Research Article

Evaluation of Bioprimed Chilli Seeds under Salt Stress Condition

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Abstract

Laboratory experiment was carried out using chilli seeds to evaluate the bioprimed seeds under salt stress condition to improve seed germination and seedling vigour. To induce salt stress, the different concentrations of NaCl viz., 0.25, 0.50, 0.75 and 1.0% were taken and study the seed quality parameters with best bioprimed seeds along with nonprimed seed. The result revealed that seed bioprimed with *Pseudomonas fluorescens* 60% for 12h could able to tolerate NaCl salt stress upto 0.50%, but beyond this level, it was determintal to both bioprimed and nonprimed seed.

Keywords: Bioprimed chilli seed, NaCl salt, germination, vigour

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Introduction

The Indian Agriculture is now environmentally affected and polluted which resulted in not only very low productivity but also damaged the soil health. Though the high quality seeds are used for sowing in the field, it undergoes several stresses during the emergence and establishment leading to poor survival and reduced plant stand. In general, salinity affects almost every aspect of the physiology and biochemistry of plants [1]. The need to develop crops with higher salt tolerance has been increased greatly within the last decade due to increased salinity problems throughout the world [2]. Salinity slows the germination rate and higher levels of salinity reduce the germination percentage. To improve salt tolerance of the plants, especially seed biopriming methods followed. Seed priming improved coriander growth under salt stress [3].

Salinity, as an abiotic stress, induces numerous problems in seeds and propagules during germination. It either completely inhibits germination at higher levels or induces a state of dormancy at lower levels. Salinity can also affect germination by facilitating the intake of toxic ions, which can cause change of certain enzymatic or hormonal activities of the seed. Salinity cause significant reductions in the rate and final percentage of germination, which in turn may lead to uneven stand establishment and reduced crop yields.

In order to overcome these stresses encountered during seed germination in the field, several authors have recommended seed priming such as hydropriming, halopriming, osmopriming and solid matric priming [4]. Many researchers have begun to use priming including some chemicals such as NaCl and PEG, KNO_3 and mannitol priming. However, biopriming with different bacterial genera especially plant growth promoting bacteria (PGPR) have not been evaluated sufficiently with respect to salt tolerance. It is accepted that microorganism such as AM fungi and plant growth-promoting rhizobacteria (PGPR) such as *Azospirillum brasilense, Pseudomonas and Bacillus,* are very effective in enhancing the ability of plants to become established and to cope with stress situations such as drought and nutrient limitation. In view of the above facts, a study was formulated to undertake seed biopriming using biocontrol agents namely *Pseudomonas fluorescens* and *Trichoderma viride* and liquid biofertilizers such as *Azospirillum* and phosphobacteria along with control seeds under different salt stress condition.

Materials and Methods

Genetically pure, fresh seeds of chilli (PKM 1) obtained from the Department of Seed science and Technology, Tamil Nadu Agricultural University, Coimbatore formed the base material for this study. The biocontrol agents namely *Trichoderma viride* and *Pseudomonas fluorescens* obtained from the Department of Plant Pathology and liquid biofertilizers viz., *Azospirillum* and Phosphobacteria collected from the Department of Agricultural Microbiology, TNAU, Coimbatore-3 were used for this study. The laboratory studies were carried out at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore during 2012-2013. The best bioprimed seed treatment [5] and [6] were used for salt stress study.

Four replicates of 50 seeds from each treatment were germinated using between paper medium at 25 ± 2° C temperature and 90 ± 3% RH. The germination paper was pre-moistened with different concentrations of NaCl viz., 0.25, 0.50, 0.75 and 1.0% as well as watered with the same solution for the entire germination period to induce salt stress. The watering using tap water served as control were evaluated for the following seed quality parameters at laboratory are germination (%), root length (cm),shoot length (cm), drymatter content (mg/ 10 seedlings) and vigour index.The data obtained from experiments were analysed for 'F' test of significance. Wherever necessary, the per cent values were transformed to angular (Arc-sine) values before analysis. The critical differences (CD) were calculated at 5 percent probability level. The data were tested for statistical significance. If the F test is non-significant, it was indicated by the letters NS.

Results and Discussion

The present study aimed to investigate the performance of bioprimed seed of chilli indicated that the seed bioprimed with *Pseudomonas fluorescens* 60% for 12h could withstood NaCl salt stress upto 0.50% concentration and beyond this concentration, it was deleterious to chilli seed. The increase in germination over, non primed seeds accounted for 28 and 22 per cent under 0.25 and 0.5% NaCl salt concentrations (**Table 1**). Similar trend in the results of seedling length (**Figure 1**), drymatter production, vigour index was observed.

Table 1 Effect of biopriming treatments on germination(%) under salt stress condition

Biopriming treatments (T)	**NaCl concentrations (C)**			
	Control	**0.25%**	**0.50%**	**Mean**
Nonprimed seed	80 (52.79)	50 (45.00)	35 (36.27)	55 (47.88)
Hydropriming 6h	84 (66.42)	55 (47.88)	37 (37.46)	59 (50.12)
Azospirillum 10% 9h	86 (68.02)	58 (49.60)	40 (38.78)	61 (46.12)
Phosphobacteria 15% 9h	92 (73.57)	66 (48.67)	43 (40.97)	66 (48.67)
Trichoderma viride 60% 9h	89 (66.42)	62 (46.16)	41 (39.81)	65 (47.85)
Pseudomonas fluorescens 60% 12h	95 (77.08)	70 (56.79)	45 (42.13)	70 (56.79)
Mean	88 (56.62)	60 (54.44)	40 (38.78)	
	T	C	TXC	
S Ed	0.75	0.50	0.55	
CD (P=005)	1.50	1.00	1.12	
Figures in parentheses indicate arcsine values				

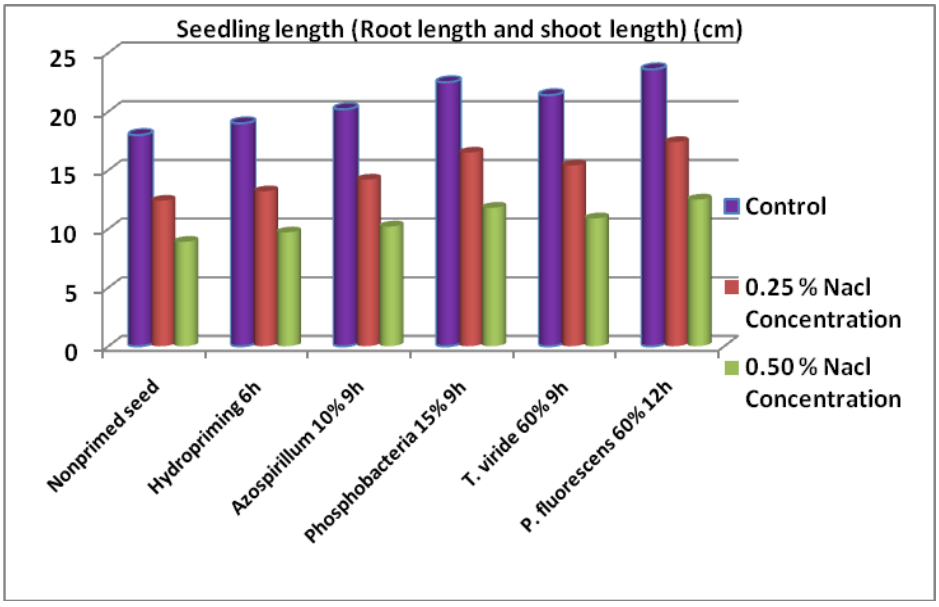

Figure 1 Influence of biopriming treatments on seedling length (cm) under salt stress condition

For these parameters also, the *Pseudomonas fluorescens* 60% bioprimed seed for 12h outperformed others and the percentage of increase over nonprimed seed was 49 and 44% for vigour index for 0.25 and 0.50% NaCl concentrations in chilli (**Table 2**).

Table 2 Effect of biopriming treatments on vigour index under salt stress condition

Biopriming treatments (T)	**NaCl concentrations (C)**			
	Control	**0.25%**	**0.50%**	**Mean**
Nonprimed seed	1440	620	312	791
Hydropriming 6h	1596	726	359	894
Azospirillum 10% 9h	1737	824	408	990
Phosphobacteria 15% 9h	2070	1089	484	1215
Trichoderma viride 60% 9h	1905	955	469	1111
Pseudomonas fluorescens 60% 12h	2242	1218	563	1343
Mean	1832	905	432	
	T	C	TXC	
S Ed	39.45	29.9	11.42	
CD (P=005)	80.20	59.8	25.10	

Both nonprimed and bioprimed seeds of chilli were highly susceptible to higher concentrations of 0.75 and 1.00% NaCl. In this study, zero germination was observed at 0.75% and 1.00% NaCl concentrations. However, bioprimed seeds of maize hybrid [7], [8] and rice [9] could able to germinate at 1% NaCl. These results clearly indicated the species difference to response to NaCl salt stress. [10] stated that all the priming agents (distilled water, NaCl, salicylic acid, acetyl salicylic acid, ascorbic acid, PEG 8000 and KNO_3 were effective in promoting the germination and seedling vigour at all salinity levels. Significant improvement in root and shoot length may be attributed to earlier germination induced by primed seed over nonprimed seed [11]. In this study also, the root and shoot length were highly suppressed by the high concentration of NaCl, which are in strong accordance with [12] who reported that the salinity reduced shoot length, fresh and dry weight of maize seedling.

Sharp decrease in germination and seedling vigour due to NaCl salt stress observed in this study might be attributed that NaCl solution created an osmotic potential external to the seed preventing water uptake as well as the toxic effects of Na^+ and Cl^- ions on the germinating seed [13]. Salt stresses are responsible for both inhibition or delayed seed germination and seedling establishment [14, 15]. It is also evident that the salinity disrupted the cellular expansion and differentiation which caused modifications in metabolic activity [16]. [17] for cowpea reported that salinity may influence germination by decreasing the water uptake.

The salinity tolerance level of *Pseudomonas fluorescens* 60% bioprimed seed for 12h by slowing down the physiological injury of bioprimed seed is in agreement with the results of [18] who reported in radish that biopriming with strains (*Agrobacterium rubi, Burkholderia gladii, Pseudomonas putida, Bacillus subtilis and Bacillus megaterium*) significantly improved the percentage of germination under saline conditions. This could be attributed to the growth promotion in response to PGPR inoculation which involves various mechanism of action. Most PGPR strains may work through multiple mechanisms, which accounts for the observed beneficial effects on the plant growth. Many researchers are of the view that a very important mechanism of direct growth promotion may be the production of plant growth regulators by PGPR. For instance, [19], [20] and [5] and noted that PGPR was able to exert a beneficial effect upon plant growth such as increasing the germination rate.

Conclusion

In the present stress study experiment, it is summarised that the seeds of chilli bioprimed with *Pseudomonas fluorescens* 60% for 12h could able to tolerate NaCl salt stress upto 0.50%, but beyond this level, it was determintal to both bioprimed and nonprimed seed which revealed the species difference to salinity response.

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