26/41*	28/17*	134/05*	167/65*	94/86*	89/68*	25/73*	27/52*

- Means followed by the same letters in each column are not significantly different

Table4: Means comparison of chemical fertilizers for Shafagh and Tarom characteristics (Duncan multiple rang test 5%)

Treatment	Grain yield (kg/ha)		Number of Tiller		Plant height (cm)		T.G.W (gr)		Number of grain in panicle		Percent of Full grains		Panicle Length	
	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh
0	4101/7b	5845/3b	13/5a	14/67b	156/33a	95/77c	27/5a	27/17b	5/72a	11/27a	94/28a	88/73a	26/65a	27/29a
50	4406/0ab	6422/7ab	14/34a	18/59a	152/83a	102/67b	26/00b	28/5b	5/14a	9/56a	94/86a	90/44a	25/39ab	28/27a
100	4394/0ab	7086/7a	14/34a	19/83a	151/17a	103/84b	26/17b	27/34ab	4/75a	9/75a	95/25a	90/25a	25/30ab	27/50a
150	4524/7a	6901/7a	13/34a	20/5a	150/67a	107/5a	25/67b	28/84a	4/36a	12/56a	95/64a	87/4a	24/87b	27/77a

- Means followed by the same letters in each column are not significantly different

Table5: Means comparison of intercepotion effects between Biotic Fertilizer and Chemical Fertilizer for Shafagh and Tarom Characteristics (Duncan multiple rang test 5%)

Treatment	Chemical Fertilizer * Biotic Fertilizer	Grain yield (kg/ha)		Number of Tiller		Plant height (cm)		T.G.W (gr)		Percent of Full grains		Panicle Length	
		Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh	Tarom	Shafagh
Biotic Fertilizer	0	3828/00*	5610/66*	13/33**	14/33*	155/66*	95/53*	27/66*	27/33*	93/13*	88/73*	26/33**	27/80*
	50	4420/00*	6203/33**	14/00*	18/33*	155/66*	103/00*	26/00*	28/66ab**	96/04**	90/82*	25/63ab	28/73*
	100	4484/00*	7014/66*	15/33*	18/66*	154/66*	105/00*	25/66*	27/33*	96/24**	88/92*	24/60*	27/80*
	150	4249/33**	6773/33**	12/66*	20/00*	153/00*	107/33*	25/66*	27/66*	95/64**	86/49*	24/93**	27/20*
Non-Biotic Fertilizer	0	4375/33**	6080/00*	13/66*	15/00*	157/00*	96/00*	27/33*	27/00*	95/64**	88/54*	26/96*	26/76*
	50	4392/00*	6642/00*	14/66*	21/00*	150/00*	102/33*	26/00*	28/33*	93/70*	89/87*	25/13**	27/80*
	100	4304/00*	7158/66*	13/33**	21/00*	147/66*	102/66*	26/66*	27/33*	94/47*	91/35*	26/00**	27/20*
	150	4800/00*	7030/00*	14/00*	21/00*	148/33*	107/66*	25/66*	30/00*	95/64ab	87/92	24/80*	28/33*

- Means followed by the same letters in each column are not significantly different

Simple treatment of chemical fertilizer consumption and control of Tarom variety with panicle Length 26/65cm and treatment of phosphorus fertilizer (150kg/ha) with panicle Length 24/87cm had the highest and the lowest panicle Length respectively (Table 4). These results were consistent with "Eftekhari 2003" [9]. They weren't Consistent with "Ardakani 2004" [11].

Persent of Full Grain: According to the results of variance analysis table the effect of phosphate biofertilizer and Chemical fertilizer was not Significant on full grain (Table 2). And the interaction effect of consuming and not consuming phosphate biofertilizer on Tarom variety shows different group. So that consumption zero (control) or 100 kg/ha of chemical Fertilizer with treatment without biochemical with the average 93/13 and 94/97% have shown the lowest and the

highest percent of full grain respectively (Table 5). Therefore it is concluded that chemical Fertilizer and phosphate biofertilizer consumption to gather has cased the increase in the percent of Full groin and the decrease in Empty grain. The results are consistent with "Eftekhari 2003" reports [9].

The Number of Grain in Panicle: According to the results of variance analysis table the effect treatment of chemical and phosphate biofertilizer and their interaction on the number of grain in panicle were not Significant. (Table 2) Based on compression of the average effects of phosphate biofertilizer treatment and not consuming phosphate biofertilizer on panicle Length were not Significant (Table 3). The reasons that the phosphate biofertilizer was not effect on the number of grain in panicle in water Logging cultivation.

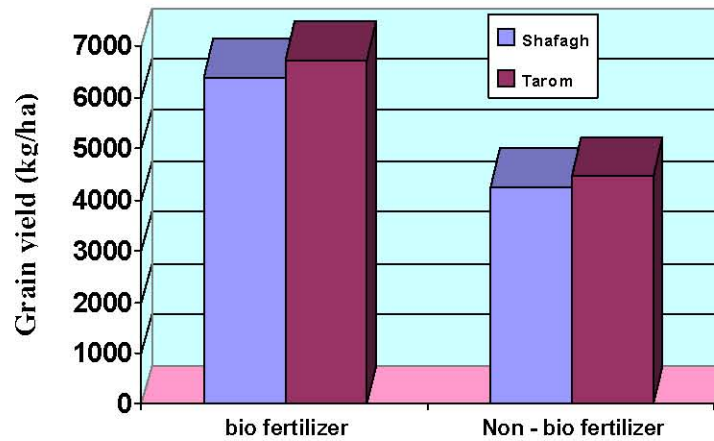


Fig. 1: Means comparison between use biotic fertilizer and Non-biotic fertilizer on the grain yield

The Grains of 1000 Weight. (T.G.W): The effect of phosphate biofertilizer was not significant on none of these varieties. The effect of chemical Fertilizer on both varieties were significant at (5%) and the interaction of phosphate biofertilizer and chemical Fertilizer only on the shafagh variety was significant at (5%). Based on means comparison table, the mean interaction effect of consumption and not consumption of phosphate biofertilizer with different treatment of chemical Fertilizer in Shafagh variety, the comparison between the consumption of 150 (kg/hc) chemical fertilizer and not consummative phosphate biofertilizer with the average weight of 1000 grains 30/00gr and consumption of zero (control) (kg/hc) chemical fertilizer with the average weight of 1000 grains 27.33 (gr) the highest and the lowest weight of 1000 grains respectively (Table5) & (Graph: 3).

Its reason is that contrary to Tarom variety, Shafagh variety is fertilizable and the increase in chemical fertilizer consumption has caused the increase in (LAI) and production of photosynthetic substance (NAR) and the weight of 1000 grains. And subsequently yield (Table 5). The results were consistent with "Eftekhari 2003" reports [9].

The Plant Height: Statistically the simple effect of bio fertilizer and the interaction of phosphate biofertilizer and chemical Fertilizer were not significant. But the effect of the treatment of chemical fertilizer on Shafagh (5%) has become significant (Table 2). The treatment of consuming 150 (kg/ha) chemical fertilizer with the average height of plant 107.5 cm, zero consuming of chemical fertilizer with average height of plant 95.77 cm, have the highest and the lowest height of plant (Table 4). The increase in chemical fertilizer and

fertilizability of Shafagh has caused the increase in height and the number of tiller and it is inconsistent with "Ardekani; 2004" reports [11].

The Number of Tiller: The result of variance Analysis table shows that the effect of the treatment of bio fertilizer and the instruction effect of phosphate biofertilizer and chemical fertilizer was not significant in these varieties. But the effect of chemical fertilizer on the number tiller is significant at (1%) (Table 2). Based on the table of average comparison (Table 5), the treatment of phosphate biofertilizer consumption 150 (kg/ hc) and zero (control) (kg/hc) of chemical fertilizer consumption in Shafah with average number of tiller 20.00 and 14.33 has the highest and the lowest value respectively. And in Tarom, 100 (kg/hc) and 150(kg/hc) chemical fertilizer with 15.33 and 12.66 average has the highest and the lowest number of tillers.

Yield: All traits measured in this study have influenced on the grain yield. Although every trait is related to genetic potential in variety, they are strongly under the influence of environmental conditions and planting management.

The results of variance analysis table don't show significant difference in the simple effect of phosphate biofertilizer and the interaction between phosphate biofertilizer and chemical fertilizer on yield of these tow varieties. Bat it shows the simple effect of chemical fertilizer on the yield of Shafgh (1%) (Table 1). Based on means comparison table the Shafagh variety with the treatment of 100 and zero (control) (kg/ha) chemical fertilizer, both height and the lowest yield of 7086.7 and 5845.3 (kg/hc) respectively (Table 3) & (Graph 1). The means comparison table consumption

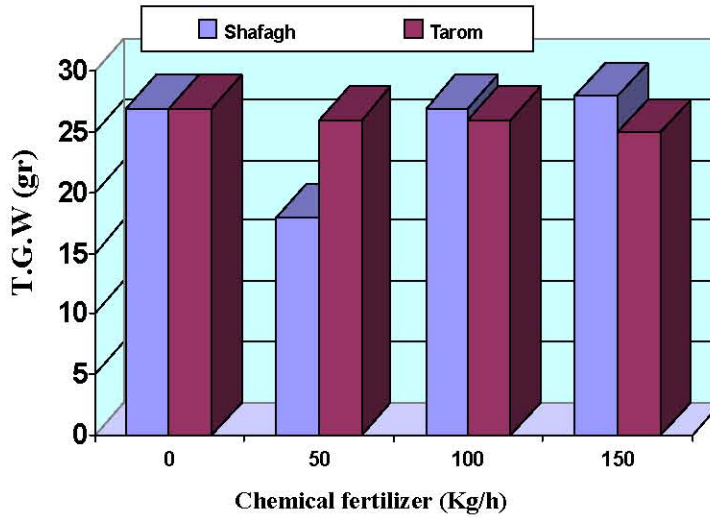


Fig. 2: Means comparison of use chemical fertilizers on the T.G.W

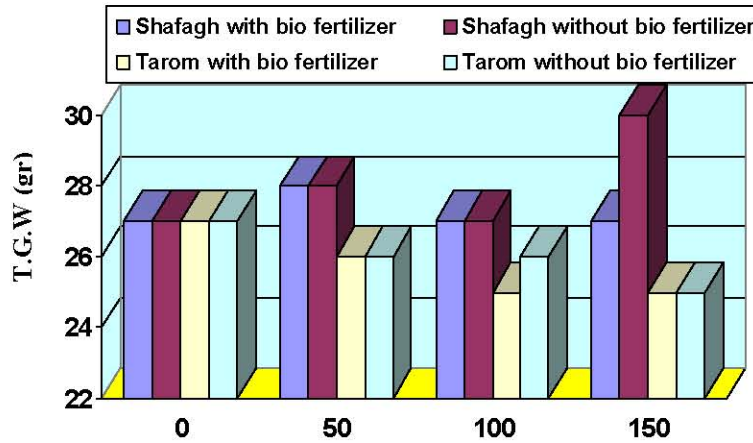


Fig. 3: Means comparison of interaction effects between use biotic fertilizer and Non biotic fertilizer whit chemical fertilizer on the T.G.W Use biotic fertilizer and non biotic fertilizer whit chemical fertilizer

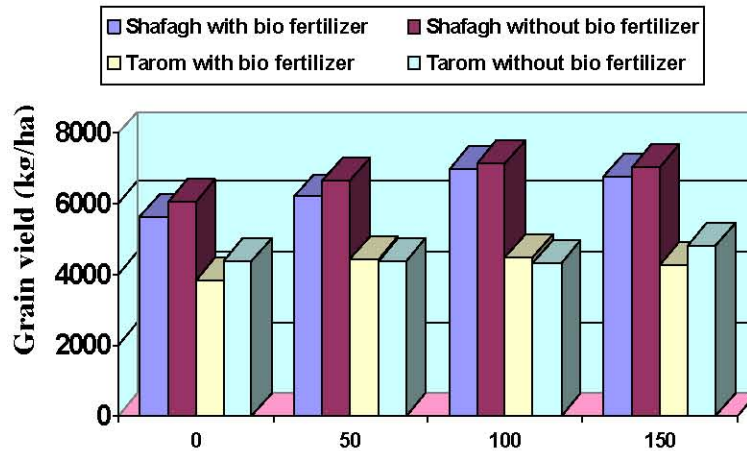


Fig. 4: Means comparison of interaction effects between use biotic fertilizer and chemical fertilizer on the grain yield Use biotic fertilizer and non biotic fertilizer whit chemical fertilizer

and not using phosphate biofertilizer with different treatment of chemical fertilizer show that in Shafagh with treatment of 100 (kg /hc) chemical fertilizer and treatment of not using bio fertilize with average yield of 7158.66 (kg/hc) and using zero (control) (kg/hc) chemical fertilizer and not using bio fertilizer with average yield of 5610.66 (kg/hc) have the highest and the lowest yield redelivery (Table 5) & (Graph 1). To interpret these result one can say that phosphate biofertilizer and chemical fertilizer has caused the increase yield and it is the result of the increase of full grains, decrease in empty grain and increase in the number of grain in panicle and the number of tillers (Table 5).

And these results are consistent with the views of Melboobi (2004), Eftekhari 2003, Selispor (2004), Eftekhari (2006) and Darzi (2005) [8, 9, 12, 4, 10].

But if chemical fertilizer consumption is more than repaired it causes the decree in yield and increase empty panicle. Because the lack of Phosphate in soil (Table 1) before application phosphate biofertilizer lead to no efficiency for values available Phosphate. Perhaps root absorption for Phosphate is low and the activations to Bacteria can't prepare suitable Phosphate. Phosphate deficient lead to decrease photosynthesis rate. Low assimilate caused to decline yield and yield components.

CONCLUSION

The effect of phosphate biofertilizer on reducing the use of chemical fertilizer and increasing Rice yield (tow varieties called Shafagh and Tarom) was carried out in Amol province Agricultural Rice research in 2009.

The analysis of variance showed that, there is no significant influence biotic fertilizer and interaction between phosphate biofertilizer and chemical fertilizer on none of trait under examination such as Panicle length, percent of paddy, the percent of full and empty grains, the number of grain in panicle, the weight of 1000 grains, the height of plant, the number of Tiller and Yield. In general although phosphate biofertilizer consumption has not caused the increase of yield statistically, but based on mean comparison of phosphate biofertilizer in comparison with not consuming this fertilizer, has shown better yield. It may be the lack of adaptation and the activity of bacteria of bio fertilizer in water logging cultivation and low amount of insoluble P in soil (11 ppm) that bacteria has faced the lack of P and changed it in to soluble P. It is better to use phosphate biofertilizer in upland planting or to use compatible bacteria to upland. The reason for this is that the bacteria might be

sensible to water logging planting of Rice. Therefore, it is better to use this biotic fertilizer in upland or to use deferent kind of biotic fertilizer in water logging. And these results are consistent with the views of Eftekhari (2006) Melboobi (2004), Eftekhari 2004, Selispor (2004) and Darzi (2005) [7, 4, 9, 3].

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