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Biopriming of rice seed with phosphobacteria for enhanced germination and vigour

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ABSTRACT

Phosphate solubilizing bacteria (PSB) are able to convert insoluble forms of phosphorus to an accessible form. An investigation was carried out with MDU 6 rice seeds were bioprimed with Phosphobacteria (Concentration: 10, 15 and 20 %; Duration: 6, 12, 18 and 24 h). The seeds were also hydroprimed for 6, 12, 18 and 24 h. The nonprimed seeds served as control. Biopriming with Phosphobacteria (20 % concentration for 12 h) expressed high values for all the parameters studied namely speed of germination, germination (%), root length (cm), shoot length (cm), dry matter production (g/5 seedlings) and vigour index which accounted for 26, 15, 13, 15, 16 and 27 % increase over nonprimed seed.

Key words: *Biopriming, phosphobacteria, germination, vigour, rice*

Rice is the one of the most important food crop for more than half of the world's population accounts for around 23 % of the global calorie intake (Li et al., 2011). In recent years, a lot of studies have been done on invigoration of seeds to improve the germination rate and uniformity of growth and reduce the emergence time of many vegetables and some field crops (Basra et al., 2003). In priming, seeds are exposed to restricted water availability under controlled conditions which allows some of the physiological processes of germination to occur and before the germination is completed, the seeds are usually re-dried for short term storage before sowing (Halmer, 2003). Seed priming is now a widely used commercial process that accelerates the germination rate and improves seedling uniformity in many crops (Halmer, 2003). Hence, study was undertaken to standardize the optimum concentration and duration for seed biopriming using phosphobacteria.

Genetically pure seeds of rice var. MDU 5 used as base material for this study. The phosphobacteria collected from the Department of Agricultural Microbiology were also used for this study. Five hundred seeds were soaked twice in the volume of the respective concentration in the Phosphobacteria. For hydropriming, the seeds were soaked in water for 6, 12, 18, and 24 h. The non-primed seeds served as control. After the soaking duration, the seeds were removed from the solutions and shade dried at room temperature for assessing the seed quality parameters. The experiment was carried out with 4 replications in factorial completely randomised design (CRD). The seeds showing radical protrusion were counted daily from third day after sowing until fourteenth day. The speed of germination was calculated using the formula by Maguire (1962). Hundred seeds were placed in between paper using four replications and per cent germination was recorded after fourteenth days (final count) (ISTA, 1999). At the time of germination count, ten normal seedlings were selected at random from each replication and used for measuring the root length of seedlings. Root length was measured from the point of attachment of seed to the tip of primary root. The mean values were recorded and expressed in centimeter. The seedlings used for measuring root length were also used for measuring shoot length. The shoot length was measured from the point of attachment of

Table1. Influence of biopriming with phosphobacteria on germination (%) of rice cv. MDU 5

Biopriming treatments (T)	Soaking duration in h (D) 6	12	18	24	Mean
Nonprimed seed	82 (65.08)	82 (65.08)	82 (65.08)	82 (65.08)	82 (65.08)
Hydropriming	85 (67.05)	92 (73.37)	84 (67.78)	90 (71.35)	88 (69.73)
Phosphobacteria (10%)	87 (69.04)	93 (74.66)	92 (74.19)	89 (70.45)	90 (71.35)
15%	89 (70.45)	95 (77.25)	86 (67.90)	90 (71.35)	90 (71.35)
20%	90 (71.35)	97 (80.45)	93 (74.66)	96 (79.98)	94 (75.95)
Mean	87 (69.04)	92 (74.19)	87 (69.04)	89 (70.45)	89 (70.45)
	D	T	D x T		
SEd	0.827	0.925	1.851		
CD (P = 0.05)	1.655**	1.851**	3.702*		

Values in parenthesis are arc sine transformed values, **- Significant at 5% level

cotyledon to the tip of the leaf and the mean values were recorded and expressed in centimeter. Vigour index values were computed using the following formula and the mean values were expressed in whole number (Abdul-Baki and Anderson, 1973). Vigour index = Germination (%) × Total seedling length (cm). The data obtained from different experiments were analysed for the 'F' test of significance following the methods described by Panse and Sukhatme (1985).

The speed of germination, germination, root and shoot length, dry matter production and vigour index were significantly influenced by biopriming treatment, duration of biopriming and their interaction. The results indicated the better performance of phosphobacteria (20 % for 12 h) with respect to speed of germination (8.8). The lowest speed of germination of 6.5 was noticed in nonprimed seed (Fig. 1). Seeds primed with

Table 2. Influence of biopriming with phosphobacteria on root length (cm) of rice cv. MDU 6

Biopriming treatments (T)	Soaking duration in h (D) 6	12	18	24	Mean
Nonprimed seed	19.6	19.6	19.6	19.6	19.6
Hydropriming	19.8	20.4	20.1	20.2	20.1
Phosphobacteria 10%	20.6	20.4	20.7	21.9	20.9
15%	20.7	22.6	20.2	21.8	21.3
20%	21.3	22.6	21.7	22.0	21.9
Mean	20.4	21.1	20.5	21.1	20.8
	D	T	D x T		
SEd	0.193	0.216	0.432		
CD (P = 0.05)	0.387**	0.432**	0.865*		

Table 3. Influence of biopriming with phosphobacteria on shoot length (cm) of rice cv. MDU 6

Biopriming treatments (T)	Soaking duration in h (D) 6	12	18	24	Mean
Nonprimed seed	13.8	13.8	13.8	13.8	13.8
Hydropriming	14.1	15.0	14.4	14.8	14.6
Phosphobacteria 10%	14.2	15.4	14.5	15.0	14.8
15%	14.4	15.8	15.5	14.2	15.0
20%	15.3	16.2	15.5	15.9	15.7
Mean	14.4	15.2	14.7	14.7	14.8
	D	T	D x T		
SEd	0.137	0.153	0.307		
CD (P = 0.05)	0.275**	0.307**	0.615*		

phosphobacteria at 20 % concentration for 12 h also recorded higher germination (97 %) which showed an increase of 15 % over nonprimed seed (Table 1). Seeds bioprimed with phosphobacteria at 20 % for 12 h measured longer root (22.6 cm) and shoot (16.2 cm) compared to nonprimed seed (19.6 and 13.8 cm, respectively) (Table 2 and Table 3). The biopriming involving phosphobacteria at 20 % for 12 h registered higher dry matter production (0.058 g 5 seedlings^{-1}) (Table 4) and better vigour index (3764; Table 5) compared to nonprimed seed (2739).

In the present study, seed biopriming with phosphobacteria at 20% for 12 h was found to be the best biopriming treatment for improving the seed germination and seedling vigour of paddy var. MDU 5. Similar increase in the seedling growth due to liquid phosphobacteria seed treatments was reported by Vijaya kumari (2003) in neem, kapok and amla, Gomathy et al. (2007) in maize and Mahfouz, Sharaf-Eldin (2007) in fennel and kokila in CORH 4 and its parental lines. The relative enhancement of germination and seedling vigour might be attributed to the role of phosphorus solubilising bacteria known as phosphobacteria in

Table 4. Influence of biopriming with phosphobacteria on vigour index of rice cv. MDU 6

Biopriming treatments (T)	Soaking duration in h (D) 6	12	18	24	Mean
Nonprimed seed	2739	2739	2739	2739	2739
Hydropriming	2882	3257	2898	3150	3047
Phosphobacteria 10%	3028	3329	3238	3284	3220
15%	3124	3648	3070	3240	3271
20%	3294	3764	3460	3638	3539
Mean	3013	3347	3081	3210	3163
	D	T	D x T		
SEd	29	33	66		
CD (P = 0.05)	59**	66**	132**		

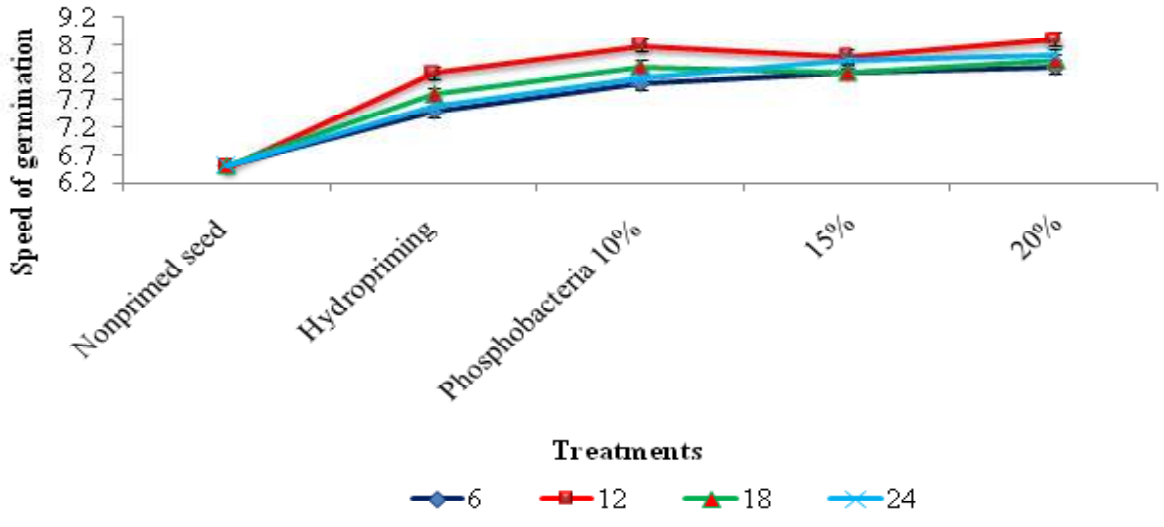

Fig. 1. Influence of biopriming with phosphobacteria on speed of germination of rice cv. MDU 5

Table 5. Influence of biopriming with phosphobacteria on Dry matter production (g/5 seedlings) of rice in MDU 6

Biopriming treatments (T)	Soaking duration in h (D)				Mean
	6	12	18	24	
Nonprimed seed	0.049	0.049	0.049	0.049	0.049
Hydropriming	0.051	0.056	0.050	0.053	0.053
Phosphobacteria 10%	0.048	0.052	0.049	0.50	0.162
15%	0.052	0.055	0.050	0.055	0.053
20%	0.053	0.058	0.054	0.051	0.054
Mean	0.051	0.054	0.050	0.142	0.074
	D	T	D x T		
SEd	0.00114	0.00128	0.00255		
CD (P = 0.05)	0.00228**	0.00255**	0.00511**		

enhancing the solubilisation of insoluble phosphorus and making it available to the germinating seed with consequent enhancement in the metabolic activity which resulted in higher germination (Cooper, 1979). According to Kavitha (2011) seed biopriming with liquid phosphobacteria at15 % for 12 h was found to be the best seed biopriming treatment for rice seed to enhance the germination rate, total germination percentage, seedling growth and vigour in ADT 43. Okra seeds bioprimed with liquid phosphobacteria -20 % for 12 h also resulted in higher germination percentage and seedling vigour (Mariselvam, 2012). Phosphobacteria at 20% concentration biopriming for 12 h was found to improve the speed of germination, germination, root length, shoot length, dry matter production, total dry matter production and vigour index Karthika and Vanangamudi (2013).

It could be concluded that, seed biopriming with phosphobacteria (20 % for 12 h) was found to be the best biopriming treatment for improving the seed germination and seedling vigour of rice var. MDU 5.

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