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Impacts of vermicompost and different organic growing media on the morpho-physiological characteristics of dragon fruit (*Hylocereus costaricensis* L.) in new alluvial zone of West Bengal

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Abstract
A study was conducted in the Horticultural Research Station, Mondouri, Mohanpur, Nadia, West Bengal during the years 2019-2021 to investigate the 'The effect of vermicomposting and different organic growing media on the morpho physiological characteristics of dragon fruit (*Hylocereus costaricensis* L.) under indo-gangetic plains of West Bengal. The experiment was planned by adopting randomized block design (RBD) consisting of 7 treatments with three replications. The treatments were as follows- 2kg vermicompost/plant (T_1), 3kg farm yard manure/plant (T_2), 1kg mustard cake/plant (T_3),1kg vermicompost along with 1.5kg farm yard manure/plant (T_4), 1kg vermicompost along with 500 g mustard cake/plant (T_5), 1kg vermicompost along with 1.5kg farm yard manure/plant and 500g mustard cake/plant (T_6) and control (T_7). Maximum plant height (285 cm), number of branches (10) per plant, maximum number of bracts (25) per fruit, highest yield (14.5) per plant were obtained in red fleshed dragon fruit from the best treatment i.e., T_6 comprising of vermicompost@1 kg+ FYM @1.5 kg+ Mustard cake@ 500g.

Keywords: Dragon fruit, vermicompost, manure, organic farming

1. Introduction
Dragon fruit (*Hylocereus costaricensis* L.) also known as pitaya or strawberry pear, is a tropical fruit known for its vibrant red colour, unique look, crisp texture which makes it a promising and lucrative fruit crop. Dragon fruit is considered to be appeared from Southern Mexico, the Pacific seacoast of Guatemala, Costa Rica, and El Salvador (Morton, 1987) [14]. It is a cactus plant belonging to family Cactaceae. Dragon fruit has been acknowledged worldwide because of its numerous health benefits and this crop considered to be a super fruit because of its great nutritious value. The taste of this fruit is delicately sweet but crispy, and it looks alluring with its green scales and pink skin. The fruit was named dragon fruit because of its scaly appearance, alike to a dragon scale. It has white and red pulp according to its variety, which is filled with black edible seeds. A great appealing colour and shape of it attracts the buyers all the time. It is a nutritious fruit with several uses and is largely valued for its reported neutraceutical characteristics. Establishing of dragon fruit plant under any circumstances is comparatively easier than any other fruit crops because of its highly adoptive nature under any adverse conditions. But indiscriminate use of chemical fertilizers, synthetic pesticides heavily contaminate the soil, water and the plants. As a result, one of the challenges growers are facing lately in the growth and development of dragon fruit plants is low productivity and low fertility of the land. To enrich the soil fertility as well as the soil structure and to get quality fruits there is no better option other than using organic products to the dragon fruit plant. Organic fertilizers and organic materials help the process of nutrient absorption by plants. Organic farming of dragon fruit is a sustainable production are made to increase the Total Profitable Value (TPV). Furthermore, the civic consumers are now nutritionally very much aware of their health and are willing to try organic products for their ever raising diseases specifically diabetes, cardio-vascular and other stress related ailments being the most common. Organically produced dragon fruit would be residue free, poisonous chemical free healthy crop, an ideal fruit crop for a health conscious person. Very scant information is available until now about the fully organic cultivation of dragon fruit, keeping this view the present experiment was undertaken to examine the effect of vermicompost and other organic manures on the morpho-physiological characteristics of dragon fruit.

2. Materials and Method

The experimental plant material, *Hylocereus costaricensis* (L), belonging to the family cactaceae, commonly called pitaya was selected for the study. The experiment was conducted in the Horticultural Research Station, BCKV, Mondouri, Mohanpur, Nadia. It comes under New Alluvial Zone (22°95 north latitude and 88°49 east longitude). The experiment was carried out from April to September in the two consecutive years of 2019-2020 and 2020-2021. The experiment was designed as randomized block design(RBD) with 3 replications. The plant growth parameters of this plant have been studied using vermicompost and different growing media *viz.* FYM, mustard cake and their mixture. Here vermicompost has been prepared through pit method. The organic matter i.e., dry straw and leaves collected from paddy fields, biodegradable wastes collected from fields and kitchen were collected in cemented pits of 2m in length and 1m in width and depth. A fine bedding was prepared by adding partially decomposed cow dung, dried leaves and other biodegradable wastes collected from fields and kitchen. Both the chopped bio-waste and partially decomposed cow dung was added continuously layer-wise into the tank up to a depth of 0.5-1.0 ft. After 24th day, around 200-600 new worms were introduced and the entire raw material is turned into the vermicompost. Vermicompost contains various macro and micro nutrients, more beneficial soil microbes like nitrogen fixing bacteria and mycorrhizal fungi (Ismail, 2005) [12]. Each organic manure was applied one week before planting, together with the preparation of experimental plots, by broadcasting to the surface of the plots and then mixed evenly with soil. Plant height was measured with a measuring tape and the data were recorded. The number of fruits per plant and number of bracts per fruit were counted manually. Fruit physical parameter such as fruit length, breadth was determined with the help of digital slide calipers (6"/150 mm, accuracy §0.02 mm, LR44,2006/66/EC) and weight, pulp weight measured using digital weighing balance. The statistical analysis was performed following the analysis of variance (ANOVA) for randomized block design based on the guidelines given by Panse and Sukhatme, 1997 [16].

3. Result and Discussions

The data on vegetative growth and yield of fruits *viz*. height, yield, number of bracts per fruit, number of branches per plant recorded at harvest stage are presented in Table 1.

The data pertaining to effect of vermicomposting and other organic manures on vegetative growth and yield on dragon fruit cv. Royal Moroccan Red showed significant difference among the treatments (Table 2). On the basis of 2 years (2019-2021) pooled data, the minimum plant height was noticed with T_7 (187.5 cm), followed by T_2 (215 cm), T_1 (231.5 cm), T_3 (232.5 cm), T_5 (242.5 cm) whereas, maximum tree height (285 cm) was observed under T_6 (Vemicompost @ 1kg+ FYM @1.5kg+ Mustard cake @500g) followed by T_4 (250 cm) which were found statistically *at par* with each other. A considerable increase in tree height were recorded in treated plants compared to the controlled. Vermicompost incorporates humic acids and growth synchronizing substances (Atiyeh *et al.*, 2002) [5], plant growth hormone (Arancon and Edwards, 2006) [4], which might be the reason of good plant growth. Similar results were in compliance with Dhakar *et al*. (2016) [9] in papaya and Yadav *et al.* (2012) [20] in acid lime.

There were significant differences observed with respect to number of branches in red fleshed dragon fruit. At the stage of final harvest, treatment T_6 recorded significantly higher number of branches (10) per plant, followed by T_3 (8), T_5 (7.5) and T_1 (7), while the lowest value was recorded in T_7 (5.5). This might be due to the fact that the presence of vermicompost around root zone of dragon fruit plants throughout the period of growth, which is a source of humus while mustard cake and FYM act as N-fixers and making nutrients available to plants, this might have resulted in the higher values with respect to number of branches per plant. These results are in conformity with the results of Ghosh *et al*. (2014) [10] in orange.

The data pertaining to effect of vermicomposting and other organic manures on yield on dragon fruit cv. Royal Moroccan Red showed significant difference among the treatments (Table 2). The minimum yield was observed on the treatment of T_7 (8.5) followed by T_1 (10.5), T_3 (11), T_5 (11.5), T_2 (13)**,** whereas maximum yield obtained from the T_6 (Vemicompost @ 1kg+ FYM @1.5kg+ Mustard cake @500g) followed by T_4 (13.5) which were found statistically *at par* with each other. Different dosage of fertilizer might be a reason of higher yield. K.H. Then (2014) [13] shows that dragon fruit plants that are given compost and fertilizer can produce much higher yield within two years. It stated that biological fertilizers and organic fertilizers have an important role to play in increasing plant growth and the quality of products that produce phytohormomes and increasing the absorption of plant nutrients so as to help sustain plant production through maintaining fertility and soil productivity (Verma *et al*., 2019) [19]. Azri's (2018) [1] research also shows that in order to obtain better dragon fruit yields, wise fertilization application is needed. The fertilization recommendations are quite varied though.

Table 1: Effect of vermicompost and other organic manures on vegetative growth and yield in dragon fruit cv. Royal Moroccan Red

Treatments	Plant height (cm)	Number of branches per plant	Number of bracts per fruit	Yield (Number/plant)
T_1	231.5	7	22	10.5
T_2	215	7	16	13
T_3	232.5	8	19	11
T_4	250	6.5	21	13.5
T_5	242.5	7.5	20	11.5
T_6	285	10	25	14.5
T_7	187.5	5.5	12	8.5
SEM±	7.20	0.78	18.80	0.92
C.D. (P=0.05)	24.91	2.28	1.48	2.69

Table 2: Effect of vermicompost and other organic manures on physical parameters in dragon fruit cv. Royal Moroccan Red

Treatments	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Edible pulp weight (g)
T_1	7.60	6.81	210	155.00
T_2	7.63	6.70	230	177.50
T_3	7.62	6.88	215	172.50
T_4	7.82	6.88	205	155.00
T_5	7.38	6.54	155	120.00
T_6	7.95	7.02	240	187.50
T_7	7.30	6.20	100	82.50
SEM±	0.18	0.10	6.87	6.73
C.D. (P=0.05)	NS	0.28	20.07	23.27

Data presented in Table 2 revealed that different treatments of vermicompost and organic manures significantly influenced the fruit weight. Maximum weight (240 g) of fruit was measured in T_6 (Vemicompost @ 1kg+ FYM @1.5kg+ Mustard cake @500g) followed by T_2 (Farm yard manure @3kg/plant) while control fruit recorded minimum weight (100 g). Fruit breadth was also influenced by different treatments of vermicompost. Fruit diameter varied from 6.05 to 6.82 cm due to different treatments of vermicompost. T_6 (Vermicompost @ 1kg+ FYM @1.5kg+ Mustard cake @500g) recorded maximum diameter (7.02 cm) of fruit followed by T_3 (6.88 cm) while controlled recorded minimum (6.20 cm).

The data also revealed that different treatments of vermicompost did not significantly influenced the fruit length. However, maximum length (7.95 cm) of fruit was measured in T_6 (Vemicompost @ 1kg+ FYM @1.5kg+ Mustard cake @500g) followed by T_4 (Vermicompost @1 kg + FYM @1.5 kg) while control fruit recorded minimum length (7.30 cm).

In case of edible pulp weight of dragon fruit data clearly revealed that different treatments of vermicompost significantly influenced the weight of the edible pulp. Maximum edible pulp weight (187.50 g) of dragon fruit was measured in T_6 (Vemicompost @1kg+ FYM @1.5kg+ Mustard cake @500g) followed by T_2 (Farm yard manure @3 kg/plant) while control fruit recorded minimum edible pulp weight (82.50 g). Number of bracts per fruit were also significantly influenced by the different treatments of vermicompost. Maximum number of bracts were noticed in T_6 (Vemicompost @1kg+ FYM @1.5kg+ Mustard cake @500g) followed by T_1 (Vermicompost @2kg/plant) while control fruit recorded minimum number of bracts per fruit (12).

Application of Vermicompost along with organic manures increased fruit weight, fruit length & bredth and yield of the fruit over the untreated control. Vermicompost @ 1kg + FYM @1.5 kg+ Mustard cake @ 500g showed most effective as compared to other treatments.

Vermicompost is basically an excrete of earthworms and earthworms are probably the most studied and used soil organisms in composting along with microbial inoculants. Products of earthworm excrete comprises of nutritious organic fertilizers, which are rich in humus, stabilized organic matter, macro and micronutrients, beneficial soil micro organisms and growth hormones (Barnal *et al*., 2009, Adhikary *et al*., 2012, Bhat *et al.*, 2018) [6, 2, 7]. Composting is a biological process of controlled aerobic decomposition that transforms organic waste into nutrient-rich and stable organic products, which can be used as agricultural fertilizers and manures (Tejada *et al*., 2008, Singh *et al*., 2010, Gutiérrez-Miceli *et al*., 2011, Akinnuoye-Adelabua *et al*., 2019) [18, 17, 11, 3]. It has been cleared that among the fertilizers that provide the largest contribution to the growth of fruit trees is manure (Leaf manure, Farm yard manure, Animal excrete manure etc.). According to Yustisia *et al.*, 2019 [21] manure has a higher water holding capacity while sand has good aeration and drainage capacity. The addition of organic matter through the application of manure will increase yield productivity and provide optimal growth for fruit plants. Verma *et al*., 2019 [19] showed that the application of a combination of organic and biological fertilizers was able to increase the plant height, number of branches per plant, number of bracts per fruit of dragon fruit plants. Increased vegetative growth was due to increased nitrogen fixation, better usage of organic nitrogen, and development of better root systems. The addition of vermicompost also enhances soil physical, chemical and biological properties (Norman *et al.*, 2005) [15]. This study has revealed that vermicompost and other organic manures have a significant effect on the physical effects on size, colour and firmness of dragon fruit and also it's morpho-physiological characteristics.

4. Conclusion

This research concluded that the application of vermicompost along with farm yard manure and mustard cake had a significant effect on the dragon fruit plant height, number of fruits, fruit weight, length, diameter, edible pulp weight and number of bracts of dragon fruit plants in the indo-gangetic plains of West Bengal. Both the treatments of T_6- vermicompost @ 1kg+ FYM @1.5kg+ Mustard cake @500g and T_4- vermicompost @1kg + farm yard manure @1.5 kg was recommended for the improvement of marketability of dragon fruit.

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