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Effect of *Pseudomonas fluorescens* inoculation on yield components and yield of bio-fortified rice

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Abstract

Seed bio-priming with bio agents is one of the new strategies for management of the crop. Present study revealed that seed bio-priming with *Pseudomonas fluorescens* enhanced Seed bio priming with *Pseudomonas fluorescens* significantly increase in plant height (102.75 and 107.83 cm), number of tillers (181.25 and 184.18 tillers/m²), dry matter accumulation (14.24 and 16.64 g/plant), number of effective tillers (175.25 and 178.18 tillers/m²), panicle length (19.08 and 21.25 cm), number of grains/ panicle (124.83 and 127.00) and grain yield (3.38 and 3.42 t/ha) was observed in crop harvesting stage during both the years of experiments and lowest yield attributing characters and yield was found under farmers practices.

Keywords: Fortified rice, seed bio priming, grain yield

Introduction

Rice (*Oryza sativa* L.) is one of the most important food crops for over half of the world's population accounts for around 23% of the global calorie intake (Li *et al.*, 2011; Bernier *et al.*, 2008) [9, 10]. Rice is the major caloric supplements for two third of Indian population with a consumption of around 220 gm daily. Malnutrition is a large and growing problem in the developing world mainly in South and South-East Asia (Reddy *et al.*, 2005) [8]. Zinc malnutrition is a major issue in India as well as some part of Chhattisgarh (Gupta *et al.*, 2023) [7]. Bio-priming treatment is potentially able to promote rapid and more uniform seed germination and plants growth associated with bacterial coatings. Seed priming with living bacterial inoculums is termed as bio priming that involves the application of plant growth-promoting rhizobacteria. It increases speed and uniformity of germination; also ensures rapid, uniform and high establishment of crops and hence improves harvest quality and yield. Seed bio-priming allows the bacteria to enter and adhere the seeds and also acclimatization of bacteria in the prevalent conditions (Mahmood *et al.* 2016) [1].

Seed bio priming is now emphasized to exploit an eco-friendly, easy and cost-effective technique to improve seed germination and growth enhancement which may ultimately lead to increase in the yield (Kumar *et al.*, 2019, Srivastava *et al.*, 2011) [3, 5]. In rice crop, priming provides a vigorous 'head start' that typically exhibit faster and uniform emergence, accomplish better stand establishment and gives high yields (McDonald, 2000) [11].

Beneficial microbes are included in the process of bio-priming mainly focuses as a technique for colonizing seed and or to control soil-borne pathogen by enhanced production of several secondary metabolites in region of sperm sphere. Different strains of *Pseudomonas* are known to enhance root growth and development, resistance to abiotic stress and uptake of nutrients (Martinez-Medina *et al.*, 2011) [4].

Materials and Methods

Experiments were conducted under Biotech Kisan Hub project during *Kharif season* 2020-21 and 2021-22 at eight villages of Kanker district (Puswada, Mohpur Choria, Komalpur, Kairkheda, Turakhar, Largaon and Kapsi) in Chhattisgarh. Experiment consists of two treatments of rice variety CG zinc rice-1, treatment consisting of T₁: farmer practice and T₂: seed

bio-priming with *Pseudomonas fluorescens*. Before sowing of seeds, seed bio-priming was done by using *Pseudomonas fluorescens* @ 5 ml/kg of seed in demonstrated plot. Climatologically, Kanker comes under the seventh Agro-climatic region of India i.e. Eastern plateau and hills, which is classified as sub-humid with hot summer and cold winter. The source of rainfall is south-western monsoon. It receives an average annual rainfall of 1200-1400 mm, mostly (86%) precipitated during the period of rainy season. Observation was recorded under-treated plot and farmers practice i.e. plant height, number of tillers, dry matter accumulation, number of effective tillers, panicle length and number of grains/ panicle and grain yield at eight villages of Kanker district.

Results and Discussion

The results revealed that the growth parameters such as plant height, dry matter accumulation and no. of tillers were significantly influenced by seed bio priming with *Pseudomonas fluorescens* (Table 1). Seed bio-priming with *Pseudomonas fluorescens* has a significant influence on plant height (102.75 and 107.83 cm), number of tillers (181.25 and 184.18 tillers/m²) and dry matter accumulation (14.24 and 16.64 g/plant) was observed during both the years and lowest growth parameters were found under farmer's practices. Contrary to this result, Mathivanan *et al.* (2006) [12] reported that application of *P. fluorescens* significantly increased rice plant height. In addition, Naveed *et al.* (2008) [13] reported that application of *Pseudomonas* strains significantly increased plant height. The yield attributing characters and yield were affecting

significantly due to various seed bio priming with *Pseudomonas fluorescens* (Table 2). Among the treatments, Seed bio priming with *Pseudomonas fluorescens* @ 5 ml/kg significantly increase in effective tillers (175.25 and 178.18 tillers/m²), panicle length (19.08 and 21.25 cm), number of grains/ panicle (124.83 and 127.00 grains/panicle) and grain yield (3.38 and 3.42 t/ha) was observed in crop harvesting stage during both the years of experiments and lowest yield attributing characters and yield was found under farmers practices.

Furthermore, grain yield was significantly higher for plants inoculated with *Pseudomonas fluorescens* compared to uninoculated plants. It was observed that plants derived from seed bio-priming with *Pseudomonas fluorescens* consistently at all eight locations of Kanker district over two years improved germinations and plant growth. Seed bio-priming forms protective covering around the seed coat which ensures better seedling germination and reduces pre and post-emergence mortality of seedling due to different seed and soil-borne pathogens. Potential bacteria *Pseudomonas fluorescens* used in the present investigation had strong hormonal effects on plants through bio-priming. The similar findings have been also reported by Kotasthane *et al.* (2014) [2]. *Pseudomonas fluorescens* a well-known major rhizobacteria encouraged the plant growth through producing yellow-greenish siderophores which are known for high-affinity transport of iron in the cell. It has been shown that the bacteria completely colonized the roots and caused significantly increase in the root and shoot length which ultimately led to enhancement in yield (Mandal and Kotasthane, 2014) [6].

Table 1: Plant height, number of tillers, Dry matter production and Panicle fertility as influenced by seed bio priming with *Pseudomonas fluorescens* in Bio-fortified rice

Treatment	Plant height (cm)		No. of total tillers (/m ²)		Dry matter production (g)/ plant	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
T1: Farmer Practices	96.67	99.25	162.67	168.31	11.65	14.83
T2: Seed bio-priming with <i>Pseudomonas fluorescens</i>	102.75	107.83	181.25	184.18	14.24	16.64
S.Em±	3.90	2.49	6.76	7.19	0.93	0.89
CD (0.005)	11.58	7.40	20.09	21.36	2.79	2.64
CV	6.77	4.16	6.81	7.07	10.85	9.79

Table 2: No. of Effective tillers, panicle length, number of grains panicle and grain yield as influenced by seed bio priming with *Pseudomonas fluorescens* in Bio-fortified rice

Treatment	No. of Effective Tillers (/m ²)		Panicle Length (cm)		No. of Grains/ Panicle		Grain Yield (t/ ha)	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
T1: Farmer Practices	158.88	163.31	15.33	17.00	117.51	121.36	3.30	3.34
T2: Seed bio-priming with <i>Pseudomonas fluorescens</i>	178.81	178.18	19.08	21.25	135.74	136.61	3.38	3.42
S.Em±	6.76	7.19	0.80	0.72	4.71	3.49	0.11	0.10
CD (0.005)	20.09	21.36	2.38	2.14	13.99	10.37	0.32	0.30
CV	6.94	7.29	8.05	6.52	6.44	4.69	5.65	5.10

Conclusion

It may be concluded that there was significant effect of Seed bio-priming with *Pseudomonas fluorescens* on bio-fortified rice. However, the priming effect differed with However; the priming effect differed with Seed bio-priming with *Pseudomonas fluorescens* and farmers practices.

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