

Importance of Bio-Priming on Improving Seed Quality in Chilli (*Capsicum Annuum* L.)

ABSTRACT

Chilli (*Capsicum annuum* L.) is an important spice crop of India and the quality of its seed is an important commercial trait. However, the quality of the seeds is lost if they are stored for the months between harvest and the subsequent sowing. The seeds of Rudra and Byadgi Dabbi varieties were subjected to bio-priming with the *Pseudomonas fluorescens*, *Bacillus* and *Trichoderma viride* on qualitative parameters with seven treatments. The experiment was carried out using CRBD. The culture of *Pseudomonas fluorescens*, *Bacillus* and *Trichoderma viride* at 2.5g and 5.0g concentration were used as pre-sowing bio-priming treatments. From the results it was found that the Bio-priming influenced significantly on the capability of the chilli seedlings with the improved germination percentage of 98.69% (2.5 g *P. fluorescens*, T₁), shoot length 6.53cm (5 g *P. fluorescens*, T₂), root length 7.18cm (5 g *T. viride*, T₆), seedling length 13.43 cm (5 g *P. fluorescens*, T₂) and seedling vigour index 1216.44 (5 g *P. fluorescens*, T₂) in Byadgi Dabbi cultivar and where as in Rudra cultivar recorded germination percentage of 99.75% (T₂), shoot length 4.13cm (5 g *T. viride*, T₆), root length 7.38cm (5 g *T. viride*, T₆), seedling length 11.56 cm (5 g *T. viride*, T₆) and seedling vigour index 1140.12 (5 g *T. viride*, T₆) when compared with control. Therefore, bio-priming with *Pseudomonas fluorescens*, *Bacillus* and *Trichoderma viride* are effective in enhancing the quality parameters of seed in chilli.

Key words: Bio-priming, *Pseudomonas fluorescens*, *Trichoderma viride*, *Bacillus*, Chilli

1 INTRODUCTION:

Chilli (*Capsicum annuum* L.) is key vegetable crop among Solanaceous vegetables which cultivated in sub-tropic and tropics areas where both ripe and unripe fruits are used for different medicinal and industrial purpose (Rai *et. al.*, 2019). Imbalance use of fertilizers, improper plant protection, poor growth and sub-optimum plant population are the most important factors by which there is reduced in yield and lowering the quality parameters of chilli. Suboptimum plant population generally results from poor and erratic germination. In current years, a lot of studies have been done on invigoration of seeds to improve the

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germination rate and uniformity of growth and reduce the emergence time of many vegetables and some field crops. Seed priming is now a widely used commercial process that accelerates the germination rate and improves seedling uniformity in many crops (Basra *et al.*, 2003). The seed is the most primary requirement of agriculture. Hence, it is crucial to maintain the quality of the seeds through nature-based solutions having multiple benefits. Among the pre-sowing techniques, seed priming is one of the most important developments to help rapid and uniform germination and emergence of seeds and to increase seed tolerance to adverse environmental conditions (Harris *et al.*, 1999).

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Among the seed priming techniques, bio-priming has emerged out to be the most simple, economical, and eco-friendly delivery system of beneficial microorganisms in the agroecosystem. Therefore, comprehension regarding the applicability of bio-priming in restoring soil health, improving plant nutrition, and maintaining crop/seed quality has a major role in achieving the UN-Sustainable Development Goals such as no poverty, zero hunger, good health and well-being, etc. (Sarakret *et al.*, 2021). Bio-priming is a process of biological seed treatment that refers to combination of seed hydration (physiological aspect of disease control) and inoculation (biological aspect of disease control) of seed with beneficial organisms to protect seed. It is an ecological approach using either bacteria or selected fungal antagonists against the soil and seed-borne pathogens. ~~Biological seed treatments may provide an alternative to chemical control of crop diseases.~~ Some bacteria and fungi prevent diseases and enhance plant growth, in which *Pseudomonas fluorescens*, *Bacillus* and *Trichoderma viride* are most popular.

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Trichoderma viride is a fungus used as bio-agent. It is used for seed and soil treatment for suppression of various diseases caused by fungal pathogens. The increased growth response induced by *Trichoderma* sp. has been reported for many crops such as beans (*Phaseolus vulgaris*), cucumber (*Cucumis sativus*), pepper (*Capsicum annum*), carnation (*Dianthus carophyllus*), maize (*Zea mays*), and wheat (*Triticumaestivum*) (Lo and Lin, 2002). *Trichoderma* produce phytohormones, such as indol acetic acid (IAA) and ethylene, whose metabolic pathways have been identified (Osiewacz, 2002) which produce cytokinin-like molecules, e.g. zeatin and gibberellin GA3 or GA3-related have been recently detected (M. Ahsanur Rahman *et al.*, 2012). The controlled production of these compounds could improve bio-fertilization (Osiewacz, 2002). *Pseudomonas fluorescens* is another bioagent used widely to control diseases and also known as plant growth rhizobacteria due to production of plant growth-regulating substances (PGRs), phytohormones, mineralization of organic phosphorus, production of phytoalexin

flavonoids-like compounds, enhancement of mineral uptake, etc. (Mukerji *et al.*, 2006). Increased dry weight and plant height were recorded with *Pseudomonas* sp. MML2212 and *Pseudomonas fluorescens* on rice and green gram when compared with the control (Mathivanan *et al.*, 2005, Shanmugaiah *et al.*, 2005, 2007). Hence, the present study was initiated to evaluate the ~~research on~~ response of different chilli genotypes towards bio-priming with *Pseudomonas fluorescens* and *Trichoderma viride* in respect to growth, yield, and quality attributes will have immense use to the farmers and seed industry.

2 MATERIALS AND METHODS

The present study was carried out at UHS, Bgalkote using byadgidabbi and rudra genotypes of chilli. Which are very popular in the area. The experiment was carried out using complete randomized design comparing with seven treatments like T₁-2.5 g *P. fluorescens*, T₂-5 g *P. fluorescens*, T₃-2.5 g *Bacillus*, T₄-5 g *Bacillus*, T₅- 2.5 g *T. viride*, T₆- 5 g *T. viride.*, T₇- Untreated control.

2.1 Seed treatment: Seeds of both ByadgiDabbi and Rudra genotypes of chilli were bio-primed with *P. fluorescens*, *Bacillus* and *T. viride* individually for twenty-four hours at different concentration and the seeds soaked in distilled water for the same duration were used as control. After the treatment, seeds were shade dried for 30 minutes and then those seeds were utilized for laboratory experiments.

2.2 Laboratory experiments: For in vitro experiment, 100 seeds with four replications for individual treatments and genotypes were placed in petriplates lined with two layers of Whatman filter paper soaked in sterilized distilled water and incubated at 25±10°C. Germination percentage was recorded at (14 DAS) as per ISTA. Paper Plate method used to measure root and shoot length of seedling and they were recorded after the 14 DAS by random selection of five seedlings from each replication. The data was recorded and further analyzed stastically ~~stastically~~.

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3 RESULTS AND DISCUSSION:

Seeds produced after pre-sowing bio-priming ~~of seeds~~ were subjected to laboratory testing for its quality assessment through different quality parameters like germination percentage, root length, shoot length, seedling length and vigor index. It was found ~~The result revealed~~ that there ~~is was~~ asignificant effect of different treatment ~~was found~~ on the quality parameters' of ~~seed in~~ chilli.

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3.1 Germination percentage

The ~~resulted data~~ revealed that the highest germination percentage was observed in 2.5 g *P.*

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fluorescens(T₁) with value of 98.69% for after 14 DAS of sowing followed by 5 g *Bacillus*(T₄), 5 g *T. viride* (T₆) and 2.5 g *T. viride*(T₅) respectively, whereas lowest was recorded in treatment 2.5 g *Bacillus*(T₃) of about 90.00% for germination percentage in Byadgi Dabbi variety. The Rudra variety recorded higher germination percentage in 5 g *P. fluorescens*(T₂) with value of 99.75% and all other treatments are/were on par with each other with lower germination percentage recorded in untreated control (T₇) of about 98.00% mentioned in table 1 and 2. Average influence of *Pseudomonas fluorescens* was found to be greater on this character in comparison to that of *Bacillus* and *Trichoderma viride* in both varieties. Response of Rudra variety towards pre-sowing bio-priming of seed germination on par with each other and influence of three the bio-inoculants was same almost same better than control. Whereas, in Byadgi Dabbi significant differences observed for all the treatments. Influence of *Pseudomonas fluorescens* was more for both genotypes. Germination percentage was also increased by *Trichoderma viride* in all condition. Supporting results was found in Hanson, 2000; Mishra and Sinha, 2000, Mukhtar I 2008.

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3.2 Root Length

Root length was recorded as maximum as 7.18cm and 6.93 cm in 5 g *T. viride*(T₆) and (T₂) in Byadgi Dabbi variety, when average was made over treatments, though 5 g *T. viride*(T₆) and 5 g *P. fluorescens*(T₂) performed statistically at par for this character. Significantly shortest root length was recorded for untreated control(T₇) followed by 2.5 g *Bacillus*(T₃) and 5 g *Bacillus*(T₄). The possible reason may be due to its unique genetic expression. The genotype Rudra recorded as maximum as 7.38cm and 7.25 cm in 5 g *T. viride*(T₆) and 2.5 g *P. fluorescens*(T₁) treatments, whereas shortest root length was recorded for Untreated control(T₇) of about 4.80cm followed by 2.5 g *Bacillus*(T₃) with root length of about 4.90cm (Table 1 and Table 2) as mentioned in table no. 1 and 2. Significant positive influence of *Trichoderma viride* bioinoculant over control as well as *Pseudomonas fluorescens* and *Bacillus* was noted for expression for this character in both varieties. The interaction effects were significant in both varieties, maximum root length was produced when biopriming was made with *Trichoderma viride* (Raiet al., 2019, Sarkar et al., 2021). Similar result found by Lo, C.T. and Lin, C.Y. (2002) regarding screened *Trichoderma* strains root growth of bitter melon, loofah and cucumber.

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3.3 Shoot Length

The longest shoot length was produced in Byadgi Dabbi variety with treatment 5 g *P. fluorescens*(T₂) of about 6.53cm when overall performance of the all treatments were considered followed by 5 g *Bacillus*(T₄) with 5.15cm, whereas shortest shoot length

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was recorded in 5 g *T. viride*(T₆) with 2.30cm. In Rudra cultivar longest shoot length ~~noticed~~ recorded with 4.13cm in (T₆) and shortest ~~noticed~~ recorded of about 2.15cm in 5 g *P. fluorescens*(T₂). ~~All the treatments were statistically significant with each other in both varieties.~~ Average influence of *Bacillus*, *Trichoderma viride* and *Pseudomonas fluorescens* were found to be statistically significant with each other and positive over unprimed control. While greater influence of *Trichoderma viride* could be noted in Rudra variety whereas *Pseudomonas fluorescens* noticed in Byadgi Dabbi variety. The ~~treatment~~ Untreated control(T₇) in Rudra cultivar responded in similar way towards priming like *Trichoderma viride*, *Bacillus* and *Pseudomonas fluorescens*.

3.4 Seedling Length

Significantly longest seedlings were produced by 5 g *P. fluorescens*(T₂) with 13.43cm followed by (T₂) with 10.26cm in Byadgi Dabbi, while shortest recorded for untreated control(T₇) with 8.23cm. In Rudra variety longest seedlings were produced by 5 g *T. viride*(T₆) with 11.50cm followed by 2.5 g *P. fluorescens*(T₁) with 10.28cm, whereas shortest recorded for 2.5 g *T. viride*(T₅) with 8.63cm. Statistically similar performance was noted for *Bacillus* in both genotypes. The untreated control(T₇) produced seedlings of the smallest type irrespective of the varieties. Average influence untreated control of *Bacillus*, *Trichoderma viride* and *Pseudomonas fluorescens* were found to be significant positive over unprimed control over the years, while greater influence of *Trichoderma viride* at higher concentration could be noted in Rudra variety whereas less influence recorded in same variety at lower concentration (Dubey *et al.*, 2007). Similar trend was recorded for all the individual varieties and it was of higher magnitude after bio-priming of seeds with *Trichoderma viride*, which may also be assessed through table on change over control due to priming (Rai *et al.*, 2019, Sarkar *et al.*, 2021).

3.5 Vigour Index

~~Critical analysis on average performance of both varieties for this derived seedling parameter may lead to identify superior most varieties for expression of this important characters.~~ Like seedling length, significantly lowest magnitude of vigour index was derived for untreated control(T₇) may be due to inherited potential of its seedling length as well as greater influence of its seed germination potential. Significant influence of bio-priming for enhancement in vigour index over control could be noticed in both varieties (Rai *et al.*, 2019, Sarkar *et al.*, 2021, Asaduzzaman *et al.*, 2010, Mishra, D.S., and Sinha, A.P. 2000). Superior influence of *Trichoderma viride*(5 g *T. viride*, T₆=1140.12) for determination of average vigour index was observed over *Pseudomonas fluorescens*(2.5 g *P. fluorescens*,

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T₁=1022.37 and 5 g *P. fluorescens*, T₂=803.09) in Rudra cultivar whereas its reverse trend positive superiority in influence of *Pseudomonas fluorescens* (5 g *P. fluorescens*, T₂=1216.44) could be noticed over that of *Trichoderma viride* (5 g *T. viride*, T₆=911.99) in Byadgidabbi variety (Table 1 or Table 2) as mentioned in table 1 and 2, while it was statistically at on par response of both varieties towards bio-priming for production of seeds with enhanced vigour over control followed the similar trend. Significantly similar influence of all the bio-inoculants on both varieties was recorded, exception was noted for 2.5 g *Bacillus* (T₃) in for which low superiority in influence with low concentration of *Trichoderma viride*.

CONCLUSION:

From the study it was found that there is enhancement in the seed quality parameters of chilli when there is biopriming of *Pseudomonas fluorescens*, *Bacillus* and *Trichoderma viride*. The significant variation was found when compared with the control treatment, so from the study it concludes that to improve the crop quality, there is need to have the biopriming of the mentioned microorganisms. Preferably *Pseudomonas fluorescens* to be used for the better results when compared with others.

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Table 1: Effect of seed bio-priming on seed quality of ByadgiDabbichilli genotypes

Treatments	Germination Percent (%)	Root Length (cm)	Shoot Length (cm)	Seedling Length (cm)	Vigour Index
T ₁	98.69	5.38	4.33	9.71	957.99
T ₂	90.75	6.93	6.53	13.43	1216.44
T ₃	90.00	4.63	4.75	9.38	845.02
T ₄	97.25	4.88	5.15	10.03	974.78

T ₅	96.13	6.05	4.21	10.26	986.58
T ₆	96.25	7.18	2.30	9.48	911.99
T ₇	94.50	4.53	4.70	8.23	777.26
SEM	1.15	0.09	0.11	0.21	20.89
CD@5%	3.37	0.27	0.32	0.61	61.44
CV	2.42	3.26	4.88	4.13	4.38

Table 2: Effect of seed bio-priming on seed quality of Rudrachilli genotypes

Treatment s	Germination Percent (%)	RootLength th (cm)	Shoot Length (cm)	Seedling Length (cm)	Vigour Index
T ₁	99.50	7.25	3.03	10.28	1022.37
T ₂	99.75	5.90	2.15	8.05	803.09
T ₃	99.38	4.90	2.53	7.43	738.01
T ₄	99.44	6.03	3.23	9.25	919.94
T ₅	98.50	5.20	3.43	8.63	849.54
T ₆	99.15	7.38	4.13	11.50	1140.12
T ₇	98.00	4.80	3.88	8.68	850.00
SEM	0.32	0.13	0.07	0.22	22.48
CD@5%	0.93	0.38	0.21	0.66	66.12
CV	0.64	4.34	4.54	4.90	4.98