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Assessing the Different Bio-priming Methods and Knowledge Dissemination through On Farm Trial in Salem District

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

One of the most important pre sowing seed improvement techniques for managing biotic and abiotic challenges is seed bio-priming, which ensures uniform stand establishment under adverse conditions. "Bio-priming" seed treatment combines biological (inoculating seeds with protective organisms) and physiological (hydrating seeds) components of vigour improvement, disease

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management. Recently, it has been employed as an alternate technique for not only to eradicate numerous soil- and seed-borne diseases but also improves the field establishment and vigour. In the current study, an On-Farm Trial bhendi seeds were soaked with two biopriming treatments *Viz.,* (i) 10% *Pseudomonas fluorecens*, (ii) 10% *Trichoderma viridi,* for 6 hours followed by shade drying and sown in farmers' fields during kharif, 2020. Untreated seeds served as the control. The findings showed that 10% *Pseudomonas fluorescens* outperformed than *Trichoderma* and untreated seed in terms of yield (172.5 q/ha), net return (Rs. 2,58,750/ha), and benefit-cost ratio (2.59), The 10% *Trichoderma* primed seeds, which was the next-best treatment, had high yields, net returns, and BCR values of 169.8q/ha, Rs. 2,54,700/ha, and 2.56 respectively. So, it was concluded that bioprimingof seeds with 10% *Pseudomonas fluorescens* for six hours increased the production of bhendi. The dissemination of extension activities like training and method demonstration increased the understanding of farmers about biopriming from 5.4 to 52.5 percent.

Keywords: Bhendi; seed biopriming; knowledge dissemination and yield.

1. INTRODUCTION

Bio-priming is an originative skill and cost effective seed treatment that assimilates biological (inoculation of seed with beneficial organism to protect seed) and physiological facets (seed hydration) of disease control [1]. Bio-priming is directly involved in the enhancement of plant growth by the secretion of compounds and mineral solubilization [2]. Advance technologies are being used in modern agriculture to increase crop productivity and break through yield barriers. Creating diverse seed enhancement technologies play a significant role in ensuring uniform field emergence, better crop stands and higher yield for various crops. Bio-priming, which combines a variety of plant extracts, microbial products and biotic agents to manage seed crops and target them against biotic and abiotic stresses, has been hailed as a novel management strategy because it uses fewer chemicals, increases the efficacy of the seeds, lowers management costs, eliminates pollution risks and interferes with biological equilibrium to the least amount possible. Therefore, using "On Farm Testing" in farmers' fields, an effort was undertaken to gauge the effectiveness of seed biopriming with novel biocontrol agents (*Tirchoderma viridi* and *Pseudomonas fluorescens*) in bhendi.

2. MATERIALS AND METHODS

In order to shorten the time, lag between the development of a technology and its adoption by farmers, Krishi Vigyan Kendra, Salem demonstrate the newest agricultural technologies to farmers and extension workers of the State Agriculture Department through "On Farm Testing (OFTs) and Frontline demonstrations (FLDs). During the kharif season in 2020, the "On Farm Testing on biopriming in bhendi" was done at five farmers field in Puthuragraharam Village, Veerapandi block of Salem district, Tamilnadu. Farmers about about seed biopriming treatments and other improved crop management techniques for bhendi through training programmes prior to the OFT. The CO(Bh)H 4 bhendi seeds were bioprimed for 6 hours with 10% *Trichoderma viridi*, 10% *Pseudomonas fluorescens* and were compared with untreated control seeds. The beneficiaries received the crucial inputs, including bhendi bioprimed seeds (CO(Bh)H 4), Arka vegetable special contain micronutrients and growth regulators required for vegetables and IPDM components. The approved package of practice by Tamil Nadu Agricultural University's for bhendi were educated to farmers. The KVK scientists routinely visited the OFT fields during various crop stages to ensure that nutrients and plant protection measures were applied in a timely manner. They also offered the farmers other suggested measures and collected feedback data on each stage to further improve the research and extension programme.

The yield data was assessed using the cumulative yield method, field day was held in conjunction with extension agents from the Department of Agriculture to share the improved farming practices used by OFT farmers with other farmers. A well planned interview schedule with a predetermined list of questions was used to gather the pertinent information regarding the cost of cultivation, market preferences and other restrictions. Each farmer provided statistics on crop output and profitability for the OFT and control plots, which were then averaged across all locations. Using the appropriate statistical methods, the gathered data were pooled and tabular analysis was completed to determine the

technical gap. When the cropping phase is completed, furthermore, using, the knowledge level of OFT farmers using improved bhendi production technology was compared before and after KVK interventions and knowledge test was done as recommended by A.K. Singh (1986) [3]. The response also received the various improved production technologies such as the choice of improved varieties, Integrated Nutrient Management (INM), foliar spray of crop boosters (Arka vegetable special), and Integrated Pest and Disease Management (IPDM).

The knowledge level was scored, with each correct response receiving two points and each erroneous response receiving one point [4]. The pre- and post-evaluation scores were evaluated, and the respondents' knowledge Index was determined as shown below.

The formula used for the calculation of knowledge index of each respondent was

$$Knowledge\ Index\ = \frac{K}{P} x\ 100$$

Where,
K - Knowledge scores obtained by an individual respondent
P - Maximum possible scores for all items
The respondents were classified into three categories such as low, medium and high using mean and standard deviation.

3. RESULTS AND DISCUSSION

The results of the current study, which evaluated the efficiency of seed biopriming with *Tirchoderma viridae* and *Pseudomonas fluorescens* of bhendi from fruit yield in farmers' fields, are summarized Table 1.

The results showed that the farmers, using 10% *Pseudomonas fluorescens and Tirchoderma viridi* 10% primed seeds, respectively, produced an average fruit production of 172.5 and 169.8 q/ha, compared to the control's 159.7 q/ha (Table 1). The fruit output higher in *Pseudomonas fluorescens* primed seed when compare to Trichoderma and control. *Pseudomonas fluorescens* primed seeds also performed exceptionally well in terms of plant population, field emergence, number of fruits per plant and number of harvest.

The same outcome is also supported by [5], who discovered that seeds treated with *Pseudomonas fluorescens* had improved bhendi yield and growth. An increase in okra plant height, fruit production, and yield per plant had received due to presence of plant growth promoting substance and mineral solubilization by *Psudomonas fluorescens* [6]. Bioprimed seeds with *Trichoderma harzianum*, enhanced plant tolerance to abiotic stressors and controls disease-causing organisms through the release of antimicrobial compounds [7,8]. The treatment with *Pseudomonas fluorescens, and Tirchoderma viridi* have been shown to protect a variety of crop plants by hyperparasitizing pathogenic fungi [9,10]. Bioagents have a remarkable ability for multiplication to grow exponentially, they can even resist stress conditions by spores with strong walls form [11]. The results of the present experiment are supported by data from [12,13] on improvements in the vegetable output of bitter gourd and brinjal respectively. *Pseudomonas fluorescens* were used to increase yield in white cabbage and cauliflower, according to [14].

Seed hydration followed by the introduction of helpful microorganisms to the seed surface in a process known as seed biopriming, is regarded as an advanced method of seed treatment [1,15,16]. According to initial inoculum levels, it was found that during biopriming, bacterial populations increased (10 to over 10,000 folds) [17]. Different priming techniques are used in the

Table 1. Performance of biopriming in bhendi under OFT programme

Technology option	Field Emergence (%)	Plant population at 60 DAP(%)	Fruit Nos.	No. Harvest	Fruit Yield (q/ha)
Untreated	82	74	23	19	159.7
Biopriming with 10% *Pseudomonas fluorescens*	94	90	27	22	172.5
Biopriming with 10 % *Tirchoderma viridi*	90	84	25	21	169.8

seed biopriming process, such as wet finely crushed lignite or coal (solid matrix priming) [18] or moist conditions in a plastic bag [19]. Before priming, it's crucial to disinfest seeds in an order to minimise or get rid of the undesirable microorganisms, if the seeds are diseased or contaminated with pathogens, this will be amplified during the priming process, having unfavourable consequences on emerging plants [1,20,21]. Additionally, the survival of helpful bacteria used during the seed biopriming process may be harmed by the growth of undesirable indigenous microorganisms [21].

The economic analysis of biopriming was studied based on gross income which was calculated with average yield multiplied by prevailing market price of Rs.1000 /quintal during that particular year. It could be observed that the average net income of the *Pseudomonas fluorescens* bioprimed seeds was Rs.1,01,250/- ha, which was Rs.98,550 per ha, and Rs.88,950 in *Trichoderma viride* and control plots, respectively. Further, the benefit cost ratio was 2.42, 2.38 and 2.26 respectively (Table 2).

Knowledge is a requirement for innovation adoption and would give farmers the ability to fully understand a technology and its relative advantages. When evaluating the effective diffusion of technology, the level of farmer knowledge regarding the effects of biopriming and other improved techniques is essential. So, an effort was undertaken to compare the level of knowledge before and after KVK interventions during the conduct of OFT programme. The degree of expertise of medium category bhendi growing farmers in upgraded technologies increased from 52.5 to 62.5% (Table 3). Due to extension activities, the percentage of farmers with modest expertise was reduced from 35 to 12.5%.

When it comes to farmers' understanding of new technologies, it can be shown that before the OFT programme was implemented, only about 12.5 percent of farmers knew about presowing seed treatment ofbiopriming, and that number rose to 87.5 percent after the programme was implemented (Table 4).

Similar to this, the percentage improvement in farmers' knowledge on the usage of hybrid bhendi, optimum seed rate, seed biopriming, foliar nutrition, INM, IWM and IPDM was 55.0, 15.0, 75.0, 32.5, 42.5, 40.0, and 65.0 percent, respectively. Improved level of knowledge on bhendi production technologies could be due to the extension activities like training sessions, method demonstrations, and field days conducted during OFT programme by KVK. Additionally, KVK Salem contributed significantly to the spread of technologies by providing important material throughout the extension operations.

Table 2. Economic analysis of bioprimed seeds in bhendi

Treatments	Gross cost (Rs./ha)	Gross income(Rs./ha)	Net income(Rs./ha)	BCR
Untreated	70,750	1,59,700	88,950	1:2.26
Biopriming with 10 % *Pseudomonas fluorescens*	71,250	1,72,500	1,01,250	1:2.42
Biopriming with 10%*Trichoderma viride*	71,250	1,69,800	98,550	1:2.38

Table 3. Distribution of respondents based on their knowledge level (n = 40)

S.No.	Category	Before OFT		After OFT	
		Number	Per cent	Number	Per cent
1	Low	14	35.0	5	12.5
2	Medium	21	52.5	25	62.5
3	High	5	12.5	10	25.0
	Total	40	100	40	100

Table 4. Knowledge level of the bhendi farmers in improved production technologies (n=40)

S.No.	Technologies	Before OFT programme		After OFT programme		% Increase in Knowledge level of farmers
		Number	%	Number	%	
1	Application of FYM	40	100	40	100	0
2	Improved Bhendi varieties from public sector	10	25.0	32	80.0	55.0
3	Optimum seed rate	32	80.0	38	95.0	15.0
4	Seed biopriming	5	12.5	35	87.5	75.0
5	Foliar nutrition	20	50.0	33	82.5	32.5
6	INM	19	47.5	36	90.0	42.5
7	IWM	10	25.0	26	65.0	40.0
8	IPDM	10	25.0	36	90.0	65.0

4. CONCLUSION

It may be established that seeds biopriming with 10% *Pseudomonas fluorescens* out-performed other bioprimed seeds and untreated control in terms of yield (165.1 q/ha), net return (Rs. 93,340/ha), and cost benefit ratio (2.36) followed by the 10% *Trichoderma viride* primed seeds, which had high yield, net return and BCR values of 162.3 q/ha, Rs, 90,340/ha and 2.28, respectively. The knowledge on seed bio-priming increase among bhendi cultivating farmers from 12.5 to 87.5 percent due to better field establishment, higher fruit yield, import of training and field day conducted during harvesting stage of bhendi bioprimed field.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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