



Research Article

SEED BIO-PRIMING WITH PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR) IN TOMATO (*Solanum lycopersicum* L.) CV. PKM1

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Abstract: An experiment was carried out to know the effect of seed biopriming in tomato under laboratory condition. Tomato (*Solanum lycopersicum* L.) seeds were subjected to biopriming with plant growth promoting rhizobacteria (PGPR) viz., *Bacillus amyloliquefaciens* VB7 and *Bacillus licheniformis* BSC2 of different concentrations viz., 1%, 2%, 4%, 6%, 8% and 10% for 9hr soaking durations along with hydropriming and nonprimed seed formed the control. The results revealed that seeds bioprimed with *Bacillus amyloliquefaciens* VB7 6% recorded maximum speed of germination (6.12) seed germination (93%), root length (16.89), shoot length (5.78) and vigour index (2108) than the other treatments.

Keywords: Tomato, Biopriming, PGPR, Seed germination and vigour index

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Introduction

Tomato is one of the most important "protective foods" because of its special nutritive value. Tomato fruit is an excellent source of vitamin C (160-240 mg), edible protein (100 g), minerals such as copper (0.01-0.09 mg), manganese (0.09-0.13 mg) and zinc (0.1-0.17 mg kg⁻¹ of fruit). Since the seed cost is very huge, it is important for the farmers to get a good and healthy plantable seedlings from each and every seed sown by him. Besides, delayed and erratic emergence is a serious problem in tomato that creates the production of non-uniform seedling with poor seedling vigour in the nursery [1]. Seed priming is one of the presowing seed management techniques, where the seeds are partially soaked and subsequently dried back for invigourative effect that expresses on field emergence and extends upto yield [2,3]. In seed priming, the amount of water absorption is controlled so as necessary metabolic activities occurred for germination, but radical emergence is prohibited. Biological control agents (BCAs) and plant growth-promoting rhizobacteria (PGPR) are effective plant conditioners in improving plant health [4-6] and seed treatment with BCA or PGPR protect seeds and germinating seedlings from infection of seed or soil borne pathogens. Advantages of seed treatments are the only a small amount of BCA or PGPR are required and the subsequent resilience of the seedlings. BCA and PGPR can multiply on seed surface, eventually proliferating on and colonizing whole root system [7]. However, little is known of the movement of PGPR, or indeed that of many other BCAs, from the seed to the rhizosphere. For BCAs to be effective, they need to rapidly and extensively colonize seed structures to protect seeds from pathogens. This short period before pathogen infection is a critical time for seed protection [8]. In view of the above, the present study was designed to investigate the beneficial effects of biopriming on tomato using plant growth promoting rhizobacteria (PGPR) on germination and seedling vigour.

Materials and Methods

Genetically pure seeds of tomato cv. PKM 1 obtained from the Department of Vegetables, Horticultural College and Research Institute, Periyakulam formed the base material for this study. Plant growth promoting rhizobacteria (PGPR) viz., *Bacillus amyloliquefaciens* VB7, *Bacillus licheniformis* BSC2, were obtained from

the Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore. The details of the liquid formulation of biopriming agents, their concentration, soaking volume, duration are given in the table below:

Treatments	Concentrations (%)	Volume of soaking(V/V)	Soaking Duration (h)
Non primed seed	-	-	-
Hydropriming	-	1:1	9
<i>Bacillus amyloliquefaciens</i> VB7	1, 2, 4, 6 & 8	1:1	9
<i>Bacillus licheniformis</i> BSC2	1, 2, 4, 6 & 8	1:1	9

Seeds were bioprimed with liquid formulation of *Bacillus amyloliquefaciens* VB7, *Bacillus licheniformis* BSC2, at different concentrations of 1, 2, 4, 6 and 8%. After soaking duration, the seeds were removed from the solutions and shade dried at room temperature. Seeds were taken for hydro priming using distilled water and the nonprimed seeds act as control. The control and treated seeds were evaluated for physiological parameters. The experiments were carried out with four replications in completely randomised design (CRD). The speed of germination was calculated using the following formula and the results were expressed as number [9]. Germination test was conducted by following the procedure outlined in ISTA Seed Testing Rules (2011)[10] with roll towel medium using 4 x 100 seeds in a germination room maintained at 25 ± 2°C temperature and 95 ± 3 % RH. Seedlings were evaluated and based on normal seedlings, the germination was calculated and the mean expressed as percentage. Seeding vigour index was computed by adopting the method suggested by Abdul-Baki and Anderson (1973) [11].

Results and Discussion

The treatments of Plant growth promoting rhizobacteria (PGPR) of *Bacillus amyloliquefaciens* VB7 6% and *Bacillus licheniformis* BSC2 4% as seed biopriming significantly increase the speed of germination, germination percentage, length of root and shoot, drymatter production and vigour index as compared to hydroprimed and nonprimed seeds. The results showed that seeds bioprimed with *Bacillus amyloliquefaciens* VB7 6% recorded maximum speed of germination (6.12), highest percentage of germination (93%), root length (16.89), shoot length (5.78) and vigour index (2108) compared to the other treatments [Table-1].

Table-1 Effect of seed biopriming with *Bacillus amyloliquifaciens* VB7 on physiological traits in tomato cv. PKM1

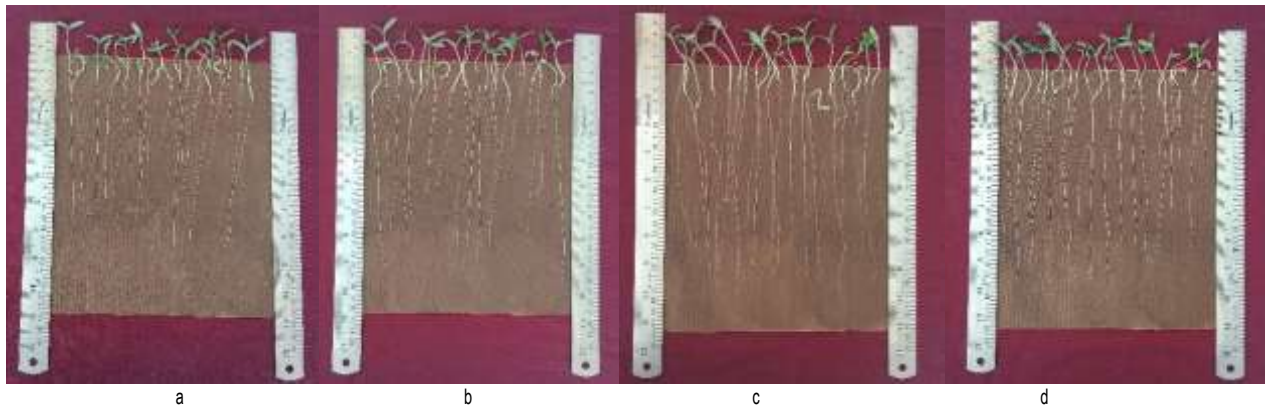
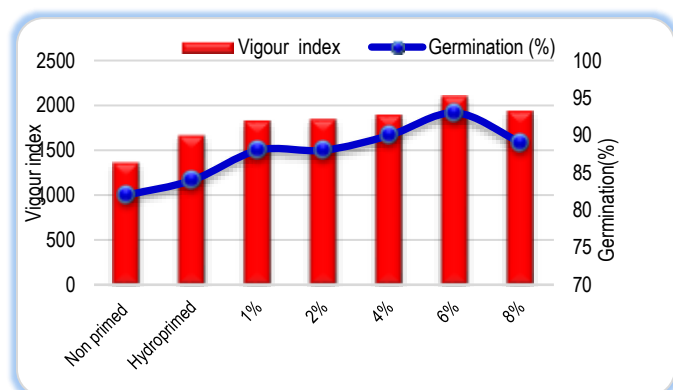
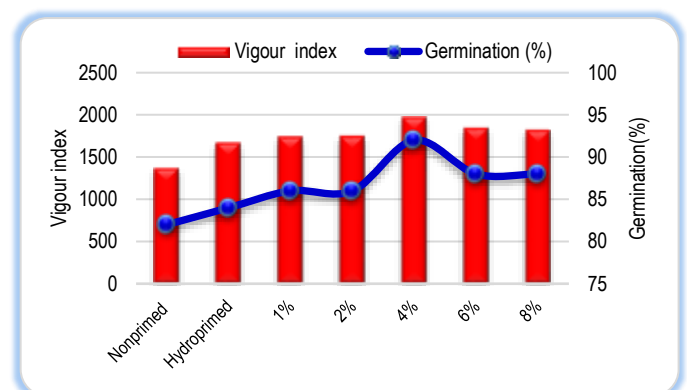
Biopriming Treatments (T)	Speed of germination	Germination (%)	Root Length (cm)	Shoot Length (cm)	Vigour index
Nonprimed	5.14	82(63.45)	12.14	4.46	1361
Hydropriming	5.45	84(66.43)	14.63	5.19	1665
<i>Bacillus amyloliquifaciens</i> 1%	5.91	88(69.52)	15.42	5.36	1829
<i>Bacillus amyloliquifaciens</i> 2%	5.95	88(69.52)	15.37	5.58	1844
<i>Bacillus amyloliquifaciens</i> 4%	6.05	90(71.71)	15.55	5.51	1895
<i>Bacillus amyloliquifaciens</i> 6%	6.12	93(75.07)	16.89	5.78	2108
<i>Bacillus amyloliquifaciens</i> 8%	5.99	89(70.64)	16.18	5.62	1940
Mean	5.81	88(69.48)	15.17	5.36	1801
SEd	0.095	1.05	0.245	0.069	25.96
CD (P=0.05)	0.198	2.19	0.510	0.144	53.98

Figures in parenthesis indicate arcsine transformed values

Table-2 Effect of seed biopriming with *Bacillus licheniformis* BSC2 on physiological traits in tomato cv. PKM1

Biopriming Treatments (T)	Speed of germination	Germination (%)	Root Length (cm)	Shoot Length (cm)	Vigour index
Nonprimed	5.14	82(63.45)	12.14	4.46	1361
Hydropriming	5.45	84(66.43)	14.63	5.19	1665
<i>Bacillus licheniformis</i> 1%	5.80	86(67.83)	14.85	5.32	1735
<i>Bacillus licheniformis</i> 2%	5.85	86(67.83)	14.92	5.36	1744
<i>Bacillus licheniformis</i> 4%	6.06	92(73.78)	16.37	5.51	1969
<i>Bacillus licheniformis</i> 6%	6.01	88(70.45)	15.41	5.48	1838
<i>Bacillus licheniformis</i> 8%	5.89	88(70.45)	15.23	5.40	1815
Mean	5.74	87(68.51)	14.79	5.60	1740
SEd	0.060	1.20	0.238	0.060	49.33
CD (P=0.05)	0.125	2.49	0.494	0.125	102.58

Figures in parenthesis indicate arcsine transformed values

Plate-1 Effect of seeds bioprimed with concentration of PGPR's on seed germination and seedling vigour (i) Nonprimed (ii) Hydroprimed (iii) Bioprimed with *Bacillus amyloliquifaciens* VB7 6% (iv) Bioprimed with *Bacillus licheniformis* BSC2 4%Fig-1 Effect of seed biopriming with *Bacillus amyloliquifaciens* VB7 on germination (%) and vigour indexFig-2 Effect of seed biopriming with *Bacillus licheniformis* BSC2 on germination (%) and vigour index

Regarding seeds bioprimed with *Bacillus licheniformis* BSC2 4%, recorded maximum speed of germination (6.06), highest percentage of germination (92%), root length (16.37cm), shoot length (5.51cm) and vigour index (1969) compared to other treatments [Table-2].

Standardization of concentration for priming with *Bacillus amyloliquifaciens* VB7 indicated that the seeds bioprimed with 6 % concentration increased the speed of germination by 19.1% germination by 8%, root length by 39.1 percent, shoot length by 30 % and vigour index by 55 % and over the nonprimed seeds [Fig-1].

The results of the present study are also in agreement with the reports of Bhattacharyya (2014) [12]. The isolated strain of *Bacillus amyloliquefaciens* plays a unique role in plant growth promoting activities in jute and showed the best effect in seed germination, seedling growth, highest pathogen inhibition and reduction of stem rot disease severity in the green house test. It also evident from the present study revealed that seeds biopriming with *Bacillus amyloliquefaciens* 6 percent improved the germination, root length, shoot length and vigour index compared to control which was observed in chilli also Sathya (2015) [13]. The Plant Growth Promoting Rhizobacterium (PGPR) such as *B. amyloliquefaciens*, can enhance growth in several economic crops such as soybean, vegetable soybean, corn, rice, Chinese kale and cauliflower [14-16]. This process is mediated in part by the excretion of phyto-hormones such as auxin and indole-3-acetic acid (IAA), lipopeptides and extracellular proteins [17]. This could account for interaction with plants that the *Bacilli* group synthesize phytohormones, similar to the plant endogenous growth regulator and their enhanced levels in plant is involved in the initial processes of lateral and adventitious root formation and elongation [18]. The standardization of concentration for priming with *Bacillus licheniformis* BSC2 indicated that the seeds bioprimed with 4 percent concentration increased the germination by 12 percent, root length by 35 percent, shoot length by 24 percent, vigour index by 45 percent and dry matter production by 57 percent over the nonprimed seeds [Fig-2]. The results of the present investigation are also in agreement with the reports of Elazzazy (2012) [19] in cucumber. *B. subtilis* increased germination, root length, shoot length and dry weight of the seedlings in cotton, cucumber, pigeon pea, tomato and egg plant [20].

Conclusion

From this study, it can be concluded that seeds bioprimed with plant growth promoting rhizobacteria (PGPR) of *Bacillus amyloliquefaciens* VB7 6% concentration for 9hr improved the seed germination, and produced the vigorous seedling than nonprimed in tomato.

Application of research: The findings of the research will be useful for the seed's men and researchers who are involved in seed preservation.

Research Category: Seed Science and Technology

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Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Sample Collection: Sample Seeds were collected from the Department of Vegetables, Horticultural College and Research Institute, Periyakulam. Biocontrol agents viz., *Bacillus amyloliquefaciens* VB7, *Bacillus licheniformis* BSC2 were obtained from the Department of Plant pathology, Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu.

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