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BIO SEED TREATMENT IN SUSTAINABLE AGRICULTURE BY INDUCING MOISTURE STRESS TOLERANCE IN RICE SEED GERMINATION

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KEYWORDS

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Moisture stress
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ABSTRACT

A laboratory experiment was conducted in the Department of Seed Science and Technology, TNAU, Coimbatore during 2013-2014 to analyse the impact of bio priming seed treatment on drought resistance. In this experiment, addition of beneficial microorganism in rice seed priming treatment, induced the drought tolerance in seed germination and established the vigorous seedlings. Seeds of rice hybrid CORH 4 and its parental lines *viz.,* COMS 23A (male sterile), CB 174R (male) were bioprimed with 4 % *Pseudomonas fluorescens*, 20% liquid *Azospirillum*, 15% liquid phosphobacteria and 20 % liquid Azophos, for 12 h duration, separately. Hydroprimed and nonprimed seeds act as control. Among the different bioagents, 4% *Pseudomonas fluorescens*for 12h was found to be the best seedbiopriming treatment which substantially improved the speed of germination, germinationpercentage, seedling length, dry matter production, vigour index over control, under moisture stress condition. This treatment improved 11% of CORH 4 seed germination under extreme moisture stress (20% Water Holding Capacity) condition over unprimed control.

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INTRODUCTION

Indian agriculture mainly depends on monsoon rainfall. Generally usage of beneficial microorganism like bio control agents and bio fertilizers effectively reduces the chemical fertilizers and pesticide in rain fed agriculture (Shaguntala *et al.*, 2012).Moisture stress is a critical environmental factor that restricts seed germination.Moisture stress during the earlier phase of seed germination affects the field emergence, seedling establishment ultimately the yield of the crop (Ceesay, 2004).

Seed priming is an efficient method for increasing seed vigour and synchronization of germination, as well as the growth of seedlings of many crops under stressful conditions and it play a positive role in the tolerance to abiotic stresses.Priming is seed invigoration treatments, which consist of a controlled imbibitions of the seeds followed by dehydration back totheir initial water content (Bradford, 1986). This treatment could enable the crop to establish under initial moisture stress condition and established vigourous seedling also give higher yield under terminal moisture stress condition (Musa *et al.*, 2001).

In addition to that many beneficial bioagents also involved in sustainable agriculture under abiotic stress condition. So this experiment was conducted for analyse the combined effect of priming and bioagent as biopriming seed treatment andto identify the perfect biopriming treatment which enhance the germination of CORH 4 rice hybrid under moisture stress condition.

MATERIALS AND METHODS

Bio priming

The bioagents*viz.*,4 % *Pseudomonas fluorescens*, 20% liquid *Azospirillum*, 15% liquid phosphobacteria and 20 % liquid Azophos were prepared and the seeds were soaked in equal volume of solutions for 12h durations. After biopriming, the seeds were removed from the solutions and shade dried at room temperature till bring back the seed moisture to its original level.

Moisture Stress

A known quantity (weight basis) of sand was taken in an aluminium tray. Then, known quantity of water was added till the media reached saturation and weighed again. The difference in weight and the total quantity of water added to reach saturation was noted. This ratio of sand and water was taken as 100 % moisture holding capacity and accordingly, 80, 60, 40 and 20 % of water was added to sand media to create 80, 60, 40 and 20 % water holding capacities, respectively. Four replicates of 100 seeds from each treatment were sown in each of the above water holding capacity and kept in the germination room and at the end of 14 days, the following observations were made.

Germination

The germination test was conducted by following the procedure outlined in ISTA (2011) using paper medium by following between paper method. Four replicates

of 100 seeds each were germinated in a germination room maintained at 25 ± 2 p C temperature and 90 ± 3 % RH. At the end of fourteenth day of sowing, the number of normal seedlings in each replication was counted and the germination was calculated and expressed in percentage.

Root length

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 calculated and expressed in centimetre.

Shoot length

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 seed to tip of the terminal leaf and the mean values were expressed in centimetre.

Vigour index

Vigour index was computed using the following formula and the mean values were expressed in whole number (Abdul-Baki and Anderson, 1973).

Vigour index = Germination (%) x Seedling length (cm)

RESULTS AND DISCUSSION

The performance of bioprimed seed under different water holding capacities namely 20, 40, 60 and 80 per cent was compared with nonprimed seeds. The results revealed that the seeds bioprimed with 4 per cent *Pseudomonas fluorescens* for 12 h enhanced the germination under moisture stress conditions than other bioprimingtreatments (figure 1). The increase in germination over nonprimed seeds was 11, 10, 7 and 6 per cent in COMS 23A, 10, 8, 8 and 7 per cent in

CB 174R and 11, 13, 7 and 7 per cent in CORH 4 under 20, 40, 60 and 80 per cent water holding capacities, respectively. All bioprimedseeds exhibited improved germination rate (figure1), seedling length (table 1 &2and vigour index (plate 1&figure 2) over nonprimed and hydroprimed seeds under different moisture stress condition.

This result agrees with Chavan*et al*. (2014) who reported that the primed soybean seed produced taller seedling than nonprimed seed.Seed priming has improved seed germination and seedling establishment under extreme drought conditions.

Table 1: Effect of seed biopriming on root length (cm) under moisture stress conditions in rice hybrid CORH 4 and its parental lines COMS 23A andCB 174R.

WHCBiopriminCOMS 23A gtreatments(T)						CB 174R					CORH 4				
	20 %	40%	60%	80%	Mean	20 %	40%	60%	80%	Mean	20 %	40%	60%	80%	Mean
T_0	16.2	17.4	18.0	18.3	17.5	15.0	16.0	16.5	17.0	16.1	16.4	17.0	17.8	18.2	17.4
T_1	17.0	17.8	18.2	18.5	17.9	16.4	16.5	17.2	17.4	16.9	16.6	17.2	18.0	18.5	17.6
T_2	18.5	19.0	19.5	19.8	19.2	18.0	18.2	18.5	18.5	18.3	18.4	18.4	18.8	19.0	18.7
T_3	17.5	18.0	18.6	19.0	18.3	16.4	17.2	17.5	17.9	17.3	17.2	17.4	18.3	18.5	17.9
T_4	17.6	18.3	18.8	19.0	18.4	17.1	17.4	18.0	18.2	17.7	17.3	17.6	18.5	18.8	18.0
T_5	17.8	18.0	18.3	19.3	18.4	16.8	17.5	17.9	18.0	17.6	17.0	17.5	18.4	18.6	17.9
Mean	17.4	18.1	18.6	19.0	18.3	16.6	17.1	17.6	17.8	17.3	17.2	17.5	18.3	18.6	17.9
	T		W		T x W	T		W		T x W	T		W		T x W
SEd	0.113		0.093		0.227	0.119		0.097		0.238	0.125		0.102		0.250
CD (P = 0.05)	0.226		0.185		NS	0.237		0.193		NS	0.249		0.203		NS

Treatment (T) details:
T_0-Nonprimed seed; T_1- Hydropriming for 12 h; T_2- Biopriming with 4 % *P.fluorescens*for 12 h; T_3- Biopriming with 20 % *Azospirillum* for 12 h; T_4- Biopriming with 15 % phosphobacteria for 12 h;T_5- Biopriming with 15 % Azophos for 12 h

Table 2: Effect of seed biopriming on shoot length (cm) under moisture stress conditions in rice hybrid CORH 4 and its parental lines COMS 23A andCB 174R

WHC Biopriming treatments (T)	COMS 23A 20 %	40%	60%	80%	Mean	CB 174R 20 %	40%	60%	80%	Mean	CORH 4 20 %	40%	60%	80%	Mean
T_0	7.8	8.0	10.0	10.2	9.0	7.5	8.4	9.0	9.5	8.6	8.5	9.0	9.4	10.0	9.2
T_1	8.2	8.8	10.4	10.6	9.5	8.0	8.8	9.3	9.8	9.0	9.0	9.2	10.0	10.5	9.7
T_2	9.5	10.8	11.0	12.0	10.8	9.5	10	10.4	10.8	10.2	10.0	11.0	11.4	11.5	11.0
T_3	9.1	9.6	10.0	11.5	10.0	9.3	9.8	10.2	10.7	10.0	9.7	10.6	11.0	11.0	10.6
T_4	9.0	9.7	10.2	11.0	10.0	8.5	9.0	9.8	10.2	9.4	9.5	9.8	10.5	10.8	10.1
T_5	8.8	9.2	9.8	10.8	9.6	9.0	9.5	10.0	10.5	9.8	9.5	10.0	10.7	11.0	10.3
Mean	8.7	9.4	10.2	11.0	9.8	8.6	9.3	9.8	10.3	9.5	9.4	9.9	10.5	10.8	10.1
	T		W		T x W	T		W		T x W	T		W		T x W
SEd	0.065		0.053		0.130	0.074		0.061		0.149	0.076		0.062		0.152
CD (P = 0.05)	0.130		0.106		0.259	0.148		0.121		NS	0.152		0.124		0.304

Treatment (T) details:
T_0-Nonprimed seed; T_1- Hydropriming for 12 h; T_2- Biopriming with 4 % *P.fluorescens*for 12 h; T_3- Biopriming with 20 % *Azospirillum* for 12 h; T_4- Biopriming with 15 % phosphobacteria for 12 h; T_5- Biopriming with 15 % Azophos for 12 h

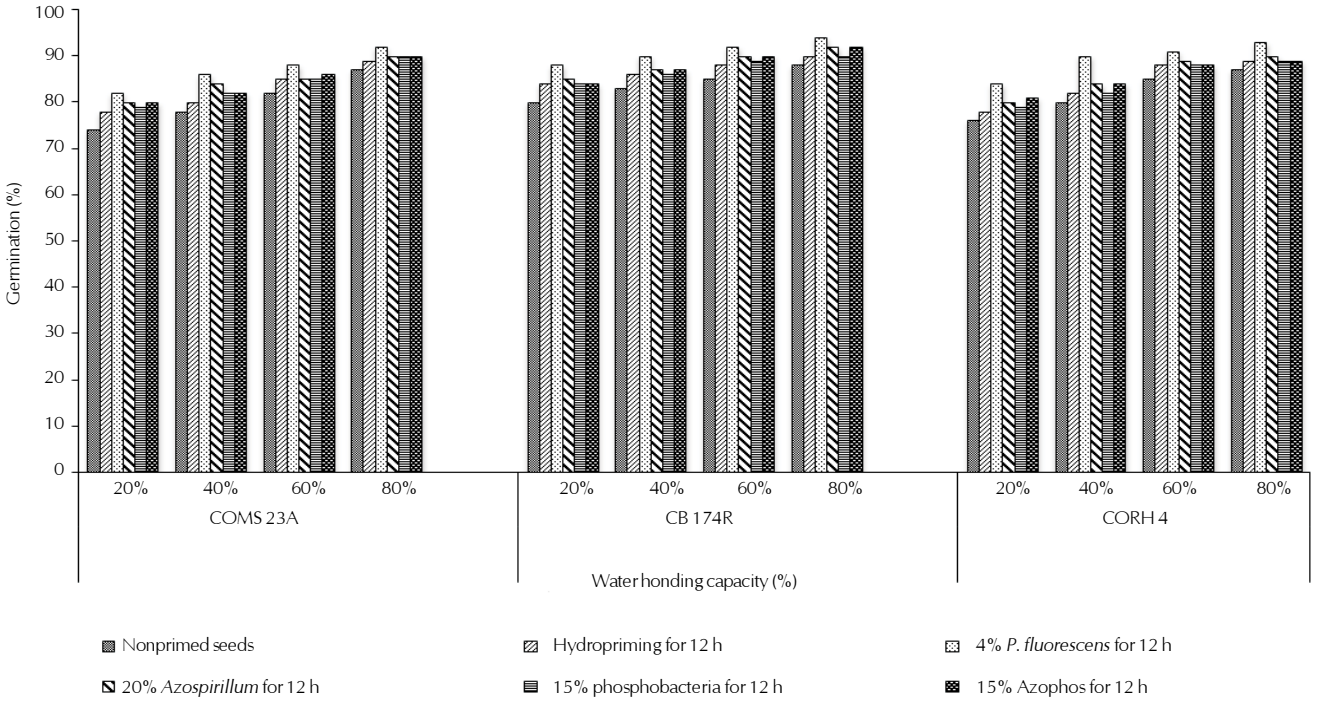

Figure 1: Germination (%) under moisture stress conditions in bioprimed seeds of rice hybrid CORH 4 and its parental lines COMS 23A and CB 174R

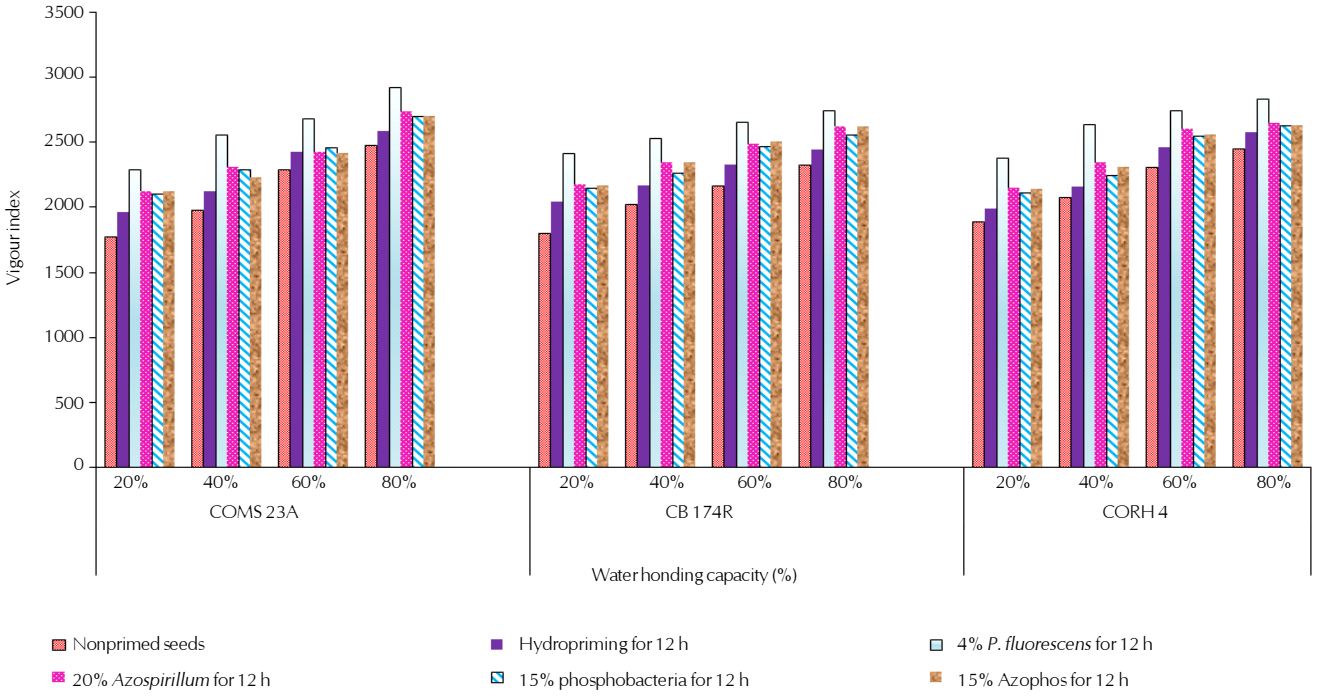

Figure 2: Vigour index under moisture stress conditions in bioprimed seeds of rice hybrid CORH 4 and its parental lines COMS 23A and CB 174R

The positive role of priming on abiotic stress tolerance might be due to the improved antioxidant production (Mittler, 2002).Antioxidants are natural defensive elements in seed that scavenge excessive reactive oxygen species (ROS). In priming the excessive ROS were scavenged during early imbibition process and it play an essential role in ensuring successful germination, especially under stress conditions(Baillyet *al.*, 2008).

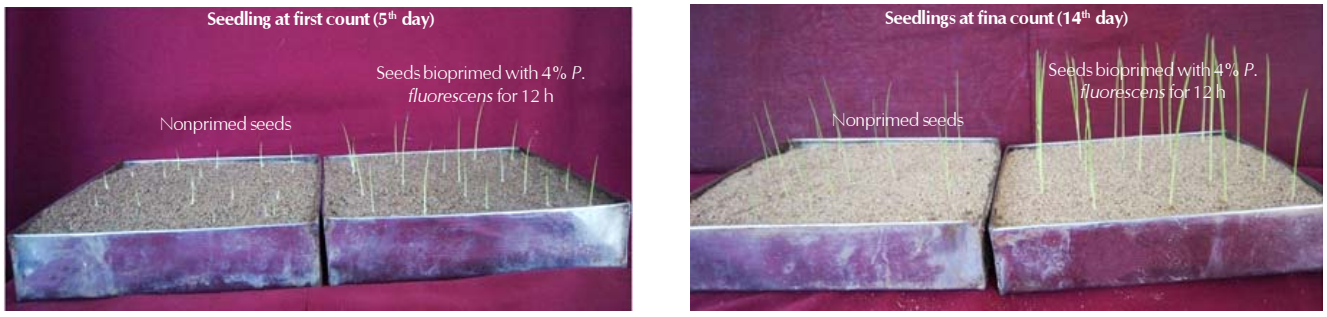

Plate 1: Seedling growth of bioprimed CORH 4 rice seed under water stress of 20% water holding capacity

With regards to PGPR strains, application of PGPR can enhance phytohormones content of seed under moisturestress condition (Ansari *et al.*, 2012). Phytohormones plays critical role in regulating plant growth and its response to stress. *Pseudomonas fluorescens* treatment had improved phytohormonal characters under water deficit condition. The *P. fluorescens* protect plants from drought stress (Loon, 1998) and significantly promote the seedling growth under stress condition.Application of *Pseudomonades sp*. under water stress improved the antioxidant (Heidari and Golpayegani, 2012). This experiment concluded that rice seed bioprimed with 4% *Pseudomonas fluorescens* for 12h could able to withstand extreme moisture stress (20 % WHC) condition. The tolerance nature of bioprimed seeds might be due to enhanced antioxidant and phytohormone accumulation during biopriming.

REFERENCES

Abdul-Baki, A. A. and Anderson, J. D. 1973. Vigour deterioration of soybean seeds by multiple criteria. *Crop Sci.* **13:** 630-633.

Ansari, O., Choghazardi, H. R., Zadeh, F. S. and Nazarli, H. 2012. Seed reserve utilization and seedling growth of treated seeds of mountain ray (*Secalemontanum*) as affected by drought stress. *Cercetari Agronomice in Moldova*. **2(150):** 43-48.

Bailly, C., Bouteau, H. E. M. and Corbineau, F. 2008. From intracellular signaling networks to cell death: the dual role of reactive oxygen species in seed physiology. *C. R. Biologies*. **331:** 806-814.

Bradford, K. J. 1986. Manipulation of seed water relations via osmotic priming to improve germination under stress conditions. *Hort. Science*. **21:** 1105-1112.

Ceesay, M. A. 2004. Management of rice production systems to increase productivity in the Gambia, *Ph.D. Thesis, Graduate School of Cornell University, WestAfrica*.

Chavan, N. G., Bhujbal, G. B. and Manjare, M. R. 2014. Effect of seed priming on seed yield of soybean (*Glycine Max* (L) *Merill*) varieties. *The Bioscan*. **9(1):** 111-114.

Heidari, M. and Golpayegani, A. 2012. Effects of water stress and inoculation with

plant growth promoting rhizobacteria (PGPR) on antioxidant status and photosynthetic pigments in basil (Ocimumbasilicum L.). *J. Saudi. Soc. Agric Sci.* **11:** 57-61.

ISTA. 2011. International rules for seed testing. *International Seed Testing Association, Bassersdorf, Switzerland.*

Loon, L. C. V., Bakker, P. A. H. M. and Pieterse, C. M. J. 1998. Systemic resistance induced by rhizospere bacteria. *Ann. Rev. Phytopathol.* **36:** 453-483.

Mittler, R. 2002. Oxidative stress, antioxidants and stress tolerance. *Trends Plant Sci.* **7:** 405-410.

Musa, A. M., Harris, D., Johansen, C. and Kumar, J. 2001. Short duration chickpea to replace fallow after aman rice: The role of on-farm seed priming in the high barind tract of Bangladesh. *Exp. Agric.*, **37:** 509-521.

Shakuntala, N. M., Vasudevan, S. N., Patil, S. B., Doddagoudar, S. R., Mathad, R. C. and Vijaykumar, A. G. 2012. Organic biopriming on seed vigour inducing enzyme in paddy - An alternative to inorganics. *The Ecoscan*. **1:** 251-257.