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EFFECT OF VARIOUS BIO PRIMING SEED ENHANCEMENT TREATMENT ON SEED QUALITY IN CERTAIN MINOR MILLETS

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Abstract

Minor millets are small coarse of grains belonging to the group of forage grass called millet, belongs to the family poaceae; most of the genera belongs to the sub-family panicoideae, that can grown in extreme ecological conditions. India occupy the first position in major production of minor millets, but we have less aware of their importance and its nutritional property. Seed enhancement technology predominantly possess a central objective to further improve seed performance by treating with specific additives/chemical/organics/ botanicals etc under very specific regimes to harness higher productivity and production. *In vitro* evaluation was carried out to study the effect of various bio priming seed treatments on seed qualities in certain minor millets in the Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University. Freshly harvested bulk seeds of certain minor millets of Varagu, Samai, Kuthiraivali, Tenai and Panivaragu were imposed with the following priming seed treatments *i.e.*, unprimed, Water (hydro priming), *Acetobacter* @ 10 % and 20 %, Phosphobacteria @ 10 % and 20 %, Azophos @ 10 % and 20 %, *Pseudomonas fluorescens* @ 10 % and 20% (liquid formulation), *Pseudomonas fluorescens* @ 10 % and 20% (dry formulation). The treated seeds were evaluated for its seedling quality characters. The study revealed that, the effect of bio priming seed treatments on seed qualities in certain minor millets, the varagu cv CO 3 and kuthiraivali cv CO 1 seeds bio primed with *Pseudomonas fluorescens* 20 % (dry formulation) for 6 h and Tenai cv. CO 6, Samai cv. CO 3 and Panivaragu cv. CO 4 seeds bio primed with *fluorescens* 20 % (dry formulation) for 6 h recorded higher seed qualities i.e., higher speed of emergence, germination percentage, seedling length, dry matter production and vigour index, when compared to other treatments.

Key words *:* Minor millets, Bio priming, Seed quality.

Introduction

Minor millets are some of the oldest of cultivated crops. The term millet is applied to various grass crops whose seeds are harvested for food or feed. Essential similarities of the members of this group of species are the resilience and ability to thrive in harsh environments, along with nutritious seed content. They have been cultivated since immemorial time. Millets mature quickly, a valuable trait important for rain-fed farming, and require relatively few inputs compared to major cereals. They grow under a range of day lengths and in poor soil, making them an attractive crop for marginal farming environments. They require few inputs and withstand severe biotic and abiotic stresses. They are also more nutritious than major cereals and have received far less research and development attention than other crops with regard to crop improvement, cultivation practices and utilization. Despite these advantages, neglect in several arenas has resulted in a steady decline in the cultivation of minor millets in India over the past few decades. Seed is a growth driver of agriculture and efficacy of all other agricultural inputs. Seed is a tool for delivery of improved technologies and is a mirror for portrayal of inherent genetic potential of a variety/hybrid. Seed offers to integrate production, protection and quality enhancement technologies through a single entity, in a cost-effective way. Seed can play a pivotal role in achieving higher productivity; the use of quality seeds alone could increase productivity by 15–20 % which highlights the important role of seed in agriculture. In modern agriculture, advance technologies are being deployed for breaking yield barriers and enhancing crop productivity. Devising varied seed

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enhancement technologies is an important domain assuring uniform field emergence, better crop stand and realisation of higher yield in various crops. Seed enhancements may be defined as "postharvest treatments that improve germination or seedling growth or facilitate the delivery of seeds and other materials required at the time of sowing". Seed priming is a technique of controlled hydration (soaking in water) and drying that result in more rapid germination when the seeds are reimbibed. (Callan *et al.,* 1997) There are different methods of priming like hydropriming, halopriming, thermopriming, bio-priming, etc. Bio-priming is a process of biological seed treatment that refers to a combination of seed hydration and inoculation of the seeds with beneficial microorganisms. It improves seed viability, germination, vigour indices, plant growth and subsequent protection against diseases and finally enhances crop yield (Rinkal Chauhan and PR Patel, 2017). In present day agriculture, the biological seed treatment methods using microbial inoculants are providing an alternative to the chemical treatment methods, being eco-friendly and safer for future agriculture and gaining importance in the seed, plant and soil health improvement programmes. The seed bio-priming is an effective seed treatment to increase the rate, uniformity of emergence and crop establishment in most of the crops especially in advanced countries in last two decades. Hence with the above background the present study were carried out to study the effect of various bio priming seed treatment on seed qualities in certain minor millets *i.e.*, kodo, foxtail, proso, little and barnyard millets.

Materials and Methods

The present investigations were carried out in the Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University (11°24'N latitude and 79°44'E longitude with an altitude of +5.79 mts above mean sea level). Genetically pure seeds of small millets *viz*., Foxtail millet (Tenai) cv. CO 6 (*Setaria italica* Beauv.), Little millet (Samai) cv. CO 3 (*Panicum Miliare* L.), Kodo millet (Varagu) cv. CO 3 (*Paspalum scrobiculatum* L.), Proso millet (Panivaragu) cv. CO 4 (*Panicum miliaceum* L.) Barnyard millet (Kudiraivali) cv. CO 1. (E*chinochloa frumentacea* Link.) were obtained from the Centre of Excellence in Millets, TNAU, Athiyandal, Thiruvannamalai constituted the basic material for the study. Freshly harvested bulk seeds of above minor millets were imposed with the following seed treatments for 6 hours.

T_0-Control (Unprimed)

T_1-Water (hydro priming)

T_2-*Acetobacter* 10 % (Liquid formulation)

T_3-*Acetobacter* 20 % (Liquid formulation)

T_4-Phosphobacteria 10 % (Liquid formulation)

T_5-Phosphobacteria 20 % (Liquid formulation)

T_6 - Azophos 10 % (Liquid formulation)

T_7-Azophos 20 % (Liquid formulation)

T_8-*Pseudomonas fluorescens* 10 % (liquid formulation)

T_9-*Pseudomonas fluorescens* 20 % (liquid formulation)

T_{10}-*Pseudomonas fluorescens*10 % (dry formulation)

T_{11}-*Pseudomonas fluorescens* 20 % (dry formulation)

The seeds primed differentially as above were evaluated for the following seed quality characters., *viz.*, Imbibition rate (%), speed of emergence (Maguire, 1962), germination percentage (ISTA, 1999), shoot length (ISTA, 1999), root length (ISTA, 1999), drymatter production (ISTA, 1999) and vigour index (Abdul-Baki and Anderson, 1973) under laboratory condition. The data were statistically analyzed as per the method of Panse and Sukhatme (1985).

Result and Discussion

Seed bio-priming is a suitable alternative to seed treatment because the microbes multiply continuously, occupy the growing root surfaces, form a biofilm around the roots and protect the plants from soil-borne plant pathogens throughout the crop-growing stages. Other advantages using microbial bio-priming are the elicitation of systemic resistance in plants that can protect the plants from foliar pathogens during the later stages of their growth and development. Biological seed treatments may provide an alternative to chemical priming. Seeds are mostly bioprimed with biofertilizers and biocontrol agents, which exert nutritive and protective advantage to the seed with resultant crop. Biofertilizers play a very significant role in improving soil fertility by fixing atmospheric nitrogen, both, in association with plant roots and without it, solubilise insoluble soil phosphates and produces plant growth substances in the soil. They are in fact being promoted to harvest the naturally available, biological system of nutrient mobilization. Azophous, Pseudomonas, and Azotobacter strains could affect germination and seedling growth. Phosphobacteria and their combination as Azophos and *Bacillus* are used either as physical or physiological seed inoculants. Azophos is the biofertilizer combination of *Azospirillum* and phosphobacteria in peat form for enrichment of rhizosphere region of crops with microbes that would help in fixing the natural nitrogen. Seeds were immersed into the bacteria solutions and after drying it resulted that the seeds inoculated by effective

Table 1: Standardization of priming agent for biopriming in TENAI CV.CO 6.

Treatments	Imbibition rate (%)	Speed of emergence	Germination (%)	Seedling length (cm)	Dry matter production 10 seedlings^{-1} (mg)	Vigour index
Control	-	31.2	76(60.66)	13.9	15.7	1057
Water	19	37.1	80(63.43)	15.0	18.2	1200
10% Acetobacter	22	34.1	82(64.89)	14.7	18.9	1205
20% Acetobacter	23	35.7	86(68.02)	14.8	19.3	1273
10% Phosphobacteria	22	35.1	80(63.43)	15.6	18.5	1248
20% Phosphobacteria	23	35.3	86(68.02)	15.4	18.9	1324
10% Azophos	21	36.2	83(66.42)	15.2	17.7	1262
20% Azophos	22	38.2	86(68.02)	15.7	18.8	1350
10% *P.fluorescens* (liq.)	23	36.8	87(68.02)	16.5	18.5	1366
20% *P.fluorescens* (liq.)	25	42.7	91(70.73)	17.8	20.1	1620
10% *P.fluorescens* (dry)	21	33.5	85(68.86)	15.6	17.5	1326
20% *P.fluorescens* (dry)	22	40.6	87(68.02)	16.9	16.9	1470
Mean	22	36.4	84(66.42)	15.6	18.3	1308
SEd	0.08	0.14	(0.20)	0.06	0.06	4.30
CD(P=0.05)	0.16	0.28	(0.39)	NS	0.12	8.54

(Figures in the parenthesis are Arcsine transformed value).

Table 2: Standardization of priming agent for biopriming in VARAGU CV.CO 3.

Treatments	Imbibition rate (%)	Speed of emergence	Germination (%)	Seedling length (cm)	Dry matter production 10 seedlings^{-1} (mg)	Vigour index
Control	-	49.2	77(62.02)	16.9	35.9	1301
Water	12	55.0	82(64.89)	17.3	40.6	1418
10% Acetobacter	13	53.2	84(66.42)	18.3	36.7	1537
20% Acetobacter	14	56.0	93(73.57)	17.4	43.2	1618
10% Phosphobacteria	13	55.2	87(69.73)	17.9	37.8	1557
20% Phosphobacteria	14	54.0	92(73.57)	17.5	43.6	1610
10% Azophos	13	51.7	82(64.89)	17.6	38.9	1443
20% Azophos	14	55.6	84(66.42)	18.4	40.8	1545
10% *P.fluorescens* (liq.)	14	54.4	90(71.56)	17.9	36.3	1611
20% *P.fluorescens* (liq.)	12	52.0	91(71.56)	17.7	38.6	1611
10% *P.fluorescens* (dry)	12	52.0	87(69.73)	17.6	39.2	1531
20% *P.fluorescens* (dry)	15	57.2	94(75.82)	20.1	45.1	1899
Mean	13	54.0	87(69.73)	17.8	39.7	1556
SEd	0.05	0.13	(0.27)	0.07	0.13	6.08
CD(P=0.05)	0.10	0.25	NS	NS	0.25	NS

(Figures in the parenthesis are Arcsine transformed value).

microorganisms (EM) and biofertilizer significantly increased the germination and vigour in carrot, cucumber, pea, beet, and tomato (Shaukat, *et al.,* 2006). The effect of bacterization of seeds was investigated in the case of several plant species with Azotobacter vinelandii on germination using the soaking method and more dilution of biofertilizer, which stimulated the germination and seedling development to different degrees when the seed-bacteria treatment was applied.

In the present study, the seeds bio primed with *Pseudomonas fluorescens* 20 % (dry and liquid formulation) for 6 h was able to germinate earlier in all the studied minor millets. The seeds bio primed with *Pseudomonas fluorescens* 20 % (liquid formulation) for 6 h produced higher speed of emergence (57.2), germination percentage (94 %), seedling length (20.1 cm), dry matter production (45.1 mg) and vigour index (1899) and speed of emergence (80.1), germination percentage

Table 3: Standardization of priming agent for biopriming in KUTHIRAIVALI CV.CO 1.

Treatments	Imbibition rate (%)	Speed of emergence	Germination (%)	Seedling length (cm)	Dry matter production 10 seedlings^{-1} (mg)	Vigour index
Control	-	66.0	77(62.02)	19.1	18.2	1471
Water	27	78.0	88(69.73)	20.2	21.2	1778
10% Acetobacter	28	78.0	90(73.57)	20.4	19.7	1836
20% Acetobacter	30	82.0	91(73.57)	20.7	21.8	1884
10% Phosphobacteria	28	88.0	84(66.42)	20.7	21.6	1739
20% Phosphobacteria	30	79.3	84(66.42)	20.6	22.3	1730
10% Azophos	27	72.0	90(73.57)	20.3	21.4	1827
20% Azophos	28	82.0	84(66.42)	20.9	23.2	1755
10% *P.fluorescens* (liq.)	29	84.0	82(64.89)	20.8	19.0	1706
20% *P.fluorescens* (liq.)	28	82.0	80(63.43)	21.2	22.1	1696
10% *P.fluorescens* (dry)	27	82.0	91(73.57)	20.3	23.2	1847
20% *P.fluorescens* (dry)	30	88.0	93(75.82)	21.9	24.9	2037
Mean	28	80.1	86(68.86)	20.5	21.5	1776
SEd	0.11	0.27	(0.29)	0.08	0.06	5.72
CD(P=0.05)	0.21	NS	(0.57)	NS	0.13	11.36

(Figures in the parenthesis are Arcsine transformed value).

Table 4: Standardization of priming agent for biopriming in SAMAI CV.CO 3.

Treatments	Imbibition rate (%)	Speed of emergence	Germination (%)	Seedling length (cm)	Dry matter production 10 seedlings^{-1} (mg)	Vigour index
Control	-	55.2	75(60.66)	12.3	14.8	923
Water	16	63.2	80(63.43)	13.4	15.3	1072
10% Acetobacter	16	59.2	87(68.02)	13.1	18.0	1140
20% Acetobacter	17	68.8	84(66.42)	13.8	20.1	1159
10% Phosphobacteria	15	66.8	82(64.89)	12.9	18.3	1057
20% Phosphobacteria	17	63.2	80(63.43)	12.4	16.1	992
10% Azophos	15	66.8	88(69.73)	13.6	17.4	1197
20% Azophos	15	62.0	86(68.02)	13.6	18.3	1170
10% *P.fluorescens* (liq.)	17	60.0	84(66.42)	13.7	18.4	1150
20% *P.fluorescens* (liq.)	18	73.2	90(70.73)	14.9	20.9	1341
10% *P.fluorescens* (dry)	15	62.4	84(66.42)	14.3	15.9	1201
20% *P.fluorescens* (dry)	16	63.2	86(68.02)	14.2	15.1	1221
Mean	16	63.6	83(66.42)	13.5	17.4	1135
SEd	0.05	0.21	(0.21)	0.05	0.05	4.23
CD(P=0.05)	0.10	0.43	(0.41)	0.09	0.10	8.41

(Figures in the parenthesis are Arcsine transformed value).

(86 %), seedling length (20.5 cm), dry matter production (21.5 mg) and vigour index (1776) when compared to unprimed seed and other treatments in respect with Varagu and Kudiraivali (Table 1 and 2). The seeds bio primed with *Pseudomonas fluorescens* 20 % (liquid formulation) for 6 h produced higher speed of emergence (42.7), germination percentage (91 %), seedling length (17.8 cm), dry matter production (20.1 mg) and vigour index (1620) in Tenai, speed of emergence (73.2), germination percentage (90 %), seedling length (14.9 cm), dry matter production (20.9 mg) and vigour index (1341) in Samai and speed of emergence (55.3), germination percentage (98 %), seedling length (23.8 cm), dry matter production (40.8 mg) and vigour index (2332) in Panivaragu when compared to unprimed seed and other treatments(Table 3,4 and 5). Pseudomonas is important biopriming agent used for biopriming but with protective and invigourative function. Colonisation of root by *P.*

Table 5: Standardization of priming agent for biopriming in PANIVARAGU CV.CO 4.

Treatments	Imbibition rate (%)	Speed of emergence	Germination (%)	Seedling length (cm)	Dry matter production 10 seedlings^{-1} (mg)	Vigour index
Control	-	41.3	80(63.43)	20.3	34.1	1624
Water	19	51.3	90(71.56)	22.3	36.7	2007
10% Acetobacter	18	48.0	92(73.57)	22.9	38.9	2106
20% Acetobacter	19	53.3	95(78.46)	22.7	39.9	2156
10% Phosphobacteria	19	48.7	96(78.46)	22.5	40.3	2160
20% Phosphobacteria	19	50.0	87(69.73)	22.2	39.4	1931
10% Azophos	18	48.7	96(78.46)	23.1	35.6	2217
20% Azophos	19	48.0	95(78.46)	23.3	40.2	2213
10% *P. fluorescens* (liq.)	19	44.0	94(75.82)	22.7	39.2	2134
20% *P. fluorescens* (liq.)	20	55.3	98(81.86)	23.8	40.8	2332
10% *P. fluorescens* (dry)	18	49.7	92(73.57)	22.5	37.3	2070
20% *P. fluorescens* (dry)	19	50.7	88(69.73)	21.8	38.4	1918
Mean	18	49	91(74.65)	22.5	38.4	2072
SEd	0.08	0.17	(0.42)	0.07	0.15	7.19
CD(P=0.05)	0.15	0.35	(0.84)	0.15	0.29	14.28

(Figures in the parenthesis are Arcsine transformed value).

fluorescens resulted in production of plant growth regulators (Vessey, 2003) antibiotics and antifungal metabolites (O'Sullivan and O'Gara, 1992) that improved the root mass and invigourates the seed and improved the productivity. In sweet corn, seed coated with *P. fluorescens* AB254 found to increase the bacterial population from 10 to 10,000 fold, depending on initial inoculums level and provided protection against damping off, better than metalaxyl seed treatment (Callan *et al.,* 1990). Kalaivani (2010) revealed that seed biopriming with *P. fluorescens* 80 per cent concentration for 12h as suitable biopriming treatment. Begum *et al.,* (2010) reported that in soybean, bioprimed seed with P. aeruginosa resulted in enhancement of seed germination ranging from 32.4 to 60.7 per cent relative to hydroprimed and unprimed seeds. (Desai *et al.,* 2002).

Similar effectiveness of biopriming with *P. fluorescens* was evident in improving the seed germination and seedling vigour in pearl millet by Raj *et al.,* (2004). The enhancement in the seedling growth noticed in this study could be attributed to suppressions of deleterious microorganisms and pathogens; production of plant growth regulators such as gibberellins, cytokinins and indole acetic acid, which increased the availability of minerals and other ions and more water uptake (Ramamoorthy *et al.,* 2000). Early germination in terms of high speed of germination was also observed in the present study due to *P. fluorescens*. Twenty per cent biopriming was in agreement with the findings of Srivastava *et al.*, (2010) who reported that in tomato, early germination by 2 - 2.5 days was noticed in the seeds bioprimed with *P. fluorescens*. 20 per cent *P. fluorescens* of the present investigation recorded the significant and faster speed of germination and seedling length which could be attributed to the quicker uptake of water coupled with early initiation of high metabolic changes. This fact is also supported by Golezanik and Abdurrahmani (2008) in lentil who observed early radicle protrusion due to priming. Higher seedling length in bioprimed seed observed in this study is also confirmed with the findings of Dezfuli *et al.,* (2008) in maize and Afzal *et al.,* (2009) in tomato.

Hence, the study revealed that, the effect of bio priming seed treatments on seed quality in certain minor millets, the varagu cv CO 3 and kuthiraivali cv CO 1 seeds bio primed with *Pseudomonas fluorescens* 20% (dry formulation) for 6 h and Tenai cv. CO 6, Samai cv. CO 3 and Panivaragu cv. CO 4 seeds bio primed with *fluorescens* 20% (dry formulation) for 6 h for 6 h recorded higher seed qualities *i.e*., higher speed of emergence, germination percentage, seedling length, dry matter production and vigour index, when compared to other treatments.

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