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Efficient Utilization of Agro-industrial Waste through Vermicomposting and its Impact on Growth and Yield of Brinjal (*Solanum melongena* L.)

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ABSTRACT

Background: Application of vermicompost produced from diverse organic wastes could be one of the most economical and attractive methods of solving waste disposal problem and increasing the nutrient contents of soil simultaneously. Vermicompost is used as an organic fertilizer, the effects of vermicompost obtained from different organic wastes on plant growth and yield.

Methods: The vermicomposting of sugarcane trash and bagasse waste was carried out during (January-March) and by using the vermicompost a field culture experiment was conducted in brinjal for three months from April-June, 2019. There are 6 treatments namely T_1-T_6 and control. Vegetative parameters such as shoot length, root length, number of leaves, fresh weight and dry weight at different stages (30, 60 and 90 DAS), number of flowers and number of branches on 60 and 90 DAS. On 90th day yield characters like number of fruits, diameter of fruits, fruit length, single fruit weight, fruit yield per plant and fruit yield per plot were analyzed.

Result: A significant increase in shoot length (32.9, 55.3 and 98.5), root length (17.85, 25.10 and 33.30), number of leaves (21.33, 50.00 and 77.00), fresh weight (31.10, 48.30 and 55.55) and dry weight (7.10, 7.95 and 9.30) was observed in T_5-C_5 (Predecomposted Sugarcane bagasse, *Trichoderma asperelloids* and earthworm (*Eudrilus eugeniae*) 5t/h) treatment, followed by T_2 - C_2 (Predecomposted Sugarcane trash, *Trichoderma asperelloids* and earthworm (*Eudrilus eugeniae*) 5t/h) treatment on 30, 60 and 90 DAS. A significant increase in number of flowers (27.50 and 55.50) and number of branches (22.50 and 27.50) was observed in T_5 treatment followed by other treatments on 60 and 90 DAS. The maximum amount in number of fruits (22.00), fruit length (15.70), single fruit weight (93.15), fruit yield per plant (10.35) and fruit yield per plot (37.25) were noted in T_5 treatment, followed by T_2 treatment on 90 DAS and minimum amount were reported in control (soil). The results of the study clearly indicated that treatment T_5 significantly increased the vegetative parameters and yield characters in brinjal.

Key words: Bagasse, Brinjal, Control, DAS, *Eudrilus eugeniae,* Sugarcane trash, *Trichoderma asperelloids*.

INTRODUCTION

Organic manures for growing crops are a composition of waste materials. Composting of organic waste offers solution to large amounts of waste worldwide. Vermicomposting is a type of organic farming by which earthworms breakdown organic waste materials, stimulate microbial activity and at the same time, increase the rate of mineralization of the soil. The technique of organic farming plays a role in cultivation of high value of vegetable crops. Application of vermicompost to field soils have also been reported to increase crop growth and yields. Sugarcane is one of the important cash crops in India and plays essentials role in both agricultural and industrial economy of the country. India approximately 6.5 million tonnes of sugar cane trash are being produced every year and most of the residues are usually burnt in the field due to lack of proper composing techniques. Besides the loss of organic matter and plant nutrients, burning of crop residues also causes atmospheric pollution due to the emission of toxic gases methane, carbon dioxide that poses threat to human and ecosystem. Insitu composting of cane trash can be a good alternate to mitigate these problem Viji and Neelanarayanan (2016). Bagasse is composed largely of cellulose, pentose and lignin. It is made up of 45-55% of cellulose, 20-25% of hemicelluloses and 18-24% lignin Surya *et al*. (2015). Brinjal popularly known as egg plant belongs to family solanaceae, one of most common vegetable crops grown in India. Brinjal is staple vegetable in almost all tropical countries in the world and utilized by both poor and rich. Its nutritive value varies among varieties. It contains vitamin A and B. The brinjal fruit contains moisture 92.7 g, protein 1.4 g, phosphorous 47 mg, iron 0.9 mg, vitamin C 10 mg, riboflavin 0.11 mg, thiamine 0.04 mg more while brinjal may have the medicinal property. White brinjal which is used for Diabetics

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patients (Palia *et al*., 2021). The main objectives of the present investigation was to evaluate the impact of sugarcane trash and bagasse on growth and yield parameters in brinjal (*Solanum melongena* L.).

MATERIALS AND METHODS

The present study was conducted from January to March 2019 at Alanthurai (10.9536 N, 76.7885 E) Coimbatore, Tamil Nadu India. The method adopted for decomposition of agro waste sugarcane trash and bagasse was pit composting and subjected to field experiment using randomized block design with three replications.

Collection of agro-industrial waste

The agro industrial waste of sugarcane trash and sugarcane bagasse was collected from in and around Coimbatore. It was chopped into small pieces, sun dried and stored in bags.

Compost pit preparation

The process of composting was conducted in 1.5 feet length and 4 square feet width compost pit. It was filled by sugarcane trash and sugarcane bagasse waste. It was allowed to decompost for 30 days.

Sugarcane trash compost

Compost 2 kg of sundried sugarcane trash agro-waste was transferred to C_1 pit, spread with 20 g of *Pleurotus florida* spawn was sandwiched uniformly. This process was repeated till the heap reaches a height of above 1 meter. The moisture content was maintained by sprinkling water with regular interval. Turning the agro-waste was manually done every week using composting process. Vermicomposting process was adopted by adding 10 to 15 earthworms after 30 days.

Compost 2 pit was filled with 2 kg of sugarcane trash waste along with 20 g of *Trichoderma asperelloids* was added. This process was repeated till the heap reached a height of above one meter. Manual turning was done every week during composting period to accelerate the decomposition process. After 30 days of composting, vermicomposting process was adopted.

Compost 3 pit was filled by sundried sugarcane trash waste. 20 g of *Trichoderma asperelloids* and 25 ml of microbial consortium was added. The process was repeated till the heap reached a height of above 1 meter. The pit moisture content was maintained to 60-70% by sprinkling of water with regular interval. Turning of compost was manually done every week.

Sugarcane bagasse compost

Same technique was repeated in place of sugarcane trash (C1, C2 and C3) sugarcane bagasse was used in the following composting pits compost 4 (C4) compost 5 (C5) and compost 6 (C6) respectively.

Field culture experiment with the treatments

The field culture experiment was conducted with brinjal (*Solanum melongena* L.) in Alanthurai, Coimbatore, Tamil Nadu. The compost was mixed thoroughly and applied to the field. Viable seeds were selected and they were sown in the field with three replications. As per recommendation of Tamil Nadu Agricultural University, Coimbatore, plant protection measures and other cultural practices were followed.

C	Control
T_1	C_1 (Predecomposted Sugarcane trash, *Pleurotus florida* and earthworm (*Eudrilus eugeniae*) 5t/h)
T_2	C_2 (Predecomposted Sugarcane trash, *Trichoderma asperelloids* and earthworm (*Eudrilus eugeniae*) 5t/h)
T_3	C_3 (Predecomposted Sugarcane trash, *Trichoderma asperelloids* and Microbial consortium 5t/h)
T_4	C_4 (Predecomposted Sugarcane bagasse, *Pleurotus florida* and earthworm (*Eudrilus eugeniae*) 5t/h)
T_5	C_5 (Predecomposted Sugarcane bagasse, *Trichoderma asperelloids* and earthworm (*Eudrilus eugeniae*) 5t/h)
T_6	C_6 (Predecomposted Sugarcane bagasse, *Trichoderma asperelloids* and Microbial consortium 5t/h)

Statistical analysis

The data obtained from various observations on 30, 60 and 90 DAS were analyzed statistically using One-way and Two-way ANOVA.

RESULTS AND DISCUSSION

Biometric characters

The results of the present study predicted the effect of composts by different treatments on biometric characters of Brinjal (*Solanum melongena* L.). A highest shoot length was observed in T_5 treatment (32.9, 55.3 and 98.5 cm) which is followed by T_2 treatment (29.5, 51.4 and 93.7 cm) and control (17.3, 33.5 and 75.3 cm) on 30, 60 and 90 days after sowing (DAS). A significant increase in root length was observed in T_5 treatment (17.85, 25.10 and 33.30 cm) followed by T_2 treatment (16.30, 22.85 and 30.75 cm) and compared to the control (8.35, 13.40 and 21.30) 30, 60 and 90 days after sowing. Maximum number of leaves was observed in T_5 treatment (21.33, 50.00 and 77.00) when compared to the T_2 treatment (19.33, 46.00 and 72.67) and control (9.00, 26.00 and 54.67) 30, 60 and 90 days after sowing as shown in Table 1.

The fresh weight of the plant increase in T_5 treatment (31.10, 48.30 and 55.55 g) which is followed by T_2 treatment (28.90, 45.35 and 52.20 g) when compared to the control (16.70, 27.05 and 34.65 g) 30, 60 and 90 days after sowing. A significant increase in dry weight was observed in T_5 treatment (7.10, 7.95 and 9.30 g) followed by T_2 treatment (6.75, 7.45 and 8.80 g) and control (3.75, 5.30 and 5.50 g) on 30, 60 and 90 days after sowing as shown in Table 2. Similar increase in results were also observed in number of flowers in T_5 treatment (27.50 and 55.50) when compared to T_2 treatment (25.50 and 52.50) and control (12.50 and 38.00) 60 and 90 days after sowing. A highest number of branches was observed in T_5 (22.50 and 27.50) treatment which is followed by T_2 treatment (20.50 and 25.00) when

compared to the control (9.50 and 14.00) 60 and 90 days after sowing as shown in Table 3.

The results par with Manimegala and Gunasekaran (2020) who observed significantly higher plant height, number of leaves, number of branches and number of flowers recorded at 60 and 90 DAS of the crop with the application of treatment vemicompost and NPK fertilizer in eggplant (*Solanum melongena* L.). Similar work was reported by Tensing Baliah and Muthulakshmi (2017) who observed that the application of the vermicompost increase the shoot length (33.5 cm), root length (22.6 cm), number of leaves (30), fresh weight (4.41 g) and dry weight (1.29 g) in okra (*Abelmoschus esculentus* L.). El- Mohamedy *et al*. (2015) A significant increase in plant height, number of leaves, number of branches, fresh weight and dry weight was observed in bio-compost when compared to the control in potato (*Solanum tuberosum* L.) plants. The results coincides with Silpa and Vijayalakshmi (2022) who confirmed that the application of biocomposted cocoa shell and jack fruit peel waste increased the shoot length (175.83 cm),

Table 1: Effect of composted sugarcane trash and bagasse on the shoot length, root length and number of leaves on *Solanum melongena* L.

Treatment	Shoot length (cm)			Root length (cm)			Number of leaves		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
C	17.3	33.5	75.3	8.35	13.40	21.30	9.00	26.00	54.67
T_1	21.3	39.5	80.4	9.60	16.15	24.00	9.67	30.67	56.67
T_2	29.5	51.4	93.7	16.30	22.85	30.75	19.33	46.00	72.67
T_3	25.4	48.2	93.3	14.25	21.40	28.60	15.67	42.00	68.33
T_4	23.3	46.1	89.6	12.45	18.80	26.60	13.67	37.33	64.00
T_5	32.9	55.3	98.5	17.85	25.10	33.30	21.33	50.00	77.00
T_6	22.4	41.4	85.4	11.25	17.50	24.05	11.67	34.00	61.33
SED		0.34231			3.2812			3.81864	
Cd (p<0.05)		0.69096			66.62340			7.70813	

DAS- Days after sowing.

Table 2: Effect of composted sugarcane trash and bagasse on the fresh weight and dry weight of *Solanum melongena* L.

Treatment	Fresh weight (g)			Dry weight (g)		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
C	16.70	27.05	34.65	3.75	5.30	5.50
T_1	20.45	34.05	37.95	4.40	5.75	6.40
T_2	28.90	45.35	52.20	6.75	7.45	8.80
T_3	27.30	41.95	48.35	6.25	7.10	8.20
T_4	24.95	39.35	45.20	5.65	6.75	7.50
T_5	31.10	48.30	55.55	7.10	7.95	9.30
T_6	22.70	35.95	41.10	5.20	6.30	7.10
SED		3.28126			0.52068	
Cd (p<0.05)		6.62340			1.05103	

DAS- Days after sowing.

Table 3: Effect of composted sugarcane trash and bagasse on the number of flowers and number of branches of *Solanum melongena* L.

Treatment	Number of flowers		Number of branches	
	60 DAS	90 DAS	60 DAS	90 DAS
C	12.50	38.00	9.50	14.00
T_1	15.50	42.00	12.00	16.50
T_2	25.50	52.50	20.50	25.00
T_3	23.00	50.50	18.00	22.50
T_4	21.00	47.50	16.00	21.00
T_5	27.50	55.50	22.50	27.50
T_6	18.00	44.50	14.50	18.50
SED	3.72678		3.57238	
Cd (p<0.05)	7.63417		7.31789	

DAS- Days after sowing.

Table 4: Effect of composted sugarcane trash and bagasse on the yield parameters of *Solanum melongena* L.

Treatment	Number of fruits	Fruit length (cm)	Single fruit weight (g)	Fruit yield per plant (kg)	Fruit yield per plot (kg)
	90 DAS	90 DAS	90 DAS	90 DAS	90 DAS
C	14.50	11.30	57.45	7.30	25.10
T_1	16.00	12.20	70.60	7.85	27.30
T_2	20.50	15.40	91.80	10.00	35.35
T_3	19.50	14.70	88.85	9.50	33.15
T_4	18.00	13.95	80.65	9.30	30.85
T_5	22.00	15.70	93.15	10.35	37.25
T_6	17.00	13.05	75.50	8.20	29.10
SEd	6.5756	6.0387	7.0298	0.8153	0.6350
CD (p<0.05)	14.1047	12.9531	15.0792	1.7489	1.3620

DAS- Days after sowing.

root length (39.23 cm) and number of leaves (37.50) in *Vigna unguiculata* (L.) Walp. The present study was supported by Pinky and Vijayalakshmi (2022) who reported that the application of vermicompost increased the shoot length, root length, fresh weight and dry weight in black gram (*Vigna mungo* L.). The present study is in correlation with Sardoei (2014) reported that the application of vermicompost increase of plant height (26.87), fresh weight (85.43) and dry weight (13.78) in marigold (*Calendula officinalis*).

The present study was also in agreement where an increase in plant height (32.56 cm) was noted with the application of T_3-Azolla vermicompost supplemented with 50% NPK, was observed Palia *et al*. (2021).

Yield parameters

The maximum number fruits was observed in T_5 treatment (22.00) followed by T_2 treatment (20.50) when compared to the control (14.50). The fruit length and single fruit weight are significantly increased in T_5 treatment (15.70 cm and 93.15 g) when compared to the T_2 treatment (15.40 cm and 91.80 g) and control (11.30 cm and 57.45 g). The fruit yield per plant and fruit yield per plot was observed maximum in T_5 treatment (10.35 and 37.25 kg) which is followed by T_2 treatment (10.00 and 35.35 kg) and control (7.30 and 25.10 kg) on 90 days after sowing as shown in Table 4.

The present results also coincide with the previous findings Rahman *et al*., (2012) that bio-compost + cowdung compost + NPK fertilizers had significant positive impact on number of fruit (62.38), fruit length (23.98) and yield per plant (24.49) in chilli. The present study was correlated with the findings of Gandhi and Sivagama Sundari (2012) who reported that the application of vermicompost increase number of fruits (6-12) in brinjal plant (*Solanum melongena*). Mamta *et al*., (2012) A significant increase in total yield per plant with the application of T_4- pv 2.5t/ha + FYM 6.25 t/ha in *Solanum melongena*.

The results was on par with Mullaimaran and Haripriya (2016) who confirmed that the application of organic manures increase number of fruits, single fruit weight, fruit yield per plant and fruit yield per plot in tomato. The present study coincides with the result of Kashem *et al*. (2015) in tomato (*Solanum lycopersicum* L.) which showed an increase number of fruits in vermicompost and NPK fertilizers. Similar work was reported by Saraswathy and Prabhakaran (2014) observed that the application of vermicompost increase number of fruits (36.57), fruit weight (71.65 g), fruit yield per plot (28.82 kg) in tomato (*Lycopersicum esculentum* Mill.).

CONCLUSION

The study revealed that the integration of sugarcane trash and bagasse had shown an enchancing effect on growth and yield of brinjal. On the basis of results, it is concluded that the vermicompost prepared from the test substrates *viz*. C_5 (Predecomposted Sugarcane bagasse, *Trichoderma asperelloids* and earthworm (*Eudrilus eugeniae*) 5 t/h) revealed beneficial outcomes with improved effects on the quality attributes of Brinjal. Thus, the study indicates that the vermicompost can be utilized effectively for sustainable crop production.

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Conflict of interest: None.

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