Journal of Applied and Natural Science
11(3): 687-693 (2019)
ISSN : 0974-9411 (Print), 2231-5209 (Online)
journals.ansfoundation.org

Response of Bio-priming in okra for vegetable production

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Article Info
https://doi.org/10.31018/jans.v11i3.2147
Received: July 16, 2019
Revised: August 28, 2019
Accepted: September 4, 2019

How to Cite
Raj, A. K. *et al.* (2019). Response of Bio-priming in okra for vegetable production. *Journal of Applied and Natural Science*, 11(3): 687 - 693 https://doi.org/10.31018/jans.v11i3.2147

Abstract
The field experiment was conducted at District Seed Farm, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal in summer season of 2011 and 2012. Pre-sowing bio-priming was done with *Trichoderma viride* and *Pseudomonas fluorescens* with an un-primed control to assess the trend of okra varieties *viz.,* Lalu, Arka Anamika, Ramya, Satsira, Lady Luck,Debpusa Jhar,Japani Jhar and Barsha Laxmi due to bio-priming of seeds towards vegetable production Significant variation among the varieties was noted for all the characters studied. Okra variety Lalu gave highest vegetable yield per plant in both years and it was statistically at par with Arka Anamika. Vegetable yield per plant was increased by 4.33 to 20.08% in first year and 3.68 to 19.60% in second year with *T. viride* as compared to *P. fluorescens* and un-primed control. Individual varieties indicated that vegetable yield per plant was maximum with Lalu when priming was made with both the bio-inoculants followed by Arka Anamika during both years. Hence, Lalu and Arka Anamika may be recommended for experimental region for higher yield and pre-sowing seed bio-priming may be recommended with both *T.viride* and *P. fluorescens* for enhanced vegetable yield of okra.

Keywords: Bio- priming, Okra, *Pseudomonas fluorescence, Trichoderma viride,* Vegetable yield

INTRODUCTION

Okra (*Abelmoschus esculentus)* is one of the most popular vegetable crops grown in India. It has a major position among vegetables due to its high nutritive and remedial value, ease of cultivation, and wider adaptability to varying climatic condition, ability to cultivate round the year, high productivity; and export potentiality (Reddy *et al,* 2012; Meena *et al.,* 2017). India has the first position in the world with 6.35 million tonnes (approximately 70 % of the total world production) of okra produced with a productivity of 11.9 t/ha (Anonymous, 2015) and second in total vegetable production after China (Saxena *et al.,* 2016). The increased pressure from public and environmental scientists on the health hazards of chemical pesticides, led to the genesis of bio-control agents (Nakkeeran *et al.,* 2005). Some bacteria and fungi prevent diseases and enhance plant growth. Beneficial free-living soil bacteria enhancing plant growth are generally referred to as plant growth-promoting bacteria and are found in association with the roots of various plants (Kloepper *et al.,* 1991; Sajjad *et al.,* 2001; Shanmugaiah *et. al*, 2005; Shanmugaiah, 2007).

Beneficial microbes associate with plants in several ways: some may inhabit the rhizosphere taking advantage of root exudates, others may live on root or leaf surfaces, and some may colonize in intracellular spaces and vascular tissues inside the plant (Preston, 2004). Seed treated with *Trichoderma spp*. check the growth of fungal diseases and improve the seed quality. This has evolved multiple mechanisms resulting in improvements in plant resistance to diseases, plant growth as well as productivity (Harman *et al*., 2004; Vinale *et al*., 2008). Possible explanation of this phenomenon include: control of minor population of pathogens leading to stronger root growth and nutrient uptake (Yedidia *et al*., 2001), secretion of plant growth regulatory factors such as phytohormones (Muthukumar *et al*., 2005); and release of soil nutrients and minerals by saprophytic activity of *Trichoderma* in soil (Ousley *et al*., 1994). The increased growth response induced by *Trichoderma sp.* has been reported for many crops such as beans, cucumber, pepper, carnation, maize and wheat (Lo and Lin, 2002).

Most of the strains of plant growth promoting rhizobacteria are from *Pseudomonas* sp. particularly *P. fluorescens* strains. In recent years, more emphasis has been laid on the combined use of biocontrol agents with plant growth promotion. Plant-associated microorganisms fulfil important functions for plant growth, such as enhancement of plant growth and protection of plants from various plant pathogens in several crops such as cucumber, radish, tomato, sugar cane and rice as reported in some of previous work (Viswanathan and Samiyappan, 1999; Ongena *et al*., 2000; Ramamoorthy *et al.,* 2001). Knowledge on response of different okra varieties/genotypes towards bio-priming with *P. fluorescens* and *T. viride* in respect to growth, vegetable yield, and quality production are of immense use to both seed industry and farming community. Hence, the present investigation was planned to assess the trend in response of eight different varieties of okra due to bio-priming of seed towards vegetable production.

MATERIALS AND METHODS

The present experiment was carried out at District Seed Farm, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal during summer season of 2011 and 2012. It is situated between 23^0N latitude, 89^0E longitude and an altitude of 9.75 meters above the mean sea level. Nature of site is sandy loam almost neutral in pH (6.4) with good drainage facility. Experiment was laid out in a split plot arrangement with three replications. Different varieties (V1-Lalu, V2- Arka Anamika, V3 - Ramya, V4- Satsira, V5- Lady Luck, V6- Debpusa Jhar, V7- Japani Jhar and V8- Barsha Laxmi) were assigned to main plots and sub-plots consisted of three seed bio-priming i.e T0- Control, T1- *T. viride* and T2- *P. fluorescens*. Pre-sowing seed bio-priming was done with two bio-agents *viz., T. viride* strain Tv-4 and *P. fluorescence* strain Psf- 2. Seeds of the varieties were first soaked for two hours in spore suspension of *T. viride* and conidia suspension of *P. fluorescence*, and then shade drying was made. Bio-primed seeds along with un-primed control seeds were sown in field with 60 × 50 cm spacing and thereafter recommended package of practices were followed throughout the growing period (Leghari *et al*., 2004). Treatment wise five plants were randomly selected to record plant height, number of branches per plant, number of nodes per plant, number of pods per plant, pod length, pod diameter, pod weight and vegetable yield per plant (Bharad and Kamlesh, 2005). Data was statistically analyzed using analysis of variance (ANOVA) as split-plot design (Gomez and Gomez, 1984). Further Significant differences between the treatments were compared with the critical difference at ±5% probability by least significant difference.

RESULTS AND DISCUSSION

Plant height: Average plant height at final vegetable harvest was maximum for Ramya in both the years (136.90 and 138.47 cm). Whereas, Barsha Laxmi (66.02 and 67.50 cm) showed shortest plant height at final vegetative stage. Unique genetic expression of each variety may cause such variation in plant height among the different cultivars. Seed priming with the bio-inoculants exerted positive influence on increasing plant height (Table 1). Seed priming with *Trichoderma viride* (98.94 and 101.03 cm) exerted superior results as compared to *Pseudomonas fluorescens* (97.35 and 99.86 cm) and control plot (93.36 and 94.72 cm) during both years of experiment. Significant enhancement in plant height of okra after seed treatment with *Trichoderma viride* and *Trichoderma harzianum* was also reported by Ahmad *et al*., 2012. Though interaction effects were insignificant in both the years, maximum plant height was produced by Ramya (142 and 145 cm) in both the years when bio- priming was made with *Trichoderma viride*. Apparently more plant height could be noticed after bio-priming with *Pseudomonas fluorescens* for Arka Anamika (112.67 and 114.74 cm) and Barsha Laxmi (69.75 and 70.89cm) only, while it was reverses for others.

Number of branches: Average number of branches per plant was found to be distinctly varied amongst the varieties in both the years with a considerable range, *viz.,* the range noted in 2011 was 2.70 for Barsha Laxmi to 4.11 for Lalu, and it was 2.75 to 4.21 in 2012 for the same varieties (Table 1). Significant positive influence of both the bio-inoculants was noted for enhancement in number of branches per plant irrespective of the year of experimentation, of which *Trichoderma viride* (3.41 cm) exerted superior influence in comparison to that of *Pseudomonas fluorescens*, when average was made over the treatments. Significantly greater influence of *Trichoderma viride* in enhancing number of branches can be noticed for Lalu (4.21cm) and Satsira (4.08),Lady Luck and Japani Jhar in 2011, Debpusa Jhar may be considered as an exception which was unable to respond significantly in any direction towards both the bio-inoculants.

Number of nodes: Maximum number of nodes per plant was recorded after Lady Luck (22.28 and 22.61) followed by Ramya, Lalu and Arka Anamika, while it was lowest for both Satsira and Barsha Laxmi (Table 2). Average influence of *Trichoderma viride* (18.17 and 18.28) was found to be greater than that of *Pseudomonas fluorescens* in enhancing the number of nodes per plant, when average was made over the varieties in both the years. *Trichoderma viride* exerted significantly

Table 1. Effect of seed bio-priming on plant height and number of branches per plant of Okra

Varieties	Plant height (cm) at final vegetable harvest							
	First Year				Second Year			
	T0	**T1**	**T2**	**Mean**	**T0**	**T1**	**T2**	**Mean**
V1	88.59	96.55	91.33	92.16	90.84	98.89	94.55	94.76
V2	101.84	110.00	112.67	108.17	104.15	112.78	114.74	110.56
V3	131.60	142.67	136.44	136.90	130.11	145.65	139.65	138.47
V4	93.54	95.25	94.11	94.30	94.77	96.89	96.84	96.17
V5	130.84	135.84	135.33	134.00	133.45	137.45	137.22	136.04
V6	66.84	73.17	69.33	69.78	67.41	75.14	71.15	71.23
V7	71.17	72.17	69.84	71.06	72.89	73.90	73.86	73.55
V8	62.45	65.87	69.75	66.02	64.11	67.51	70.89	67.50
Mean	93.36	98.94	97.35		94.72	101.03	99.86	
	V	**T**	**VXT**		**V**	**T**	**VXT**	
SEM (±)	1.606	0.892	2.613		1.409	0.932	2.573	
CD at 5%	4.871	2.571	NS		4.273	2.686	NS	
	Number of branches/plant							
Varieties	**First Year**				**Second Year**			
	T0	**T1**	**T2**	**Mean**	**T0**	**T1**	**T2**	**Mean**
V1	3.92	4.21	4.20	4.11	3.98	4.32	4.33	4.21
V2	2.94	3.17	3.05	3.05	3.05	3.28	3.15	3.16
V3	3.00	3.32	3.33	3.22	3.11	3.33	3.42	3.29
V4	3.67	4.08	3.84	3.86	3.79	4.19	3.89	3.96
V5	2.50	3.11	2.84	2.82	2.69	3.16	2.90	2.92
V6	2.65	2.69	2.83	2.72	2.77	2.78	2.86	2.80
V7	3.45	3.87	3.50	3.61	3.61	3.86	3.61	3.69
V8	2.42	2.84	2.84	2.70	2.51	2.84	2.89	2.75
Mean	3.07	3.41	3.30		3.19	3.47	3.38	
	V	**T**	**VXT**		**V**	**T**	**VXT**	
SEM (±)	0.043	0.028	0.077		0.051	0.030	0.085	
CD at 5%	0.130	0.080	0.225		0.156	0.085	NS	

V1-Lalu, V2- Arka Anamika, V3- Ramya, V4- Satsira, V5- Lady Luck, V6- Debpusa Jhar, V7- Japani Jhar, V8- Barsha Laxmi. T0- Control, T1- *Trichoderma viride,* T2- *Pseudomonas fluorescens.*

greater influence on enhancement of this parameter for Lady Luck, Lalu, Arka Anamika, and Debpusa Jhar in both the years, it was reverse for Ramya (23.33 and 23.36) only, similar influence of both the bio-inoculants could be recorded for the remaining varieties. Number of nodes significantly enhanced upto 23.95 and 22.74 % for Lady Luck in respective years after priming with *Trichoderma viride*, while it was upto 22.79 and 19.92 % for Ramya in respective years after *pseudomonas fluorescens* (Table 2). Such variation in trend may have been created due to unique response of individual varieties towards pre-sowing bio-priming for expression of this character.

Numbers of vegetable pods: It could be revealed that, on an average maximum numbers of vegetable pods per plant were harvested with Arka Anamika (20.69 and 21.04) in both the years followed by Japani Jhar, Debpusa Jhar and Lalu, though number of pods harvested in Arka Anamika was statistically at par with Japani Jhar (19.77) in first year (Table 2). While, it was lowest for Satsira (15.82 and 16.01) and Lady Luck (16.25 and 16.46) in both the years of experiment. It is important to note that the number of pods harvested after bio-priming was statistically similar for both the cases, but significantly higher over the control indicating positive influence of both the bio-inoculants in retaining more number of pods per plant till harvest. Akhtar *et al*. (2010) was also reported that number of pods per plant in lentil was significantly enhanced after seed treatment with *Pseudomonas spp.*

Pod length: Arka Anamika (12.03 and 11.79 cm) produced highest average vegetable pods length in both the years followed by Lalu, Ramya and Lady Luck. Ramya and Lady Luck produced pods which did not differ significantly in its length, while pods with statistically at par in magnitude were noticed for Lalu and Arka Anamika in 2012 only. Average pod length was consistently minimum for Satsira (10.11 and 9.95 cm) irrespective of the year of experiment. Enhancement in magnitude of average pod length was noted in 2012 for all the varieties in comparison to that of 2011 excepting Arka Anamika and Satsira, which may be due to the differences in preference of the varieties towards changed climatic conditions (Table 3). Average influence of *Trichoderma viride* was greater in first year (11.42 cm) in comparison to that of *Pseudomonas fluorescens* (11.16 cm), while both the bio-priming exerted similar influence in second year for expression of average pod length. Significantly longest pods were harvested after Arka An-

Table 2. Effect of seed bio-priming on number of nodes and pods per plant of Okra

Varieties	Number of nodes/plant							
	First Year				Second Year			
	T0	T1	T2	Mean	T0	T1	T2	Mean
V1	16.84	19.92	18.50	18.42	16.98	20.02	18.86	18.62
V2	16.50	20.00	18.00	18.17	16.92	20.15	18.11	18.39
V3	19.00	21.50	23.33	21.28	19.48	21.56	23.36	21.47
V4	13.33	13.97	13.85	13.72	13.68	14.11	13.90	13.90
V5	19.50	24.17	23.17	22.28	19.88	24.40	23.54	22.61
V6	14.33	15.50	14.83	14.89	14.36	15.62	15.00	14.99
V7	15.17	16.17	16.00	15.78	15.28	16.27	16.28	15.94
V8	13.09	14.09	13.92	13.70	13.22	14.13	13.99	13.78
Mean	15.97	18.17	17.70		16.23	18.28	17.88	
	V	T	VXT		V	T	VXT	
SEM (±)	0.079	0.036	0.114		0.070	0.038	0.112	
CD at 5%	0.239	0.103	0.338		0.212	0.110	0.312	
	Number of pods/plant							
Varieties	First Year				Second Year			
	T0	T1	T2	Mean	T0	T1	T2	Mean
V1	17.55	19.17	18.87	18.53	17.85	19.55	19.11	18.84
V2	19.81	21.07	21.20	20.69	20.11	21.15	21.85	21.04
V3	16.09	17.14	17.11	16.78	16.51	17.46	17.28	17.08
V4	15.61	15.96	15.88	15.82	15.85	16.02	16.15	16.01
V5	15.00	16.77	16.97	16.25	15.44	16.85	17.10	16.46
V6	17.32	19.33	18.98	18.54	17.59	19.88	19.49	18.99
V7	18.35	20.64	20.33	19.77	18.61	20.79	20.85	20.08
V8	16.43	17.34	17.42	17.06	16.74	17.49	17.76	17.33
Mean	17.02	18.43	18.34		17.34	18.65	18.70	
	V	T	VXT		V	T	VXT	
SEM (±)	0.315	0.123	0.425		0.290	0.146	0.444	
CD at 5%	0.956	0.355	NS		0.880	0.419	NS	

V1-Lalu, V2- Arka Anamika, V3- Ramya, V4- Satsira, V5- Lady Luck, V6- Debpusa Jhar, V7- Japani Jhar, V8- Barsha Laxmi. T0- Control, T1- *Trichoderma viride,* T2- *Pseudomonas fluorescens.*

amika (13.10 cm) when bio-priming was made with *Trichoderma viride* in first year, and it was Ramya (12.60 cm) in second year after priming with the same bio- inoculants, though influence of *Trichoderma viride* was statistically at par on Arka Anamika and Ramya in second year. Greater influence of *Trichoderma viride* over that of *Pseudomonas fluorescens* could be noted for Lalu, Arka Anamika, Ramya and Satsira in both the years, excepting Arka Anamika in second year. Critical analysis of interaction effect for individual varieties, therefore, clearly indicates its unique response towards seed priming for expression of average pod length. Report on enhancement in pod length of chilli by Rahman *et al*. (2012) after seed treatment with different strains of *Trichoderma sps.* corroborates the present findings on okra.

Pod diameter: It could be noticed through Table 3 that pods with highest diameter were produced by Satsira (15.09 and 15.45 mm) in both the years followed by Lalu and Lady Luck, though these were found to be statistically at par excepting Lady Luck (14.74mm) in second year. Pods with lowest diameter could be noticed for Ramya in all the situations. Pod diameter was grater in second year than that in first year irrespective of the varieties excepting Japani Jhar (13.79 mm), which may be due to favorable environmental condition prevailed in second year. Similar to pod length, pod diameter was also significantly influenced in a greater way after bio-priming with *Trichoderma viride* and *Pseudomonas fluorescens,* and both the bio-inoculants significantly influenced in enhancement of average pod diameter in both years.

Pod weight: Individual pod weight was recorded maximum for Lalu (15.90 and 16.05 g) during both years followed by Ramya and Satsira, and it was lowest for Debpusa Jhar (11.38 and 11.58 g). Significantly similar single pod weight was recorded for Satsira, Arka Anamika and Barsha Laxmi irrespective of the years of experimentation (Table 4). *Trichoderma viride* exerted significantly greater influence on enhancement of single pod weight in comparison to that of *Pseudomonas fluorescens*. Critical consideration of influence of bio-inoculants on individual varieties for expression of this character may indicate that significant greater influence of *Trichoderma viride* was exerted only on Debpusa Jhar and Japani Jhar in all the situations and for Ramya in first year. Both the bio-inoculants failed to influence significantly on Arka Anamika, Lady Luck and Barsha Laxmi irrespective of the years of experimentation. Similar influence of both the bio-inoculants in enhancement of

Table 3. Effect of seed bio-priming on pod length and pod diameter of Okra.

Varieties	Pod length (cm)							
	First Year				Second Year			
	T0	**T1**	**T2**	**Mean**	**T0**	**T1**	**T2**	**Mean**
V1	T0	T1	T2	Mean	T0	T1	T2	Mean
V2	11.23	12.11	11.50	11.61	11.45	12.18	11.64	11.76
V3	10.85	13.10	12.13	12.03	10.96	12.21	12.19	11.79
V4	10.11	12.40	10.95	11.15	10.32	12.60	11.02	11.31
V5	9.21	11.50	9.60	10.11	9.44	10.68	9.72	9.95
V6	10.30	11.59	11.45	11.11	10.45	11.65	11.61	11.24
V7	9.00	9.45	12.35	10.27	9.12	9.59	12.51	10.41
V8	9.95	11.09	10.95	10.66	10.06	11.28	10.96	10.77
Mean	10.10	10.09	10.35	10.18	10.19	10.32	10.63	10.38
	10.09	11.42	11.16		10.25	11.31	11.29	
SEM (±)	**V**	**T**	**VXT**		**V**	**T**	**VXT**	
CD at 5%	0.067	0.050	0.133		0.079	0.061	0.161	

Varieties	Pod diameter (mm)							
	First Year				Second Year			
	T0	**T1**	**T2**	**Mean**	**T0**	**T1**	**T2**	**Mean**
V1	14.15	15.72	14.25	14.71	14.56	15.91	14.65	15.04
V2	12.44	13.79	12.48	12.90	12.58	13.88	12.74	13.07
V3	11.15	13.57	11.91	12.21	11.44	13.76	12.06	12.42
V4	14.91	15.13	15.23	15.09	15.06	15.53	15.75	15.45
V5	14.24	14.80	14.76	14.60	14.29	15.00	14.93	14.74
V6	12.59	12.86	13.17	12.87	12.68	13.11	13.33	13.04
V7	13.73	14.03	13.99	13.92	12.94	14.32	14.12	13.79
V8	13.65	13.96	14.00	13.87	13.80	14.05	14.39	14.08
Mean	13.36	14.23	13.72		13.42	14.45	14.00	
	V	**T**	**VXT**		**V**	**T**	**VXT**	
SEM (±)	0.156	0.078	0.281		1.143	0.076	0.227	
CD at 5%	0.503	0.262	0.786		0.435	0.219	0.667	

V1-Lalu, V2- Arka Anamika, V3- Ramya, V4- Satsira, V5- Lady Luck, V6- Debpusa Jhar, V7- Japani Jhar, V8- Barsha Laxmi. T0- Control, T1- *Trichoderma viride,* T2- *Pseudomonas fluorescens.*

Table 4. Effect of seed bio-priming on pod weight and vegetable yield of Okra

Varieties	Pod weight (g)							
	First Year				Second Year			
	T0	**T1**	**T2**	**Mean**	**T0**	**T1**	**T2**	**Mean**
V1	14.88	16.50	16.33	15.90	14.96	16.69	16.51	16.05
V2	13.55	14.33	13.85	13.91	13.78	14.57	13.93	14.09
V3	14.48	15.75	14.84	15.02	14.65	15.88	15.00	15.18
V4	13.29	14.50	14.63	14.14	13.44	14.69	14.79	14.31
V5	11.76	11.95	12.00	11.90	11.89	12.08	12.19	12.05
V6	9.72	12.67	11.75	11.38	10.02	12.86	11.87	11.58
V7	10.89	13.75	12.00	12.21	10.80	13.96	12.23	12.33
V8	13.80	13.98	14.11	13.96	13.87	14.11	14.33	14.10
Mean	12.79	14.18	13.69		12.93	14.36	13.86	
	V	**T**	**VXT**		**V**	**T**	**VXT**	
SEM (±)	0.166	0.091	0.267		0.177	0.115	0.319	
CD at 5%	0.503	0.262	0.786		0.538	0.331	0.937	

Varieties	Vegetable yield per plant (g)							
	First Year				Second Year			
	T0	**T1**	**T2**	**Mean**	**T0**	**T1**	**T2**	**Mean**
V1	261.25	316.31	308.03	295.20	267.04	326.29	315.51	302.94
V2	268.54	302.05	293.64	288.08	277.12	308.16	304.37	296.55
V3	232.98	269.96	254.02	252.32	241.87	277.27	259.20	259.45
V4	207.51	231.37	232.24	223.71	213.02	235.33	238.86	229.07
V5	176.35	200.46	203.68	193.50	183.58	203.55	208.45	198.53
V6	168.35	244.91	223.08	212.11	176.25	255.66	231.35	221.09
V7	199.83	283.80	244.03	242.55	200.99	290.23	255.00	248.74
V8	226.79	242.41	245.75	238.32	232.18	246.78	254.50	244.49
Mean	217.70	261.41	250.56		224.01	267.91	258.40	
	V	**T**	**VXT**		**V**	**T**	**VXT**	
SEM (±)	5.541	2.683	8.312		5.640	2.754	8.201	
CD at 5%	16.808	7.728	24.508		17.106	7.935	25.060	

V1-Lalu, V2- Arka Anamika, V3- Ramya, V4- Satsira, V5- Lady Luck, V6- Debpusa Jhar, V7- Japani Jhar, V8- Barsha Laxmi. T0- Control, T1- *Trichoderma viride,* T2- *Pseudomonas fluorescens.*

single pod weight over the control was recorded for Lalu and Satsira. Variation in response for change in pod weight after bio-priming over the untreated control may be due to the unique response of the individual varieties. Tanwar *et al.,* (2013) also noted a significant increase in the weight and size of broccoli curds as a response to inoculation with *Trichoderma viride*.

Vegetable yield: Highest vegetable yield per plant was noted with okra variety Lalu (295.20 and 302.94 g) and it was statistically at par with Arka Anamika (288.08 and 296.55g) during both years. Both the bio-inoculants exerted positive influence in enhancement of vegetable yield per plant in both the years, and its influence were significantly similar with each other when average was made over varieties (Table 4). Significantly highest yield per plant was recorded for Lalu (316.31 and 302.94 g) and Arka Anamika (302.05 and 304.37 g) after bio-priming with *Trichoderma viride* over the years. If response of individual varieties is critically analyzed over the years, it could be sharply marked that all the varieties responded in similar manner towards both the bio-inoculants, only exception was recorded for Japani Jhar and in both the years. Greater influence of pre-sowing bio-priming with *Trichoderma viride* could be accounted properly for Japani Jhar in both the years, while both the bio-inoculants failed to exert significant influence in enhancing pod yield per plant over control for Barsha Laxmi in both the years and for Lady Luck in 2012. Variation in vegetable yield per plant among the varieties after pre-sowing bio-priming of seeds with *Trichoderma viride* and *Pseudomonas fluorescens* indicate its unique mode of response based on its genetic constitution. Same result also explains by Rafique *et al.,* (2018) as they noticed that *Pseudomonas* treated seeds improved growth and yield of Okra. Increase in plant height, number of fruits per plant and yield per plant of okra have been recorded by Rai *et al.,* (2014). When seed treatment was made with *T. viride and P. fluorescens., Trichoderma spp.* are capable of hyperparasitsing the pathogenic fungi and recorded to be involved in protection of a number of crop plants (Durrell, 1968; Barnett and Binder, 1973). Bio-agents possess remarkable capacity of multiplication and they multiply in exponential ratio after application and even can overcome stress condition by forming thick wall spores (Bharat *et al.,* 2005). Findings of Naveen Kumar *et al.* (2012) and Janaki *et al*., (2012) on enhancement in vegetable yield of bitter gourd and brinjal respectively corroborate the findings of the present investigation. Higher yield by the application of *Trichoderma* species were reported by Rosa *et al.,* in spring broccoli, Abd Alla and El-Shoraky (2017) in white cabbage and cauliflower.

Conclusion

As both *T. viride* and *P. fluorescens* exerted statistically similar influence on okra varieties *viz.* Lalu, Arka Anamika, Ramya, Satsira, Lady Luck,Debpusa Jhar and Barsha Laxmi, except Japani Jhar, pre-sowing seed bio-priming may be recommended for enhanced vegetable pod yield of okra with both *Trichoderma viride* and *Pseudomonas fluorescens*. Among the varieties Lalu and Arka Anamika may be recommended for experimental region for higher yield.

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