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Studies on sustainable tomato seedling production in plug tray using organic amendments under protected structure

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ABSTRACT

Now a day, plug tray technology is commonly adopted by nurserymen for raising of tomato seedling. After germination of seed, hapless supplementation of inorganic fertilizers, PGR, and plant protection measures affects nursery as well as post-transplant stages of seedlings. So, to protect the environment from chemicals and hazardous polluting products, and maintain the ecological balance, sustainability, and recycling of natural resources for future generations, the present investigation was carried out with different organic amendments viz. Control (T0), Bijamrut + Trichoderma harzianum + Beauveria bassiana (T1), Bijamrut + Trichoderma harzianum + Beauveria bassiana + NPK consortia (T2), Bijamrut + Jivamrut (T3) and Bijamrut + Waste decomposer (T4). The results of the study revealed that, the significantly earliest days to germination (4.07), maximum germination per cent (90.69), the height of seedling at 20 days after sowing (8.00 cm) and at transplanting stage (20.56 cm), minimum days to transplant (28.93) and maximum survival per cent (88.36) of the seedling at transplanting was observed in the application of Bijamrut (200 ml/kg) through seed treatment and media enrichment with Trichoderma harzianum (50 g) and NPK consortia (50 ml) per 10 kg media and foliar spray of Beauveria bassiana (0.6%) at 10 and 20 days after sowing under 50 per cent green shade net.

Keywords: *Bijamrut, Jivamrut, Organic, Plug tray, Protected, Tomato seedling*

INTRODUCTION

India has a diverse climate which ensures the availability of all kinds of fresh vegetables. It ranks second in vegetable production in the world after China. Tomato (Solanum lycopersicum L.) is one of the most important commercial vegetable crops in India, within the last six decades, and plays a vital role in the Indian economy. Tomato is a versatile vegetable crop grown globally and ranks second in importance after potato. From a nutritional point of view, tomato is popularly known as "The Poor Man's Apple" [1].

The fruit is rich in lycopene, which may have beneficial health effects. The red pigment in tomato i.e. lycopene is now being considered as the "world's most powerful natural antioxidant" [2]. Large quantities of tomatoes are used to produce sauce chutney, juice, ketchup, puree, paste, and powder besides fresh consumption. Tomato tops in the canned vegetables.

The production of healthy and vigorous tomato seedlings is the most important factor in the successful production and yield of tomato fruits. Germination of the seed is a critical stage, because the rest of the plant life is directly dependent upon the rate of its germination [3]. Plug tray seedlings have the prime characteristics viz., germinate early, vigorous growth, good root development, and low mortality. It is used for all kinds of seedlings. In the plug tray, soilless media was used and a single seed per cell was sown manually. It was superior as compared over the traditional method of nursery bed.

Organic formulations like Panchagvya, Bijamrita, and Jivamrita are used in organic farming [4]. The organic formulations play a major contribution to their germicidal and growth properties. These are prepared by fermentation process from locally and easily available ingredients at the farm having no major expenditure. These are the best sources of micro-flora which is beneficial and support, and stimulate the growth of the plant in turn which helps in getting better vegetative growth and quality yield of produce [5].

Organic tomato growers are interested to procure quality planting material from nurseries or produce at their own farm. But, there is no any proper module for plug tray tomato seedling production in organic manner. So, given that the present investigation was planned and executed on "Studies on sustainable tomato seedling production in plug tray using organic amendments under protected structure".

MATERIALS AND METHODS

The present investigation was carried out in 104 cavity HDPE plug trays under 50% green shade net condition at Krishi Vigyan Kendra, Sardarkrushinagar Dantiwada Agricultural University, Deesa, Dist. Banaskantha, Gujarat, India in the Kharif season.

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Total five organic amendment treatments viz. Control (T0), Bijamrut + Trichoderma harzianum + Beauveria bassiana (T1), Bijamrut + Trichoderma harzianum + Beauveria bassiana + NPK consortia (T2), Bijamrut + Jivamrut (T3) and Bijamrut + Waste decomposer (T4) were evaluated for three years i.e. 2019 to 2022. Tomato hybrid "Arka Rakshak" was used for the present study. This is a promising one and was released from IIHR, Bangalore, India. Cocopeat and vermicompost (1:1 v/v) media were used in the plug tray.

Preparation of organic amendments

In the present investigation, the different organic amendments were prepared freshly as per the procedure of NCOF, Ghaziabad [6] and applied as per the treatments.

1. Bijamrut: This is a biodynamic preparation commercially exploited for seed treatment in organic farming and reported to suppress many seed-borne diseases. For the preparation of Bijamrut, put 5 kg fresh cow dung in a cloth bag and suspend in a container filled with water to extract the soluble ingredients of dung. Suspend 50 g lime in one liter of water separately. After 12-16 hours, squeeze the bag to extract all the ingredients of cow dung and add 5 liter of cow urine, 50 g of virgin forest soil, prepared lime water, and 20 liter water. Again incubate the preparation for 8-12 hours. Filter the content and this filtrate is ready for seed treatment. Amount of Bijamrut applied on seed which can make a layer over it and dry it in shade before sowing.

2. Jivamrut: This acts as a biostimulant by promoting the activity of microorganisms in the soil and also the activity of phyllosphere microorganisms when spayed on foliage. It acts as a primer for microbial activity, and also increases the population of native earthworms. For the preparation of Jivamrut, cow dung 10 kg, cow urine 10 liter, jaggary 2 kg, gram flour 2 kg and soil under live tree 1 kg were taken in 200 liters capacity drum and the volume was made up to 200 liters with the addition of water. The drum was kept in the shade and stirred thrice in a day and covered it. After one week, Jivamrut was ready and it was used application.

Waste decomposer: This culture is used for quick composting from organic waste, soil health improvement, and as a plant protection agent. It is a consortium of microorganisms extracted from desi cow dung. For the preparation of waste decomposer, jaggary 2 kg was taken in 200 liters capacity drum and the volume was made up to 200 liters with the addition of water. Add 30 g of waste decomposer in a plastic drum containing jaggery solution. Avoided direct contact of contents with hands and mixed it properly with a wooden stick. Covered the drum and stirred it every day once or twice. After 5 days the solution of the drum turned creamy and then it was used for application.

METHOD OF APPLICATION

1. Seed treatment: Bijamrut @ 20 liter/100 kg seed.

2. Media treatment: Trichoderma harzianum 50 g/10 kg media; NPK consortia 50 ml/10 kg media.

3. Foliar spray: Beauveria bassiana (0.6%), waste decomposer (40%) and Jivamrut (4%).

4. Foliar spray of Beauveria bassiana @ 10 and 20 DAS; waste decomposer and Jivamrut @ 10, 17 and 24 DAS.

The experiment was laid out in a Completely Randomized Design as described by [7] with five replications. The treatments were evaluated and observations were recorded periodically concerning germination, growth, and survival of seedlings.

Results and Discussion

Effect of organic amendments on days to germination and germination per cent of tomato seedlings

Three year pooled data presented in Table 1 showed that the earliest days to germination (4.07) was observed in the treatment T2 (Bijamrut + Trichoderma harzianum+ Beauveria bassiana + NPK consortia) which was followed by (4.27 days) in the treatment T1(Bijamrut + Trichoderma harzianum + Beauveria bassiana) as well as treatment T3 (Bijamrut + Jivamrut). Whereas, the maximum days taken for germination (4.87) was recorded in the treatment T0(control).

Similarly, maximum germination per cent (90.69) was recorded in the treatment T2(Bijamrut + Trichoderma harzianum + Beauveria bassiana + NPK consortia) which was significantly maximum among all the treatment. Whereas, the minimum germination per cent (72.02) was recorded in the treatment T0(control).

Many investigators have confirmed the result of higher seed germination percentage in Bijamrita treated seeds might be due to the presence of useful bacteria in Bijamrita, which may produces Indole acetic acid (IAA) and Gibberellic acid (GA) as reported by [8] and [9].

Effect of organic amendments on plant height at 20 DAS and at transplanting of tomato seedlings

The three-year pooled data presented in Table 2 indicated that the maximum height of seedling at 20 days after sowing (8.00 cm) was recorded in the treatment T2(Bijamrut + Trichoderma harzianum + Beauveria bassiana + NPK consortia) which was significantly highest among all the treatment. Whereas, the lowest height of seedling at 20 DAS (5.78 cm) was recorded in the treatment T0(control).Similarly, the plant height at the transplanting stage (20.56 cm) was also recorded as maximum in the treatment T2(Bijamrut + Trichoderma harzianum + Beauveria bassiana + NPK consortia) which was also significantly highest among all the treatment. Whereas, the lowest height of the seedling at the transplanting stage (16.35 cm) was recorded in the treatment T0(control). Combined application of coir pith and vermicompost in the treatment showed a significant effect on seedlings growth parameters, due to the synergistic combination of both factors in improving the physical conditions of the media and nutritional factors [10].

Organic treatments supply micro and macro-nutrients to crops resulting in improved growth and yield [11].

Effect of organic amendments on days to transplant and survival per cent at transplanting of tomato seedlings

The data depicted in the Table 3 indicated that the significant minimum days to transplant (28.93) and maximum survival per cent of the seedlings (88.36) at transplanting were recorded in the treatment T2(Bijamrut + Trichoderma harzianum + Beauveria bassiana + NPK consortia). Whereas, the maximum days to transplant (33.93) and lowest survival per cent of a plant at translating (68.21) were recorded in the treatment T0 (control).

These results might be due to the slow release of nutrients from organic manures and when supplemented with inorganic and biofertilizers it helped to microorganisms in the faster decomposition of organic manures, thereby increasing the availability of nutrients [12].

Many investigators have confirmed the beneficial microorganisms present in Bijamrita and Jivamrita might be virtue of their constituents such as desi cow dung and urine, legume flour and jaggery containing both macro, and essential micro-nutrients, vitamins, essential amino acids, growth-promoting substances viz., Indole Acetic Acid, Gibberellic Acid and beneficial microorganisms [13 and 14].

CONCLUSION

The findings of the present investigation revealed that, as per pooled data significantly earliest germination, maximum germination per cent, highest height of seedling at 20 days after sowing and at transplanting stage, minimum days to transplant and maximum survival per cent of the seedling at transplanting of tomato in HDPE plug tray was observed in the application of Bijamrut (200 ml/kg) through seed treatment and media enrichment [Cocopeat + vermicompost (1:1 v/v)] with Trichoderma harzianum (50 g) and NPK consortia (50 ml) per 10 kg media and foliar spray of Beauveria bassiana (0.6%) at 10 and 20 days after sowing under 50 per cent green shade net.

Conflict of interest

The authors declare that no conflict of interest exists.

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Table 1 Effect of organic amendments on days taken for germination and germination per cent of tomato seedling

Treatments	Days taken for germination				Germination per cent			
	2019	2020	2021	Pooled	2019	2020	2021	Pooled
(T_0) Control	4.80	5.00	4.80	4.87	71.77	73.97	70.32	72.02
(T_1) Bijamrut + *Trichoderma harzianum* + *Beauveria bassiana*	4.00	4.60	4.20	4.27	83.23	87.94	86.67	85.94
(T_2) Bijamrut + *Trichoderma harzianum* + *Beauveria bassiana* + NPK consortia	4.00	4.20	4.00	4.07	90.48	90.48	91.11	90.69
(T_3) Bijamrut + Jivamrut	4.00	4.40	4.40	4.27	81.13	85.24	84.60	83.66
(o_4) Bijamrut + Waste decomposer	4.00	4.80	4.60	4.47	80.64	84.28	84.13	83.02
SEm ±	0.08	0.20	0.28	0.13	1.46	1.11	1.22	0.82
C.D. at 5%	0.26	NS	NS	0.36	4.31	3.27	3.61	2.31
Year x Treatment								
SEm ±				0.21				1.27
C.D. at 5%				NS				NS
C.V. (%)	4.81	9.72	14.37	10.53	4.01	2.94	3.29	3.43

Table 2 Effect of organic amendments on plant height at 20 DAS and at transplanting of tomato seedling

Treatments	Plant height (cm) at 20 DAS				Plant height at transplanting			
	2019	2020	2021	Pooled	2019	2020	2021	Pooled
(T_0) Control	5.59	5.87	5.86	5.78	15.90	16.82	16.32	16.35
(T_1) Bijamrut + *Trichoderma harzianum* + *Beauveria bassiana*	6.79	7.03	6.81	6.88	19.10	18.91	19.38	19.13
(T_2) Bijamrut + *Trichoderma harzianum* + *Beauveria bassiana* + NPK consortia	7.78	8.24	7.99	8.00	20.26	20.81	20.61	20.56
(T_3) Bijamrut + Jivamrut	6.19	6.45	6.42	6.35	18.16	18.92	18.58	18.55
(T_4) Bijamrut + Waste decomposer	6.00	6.38	6.18	6.18	18.07	18.61	18.09	18.26
SEm ±	0.19	0.19	0.12	0.11	0.29	0.47	0.28	0.22
C.D. at 5%	0.57	0.58	0.35	0.29	0.87	1.39	0.83	0.62
Year x Treatment								
SEm ±				0.17				0.36
C.D. at 5%				NS				NS
C.V. (%)	6.73	6.47	4.06	5.87	3.62	5.61	3.40	4.34

Table 3 Effect of organic amendments on days to transplant and survival per cent at transplanting of tomato seedling

Treatment	Days to transplant				Survival per cent at transplanting			
	2019	2020	2021	Pooled	2019	2020	2021	Pooled
(T_0) Control	34.00	34.40	33.40	33.93	67.70	70.80	66.10	68.21
(T_1) Bijamrut + *Trichoderma harzianum* + *Beauveria bassiana*	33.60	34.40	32.20	33.40	80.00	84.70	83.40	82.67

(T_2) Bijamrut + *Trichoderma harzianum* + *Beauveria bassiana* + NPK consortia	29.00	29.40	28.40	28.93	88.10	88.10	88.90	88.36
(T_3) Bijamrut + Jivamrut	30.80	31.20	30.60	30.87	78.70	82.20	81.60	80.86
(T_4) Bijamrut + Waste decomposer	32.80	33.20	31.80	32.60	77.60	79.30	81.10	79.37
SEm ±	0.21	0.33	0.33	0.19	1.41	0.96	1.23	0.71
C.D. at 5%	0.64	0.98	0.98	0.54	4.14	2.81	3.63	1.44
Year x Treatment								
SEm ±				0.30				1.20
C.D. at 5%				NS				NS
C.V. (%)	1.53	2.30	2.39	2.11	4.01	2.64	3.44	3.18

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