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Impact of addition of Vermicompost on Vegetable Plant Growth

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Abstract

Effect of addition of vermicompost on the vegetable plant growth was evaluated. The percentage of seed germination was 96.74, 84.32 and 92.35 percentage when the seeds of okra, brinjal and chilli were planted in 50 percentage vermicompost containing soil. Higher percentage seed germination of tomato was recorded in 75 percentage vermicompost containing soil. Significant early germination of 4.53 and 4.77 days was recorded, when the seeds of okra and brinjal sowed in the vermicompost incorporated soil. Increased root and shoot length was registered when the seeds were sown in 50 percentage vermicompost containing soil. Root length of okra was 7.07, 9.13, 13.03 cm and chilli was 5.80, 7.60, 10.90 cm attained at 30, 60 and 90 days after planting when treated with 50 percentage vermicompost containing soil. The shoot length of okra, chilli, brinjal and tomato was ranged from 33.47 to 61.50 cm and from 29.57 to 66.60 cm and from 47.27 to 81.40 cm and from 51.67 to 95.73 cm. The influence of vermicompost on branch and leaf number was high when compared to untreated control. The branch number of okra, chilli, brinjal and tomato were ranged from 4.00 to 8.00 cm, 11.67 to 19.67 cm, 9.33 to 18.33 cm and 14.00 to 19.33 cm, respectively. The leaf number was recorded as 14.00, 27.33, 17.33 and 17.00 cm in okra, chilli, brinjal and tomato when planted in vermicompost mixed soil.

Keywords: Vermicompost, Germination.

Introduction

Proliferation of industrial concerns and other anthropogenic activities in recent years have increased the concentration of different pollutants in various ecosystems causing environmental degradation[1]. Huge amount of waste water is produced in the cities due to increasing population. Indiscriminate disposal of such sewage and industrial waste water causes soil and water pollution. However, the waste water has been used in agriculture as a source of irrigation. In recent years, emphasis on use of organic manures like fly ash manure, sewage sludge and urban compost in crop production has assumed increased importance due to pressure on organic agriculture. The value of vermicompost as an organic manure has been well recognized for utilizing in agriculture as it contains valuable nutrients, inorganic form besides being a very effective soil ameliorant[2]. Composting is one of the best methods of recycling to improve soil fertility and reduce the environmental pollution. Biodegradable wastes were used in vegetable cultivation without much processes and restore soil fertility as they have a large nutrient value[3,4]. Nowadays deficiencies in soil organic matter and reduced yield of crop are alarming problem.

The Krishnan Anaikattu Kulam (KAK pond) situated in Pollachi (Coimbatore district in Tamilnadu, India) was polluted with discharge of domestic and industrial wastes from the town. The soil of the pond was also loaded with excess amount of pollutants from the wastes and unable for human use. The farmers of nearby area were using the pond soil for organic cultivation. Limited studies were done for the evaluation on the impact of vermicompost on vegetable plant growth[5]. Hence a study was conducted on the evaluation of impact on incorporated vermicompost with polluted pond soil on vegetable plant growth.

Material and Methods

Soil was collected from the KAK pond and dried under shade to amend with vermicompost. Different ratios of soil and vermicompost were prepared and divided into four groups. The physico-chemical parameters of the amended soil were analyzed[6] (table - 1).

Control	Pond Soil
T_1	1 kg of soil + 250 gm of vermicompost (25%)
T_2	1 kg of soil + 500 gm of vermicompost (50%)
T_3	1 kg of soil + 750 gm of vermicompost (75%)
T_4	1kg of soil + 1000 gm of vermicompost (100%)

Seeds of Okra, Brinjal, Chilli and Tomato were purchased from seed sales depot. of Tamilnadu Agricultural University, Coimbatore. The experiments were conducted by filling various percentages of vermicompost concentrations separately in a pot (12"height and 10"diameter). 10 healthy seeds from each plant variety were sown in different pots and watered regularly. Five replications were maintained for each treatment. Observations were recorded on percentage germination, germination period and root length, shoot length, number of branches, number of leaves and yield after for 30, 60 and 90 days after planting. The results were recorded by using centimeter scale and counting method and statistically analyzed.

Results and Discussion

Seed Germination: The influence of vermicompost on the germination of different vegetable crops was revealed that the maximum germination of 96.74, 84.32 and 92.35% were noticed in okra, brinjal and chilli with the treatment T_2 and the minimum germination was noticed as 80.6, 68.63 and 75.72% in control plants. In tomato plant, maximum germination of 97.78 % was observed at treatment T_3 and the minimum of 60.25% in control treatment. The values were found to be statistically significant (table-2). 100 percentage seed germination observed in groundnut when seeds were planted in 10 kg soil containing 200 gm of vermicompost[7]. 71.42 and 88.00 percentage of seed germination registered when the seeds of soybean and urad were planted in the soil containing vermicompost[8]. The result of the present study showed that early germination was noticed in okra (4.53 days), and tomato (4.77 days) in T_4 treatment, whereas in brinjal (7.50 days) and chilli plant (7.27 days) in T_2 and T_3 treatments, respectively. The germination period of control plants varied from 6.03 to 8.87 days in okra, brinjal, tomato and chilli. Vermicompost influences seed germination, chlorophyll concentration and yield[9]. 46.60% of seed germination was recorded in guva when vermicompost and plant growth promoting bacteria is added with soil[10].

Root and Shoot Length: The maximum root length of okra was 7.07, 9.13, 13.03 cm and chilli was 5.80, 7.60, 10.90 cm noticed in the T_2 vermicompost concentration at 30, 60, 90 days of exposure. Incorporation of vermicompost at 10, 20, 30, 40, 50 and 60 % along with the base medium resulted increase of plant height and lateral shoot length[11]. Vermicompost incorporated soil and potting substrates has enhanced plant growth[12]. In brinjal and tomato the maximum root length was 6.97, 9.47, 13.37 cm and 8.77, 12.00, 15.30 cm while treating with T_3 vermicompost (table-3). The maximum shoot length was recorded in okra and chilli as 33.47, 46.58, 61.50, 29.57, 38.93 and 66.60 cm in T_2 vermicompost concentration (table - 4). When *H. sabdariffa* and *P. anrens* seeds were planted in the soil containing 10 % vermiwash resulted in increase root and hypocotyls length[13]. In brinjal the maximum shoot length was 47.27, 61.70, 81.40 cm and in tomato it was 51.67, 74.53, 95.73 cm were noticed in T_3 vermicompost concentration after 30, 60 and 90 day of planting (table - 4). The plant growth parameters such as root and shoot length, leaf and flower numbers were attained maximum only when treated with 75 percentage vermicompost concentration[14]. The maximum branch number was noticed in the plants like red gram and okra grown in 50 percentage vermicompost concentrations at 30, 60 and 90 days period of exposure. Incorporation of earthworm compost increased plant growth, expansion of thickness of stem with more flowers in marigold[15].

Branch and Leaf Number: The influence of vermicompost on branch number study revealed that in okra the maximum numbers were 4.00, 6.00, 8.00 and in chilli the maximum numbers were 11.67, 15.67, 19.67 were noticed in T_2 vermicompost concentration at 30, 60 and 90 days of exposure period respectively (table - 5). This is correlated with the findings of Pathak *et al*., (2013). They found increased number of leaves in guva while incorporating phospho bacteria with vermicompost[10]. Plant vigour, leaf number, length and breath, stem length and breath, weight of the plant, percentage of dry matter of plant and yield in red amaranth (*Amaranthus tricolor L.*) when it was exposed to 10 tons of vermicompost in combination with 100% of NPK[16]. In brinjal and tomato the maximum branch number was noticed as 9.33, 13.33, 18.33 and 14.00, 17.67, 19.33 after 30, 60 and 90 days when planted in T_3 vermicompost concentration. The influence of vermicompost on leaf number study revealed that the maximum leaf number in okra 9.00, 13.00, 14.00 and in chilli 17.33, 22.33 and 27.33 were noticed in T_2 concentration. Addition of vermicompost from 10 to 60 percentages along with base medium resulted in increased number of leaves and stem diameter in marigold, *Calendula officinalis*[13].

In brinjal and tomato the maximum leaf number of 11.67, 17.00, 17.33 and 9.33, 12.33, 17.00 were noticed in T_3 vermicompost concentration at 30, 60 and 90 days of exposure (table - 6). Positive impact on quantitative morphology of different crops using different vermicompost[17,18]. Application of vermicompost increases the leaf yield[19]. Amplification of grain and straw yield due to conjunctive use of sewage sludge and urban compost alone are in conformity with the earlier findings in paddy[20, 21]. In the present study okra and chilli recorded maximum leaf and branch numbers in T_2 and brinjal and tomato in T_3 vermicompost concentration when compared to control plants.

Yield: The influence of vermicompost on fruit numbers revealed that in okra the maximum of 5.33 was observed in T_2 and minimum in control plant as 2.00 (table - 7). The present findings were comparable with the earlier research reports[22]. Improvement of yield is possibly due to plant growth regulators released by the microbes and humates of vermicompost[23, 24]. Application of vermicompost showed improved soil fertility, greater uptake of nutrients and yield[25]. Various vermicompost in different concentrations had positive impact on the growth of tomato as compared with the seedlings of control in which no vermicompost as well as fertilizer was added[26]. Amendment of vermicompost with sheep manure assisted better juice production in tomato[27]. Growth in 100 % vermicompost is usually less than in substitution rate of 20-40%. This can be partially explained by possibilities for large amount of inorganic salts in 100 % vermicompost[28]. Present results also supported the above views that in T_4 concentration the growth rate was minimized when compared to other concentrations. Higher growth percentage of wheat, paddy and sugarcane achieved when vermicompost incorporated with soil[17,29-31,].

Conclusion

The present study proved that the majority of yield parameter was noticed maximum in T_2 and T_3 vermicompost concentration. It could be suggested that the better yield in all the plants tested may

be due to the influence of combined effect of various ingredients of vermicompost such as macro and micro nutrients and plant growth hormones. In T_2 concentration the plants like okra and chilli performed well both in germination and growth parameters. In yield parameter the chilli performed little higher in T_3 concentration, whereas brinjal and tomato showed maximum germination and growth in T_3 vermicompost concentration. Hence, it is concluded that the addition of vermicompost with soil enhanced the soil fertility, nutrient up take, plant growth and yield of vegetable plants.

Table - 1
Nutrient status of soil

Treatment	pH	Electrical conductivity	Nitrogen	Phosphorus	Potash	Iron	Manganese	Zinc	Copper
Control	7.6 ± 0.04	1.2 ± 0.01	112 ± 0.81	14.5 ± 0.01	435.6 ± 0.41	7.15 ± 0.06	3.11 ± 0.02	1.08 ± 0.04	0.77 ± 0.02
T_1	7.5 ± 0.12	1.80 ± 0.06	104 ± 1.2	14.67 ± 0.12	500.4 ± 0.33	6.62 ± 0.02	2.97 ± 0.03	1.04 ± 0.03	0.63 ± 0.05
T_2	7.4 ± 0.02	2.07 ± 0.03	122 ± 0.98	14.5 ± 0.03	500.4 ± 0.25	6.89 ± 0.10	4.12 ± 0.01	1.12 ± 0.02	0.68 ± 0.01
T_3	7.5 ± 0.08	1.89 ± 0.09	106 ± 0.31	10.71 ± 0.18	500.7 ± 0.29	7.12 ± 0.01	2.92 ± 0.04	1.22 ± 0.01	0.72 ± 0.02
T_4	7.5 ± 0.10	2.31 ± 0.11	115 ± 0.05	9.06 ± 0.05	500.6 ± 0.26	6.95 ± 0.03	3.13 ± 0.02	1.06 ± 0.03	0.66 ± 0.04

Values given in each cell is the mean ± SD of five replicates. Electrical Conductivity expressed in dS^{m-1}, Nitrogen, Phosphorous and Potash were expressed in kg/acre, Iron, Manganese, Zinc, Copper were expressed in ppm.

Table - 2
Influence of vermicompost on the period and percentage of germination of vegetable crops

Treatment	Okra		Brinjal		Tomato		Chilli	
	Germination (days)	Percentage germination	Germination (days)	Percentage germination	Germination (days)	Percentage germination	Germination (days)	Percentage germination
Control	6.23 ± 0.37a	80.6	8.87 ± 0.21a	68.63	6.03 ± 0.17a	60.25	8.07 ± 0.12a	75.72
T_1	5.47 ± 0.33db	89.7	7.67 ± 0.17b	72.44	6.27 ± 0.41a	69.50	8.40 ± 0.16a	79.81
T_2	5.80 ± 0.08b	96.74	7.50 ± 0.29cb	84.32	5.87 ± 0.21b	94.75	7.53 ± 0.26b	92.35
T_3	5.17 ± 0.21eb	94.05	8.37 ± 0.25a	81.84	5.03 ± 0.17c	97.78	7.27 ± 0.39b	90.82
T_4	4.53 ± 0.25c	92.50	8.30 ± 0.45a	82.34	4.77 ± 0.12dc	86.53	8.43 ± 0.29a	89.63
CD (p<0.05)	**0.40**		**0.51**		**0.48**		**0.43**	

Values given in each cell is the mean ± SD of five replicates

Table - 3
Influence of vermicompost on the root length (cm) of vegetable crops

Exposure period in days	Treatment	Okra	Brinjal	Tomato	Chilli
	Control	4.97 ± 0.63	4.20 ± 0.37	6.10 ± 0.73	3.80 ± 0.71
	T_1	5.80 ± 0.71	5.77 ± 0.29	7.20 ± 0.49	4.73 ± 0.34
30 days	**T_2**	7.07 ± 0.48	6.30 ± 0.73	8.10 ± 0.24	5.80 ± 0.49
	T_3	5.23 ± 0.37	6.97 ± 0.42	8.77 ± 0.37	5.07 ± 0.62
	T_4	4.23 ± 0.33	5.63 ± 0.54	6.30 ± 0.99	4.27 ± 0.90
	Control	6.13 ± 0.68	6.27 ± 0.34	9.17 ± 0.21	5.53 ± 0.54
	T_1	7.60 ± 0.45	8.03 ± 0.33	9.90 ± 0.57	6.60 ± 0.57
60 days	**T_2**	9.13 ± 0.29	8.87 ± 0.57	11.03 ± 0.17	7.60 ± 0.43
	T_3	7.20 ± 0.45	9.47 ± 0.57	12.00 ± 0.59	6.80 ± 0.50
	T_4	6.07 ±0.34	7.47 ± 1.00	8.30 ± 0.80	6.63 ± 0.48
	Control	8.87 ± 0.56	9.40 ± 0.57	11.93 ± 0.52	8.50 ± 0.43
	T_1	11.37 ± 1.02	11.17 ± 0.86	12.77 ± 0.59	9.57 ± 0.46
90 days	**T_2**	13.03 ± 0.33	11.53 ± 0.80	13.10 ± 0.51	10.90 ± 0.57
	T_3	10.07 ± 0.34	13.37 ± 1.02	15.30 ± 0.62	10.17 ± 0.78
	T_4	9.10 ± 0.24	10.83± 0.60	11.30 ± 0.67	9.27 ± 0.86
CD (p<0.05)		**1.022**	**1.36**	**1.30**	**1.42**

Values given in each cell is the mean ± SD of five replicates

Table - 4
Influence of vermicompost on the shoot length (cm) of vegetable crops

Exposure period in days	Treatment	Okra	Brinjal	Tomato	Chilli
	Control	4.97 ± 0.63	4.20 ± 0.37	6.10 ± 0.73	3.80 ± 0.71
	T_1	5.80 ± 0.71	5.77 ± 0.29	7.20 ± 0.49	4.73 ± 0.34
30 days	**T_2**	7.07 ± 0.48	6.30 ± 0.73	8.10 ± 0.24	5.80 ± 0.49
	T_3	5.23 ± 0.37	6.97 ± 0.42	8.77 ± 0.37	5.07 ± 0.62
	T_4	4.23 ± 0.33	5.63 ± 0.54	6.30 ± 0.99	4.27 ± 0.90
	Control	6.13 ± 0.68	6.27 ± 0.34	9.17 ± 0.21	5.53 ± 0.54
	T_1	7.60 ± 0.45	8.03 ± 0.33	9.90 ± 0.57	6.60 ± 0.57
60 days	**T_2**	9.13 ± 0.29	8.87 ± 0.57	11.03 ± 0.17	7.60 ± 0.43
	T_3	7.20 ± 0.45	9.47 ± 0.57	12.00 ± 0.59	6.80 ± 0.50
	T_4	6.07 ±0.34	7.47 ± 1.00	8.30 ± 0.80	6.63 ± 0.48
	Control	8.87 ± 0.56	9.40 ± 0.57	11.93 ± 0.52	8.50 ± 0.43
	T_1	11.37 ± 1.02	11.17 ± 0.86	12.77 ± 0.59	9.57 ± 0.46
90 days	**T_2**	13.03 ± 0.33	11.53 ± 0.80	13.10 ± 0.51	10.90 ± 0.57
	T_3	10.07 ± 0.34	13.37 ± 1.02	15.30 ± 0.62	10.17 ± 0.78
	T_4	9.10 ± 0.24	10.83± 0.60	11.30 ± 0.67	9.27 ± 0.86
CD (p<0.05)		**1.022**	**1.36**	**1.30**	**1.42**

Values given in each cell is the mean ± SD of five replicates

Table - 5
Influence of vermicompost on the branch number of vegetable crops

Exposure period in days	Treatment	Okra	Brinjal	Tomato	Chilli
	Control	2.33 ± 0.61	5.00 ± 0.80	8.67 ± 0.33	5.67 ± 0.36
	T_1	2.67 ± 0.57	7.33 ± 0.52	10.00 ± 0.62	7.33 ± 0.43
30 days	**T_2**	4.00 ± 0.82	8.00 ± 0.79	11.67 ± 0.57	11.67 ± 1.31
	T_3	3.67 ± 0.52	9.33 ± 0.47	14.00 ± 0.82	10.33 ± 1.12
	T_4	3.00 ± 0.41	6.67 ± 0.41	11.00 ± 0.64	8.67 ± 0.71
	Control	3.67 ± 0.43	8.00 ± 0.63	11.00 ± 0.81	9.67 ± 0.46
	T_1	4.33 ± 0.46	11.00 ± 0.72	12.67 ± 0.94	11.67 ± 0.41
60 days	**T_2**	6.00 ± 0.82	10.67 ± 0.29	14.67 ± 0.85	15.67 ± 1.03
	T_3	5.33 ± 0.37	13.33 ± 0.22	17.67 ± 1.21	13.00 ± 0.81
	T_4	4.67 ± 0.53	10.33 ± 0.49	12.67 ± 1.07	12.33 ± 0.86
	Control	5.67 ± 0.41	11.33 ± 1.05	14.00 ± 1.63	13.67 ± 0.45
	T_1	6.00 ± 0.82	14.33 ± 1.23	14.33 ± 1.25	16.33 ± 0.92
90 days	**T_2**	8.00 ± 0.82	15.33 ± 1.18	16.67 ± 0.94	19.67 ± 1.14
	T_3	7.33 ± 0.54	18.33 ± 0.47	19.33 ± 0.47	17.00 ± 0.80
	T_4	6.67 ± 0.38	13.33 ± 0.57	18.33 ± 0.32	16.67 ± 1.11
CD (p<0.05)		**1.44**	**1.40**	**1.93**	**1.87**

Values given in each cell is the mean ± SD of five replicates

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Table - 6
Influence of vermicompost on the leaf number of vegetable crops

Exposure period in days	Treatment	Okra	Brinjal	Tomato	Chilli
	Control	5.67 ± 0.45	5.67 ± 0.47	5.33 ± 0.37	11.00 ± 0.82
	T_1	7.00 ± 0.82	7.33 ± 0.43	6.33 ± 0.42	14.00 ± 0.82
30 days	**T_2**	9.00 ± 0.80	10.33± 1.25	7.33 ± 0.48	17.33 ± 0.41
	T_3	6.67 ± 1.25	11.67± 1.25	9.33 ± 0.51	15.67 ± 0.43
	T_4	5.33 ± 0.41	8.67 ± 0.37	7.0 ± 0.82	14.67 ± 0.37
	Control	7.00 ± 0.81	12.33 ± 0.53	8.33 ± 0.44	16.00 ± 0.82
	T_1	9.00 ± 0.68	13.33 ± 0.47	9.33 ± 0.42	18.67 ± 0.27
60 days	**T_2**	13.00 ± 0.64	14.67 ± 0.32	11.0 ± 0.82	22.33 ± 0.35
	T_3	9.00 ± 0.52	17.00 ± 0.82	12.33 ± 0.41	21.0 ± 1.41
	T_4	10.00 ± 0.42	13.00 ± 0.81	10.00 ± 0.82	19.67 ± 0.36
	Control	8.33 ± 0.47	11.00 ± 0.82	12.33 ± 0.38	22.00 ± 0.82
	T_1	11.33 ± 1.25	14.00 ± 0.76	13.33 ± 0.41	23.67 ± 0.33
90 days	**T_2**	14.00 ± 1.63	15.67 ± 0.43	14.67 ± 0.47	27.33 ± 0.42
	T_3	11.00 ± 0.64	17.33 ± 0.47	17.00 ± 0.82	26.00 ± 0.82
	T_4	12.00 ± 0.82	14.67 ± 0.35	13.00 ± 0.79	24.67 ± 0.46
CD (p<0.05)		**1.81**	**1.24**	**1.40**	**1.32**

Values given in each cell is the mean ± SD of five replicates

Table - 7
Influence of vermicompost on the fruit number of vegetable crops

Treatment	Okra	Brinjal	Tomato	Chilli
Control	2.00 ± 0.82c	3.67 ± 0.47d	4.67 ± 0.47e	6.67 ± 0.94d
T_1	3.67 ± 0.94b	4.67 ± 0.54b	6.00 ± 1.63d	8.00 ± 0.82b
T_2	5.33 ± 0.43a	5.00 ± 0.52a	9.67 ± 1.70b	13.33 ± 1.25a
T_3	4.00 ± 0.78a	6.00 ± 0.82a	13.33 ± 1.25a	14.33 ± 3.30a
T_4	4.00 ± 0.82a	4.00 ± 0.73c	8.67 ± 0.94c	10.00 ± 0.82b
CD (p<0.05)	**1.93**	**1.26**	**1.55**	**2.81**

Values given in each cell is the mean ± SD of five replicates

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