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Impact of Organic Nutrient Management on Growth, Fruiting and Yield of Avocado (*Persea americana*) under Hilly Region of West Bengal

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Abstract

An experiment was laid out in farmer's field of Kamjer village, Kalimpong during the month (March to August) of the year 2022–2023 at farmer's field in Kamjer village, Kalimpong, West Bengal to study the effect of organic sources of nutrients on growth, yield and quality of avocado with eight different treatments (T_1) FYM (40 kg plant^{-1}), (T_2) Vermicompost (20 kg plant^{-1}), (T_3) Leaf mould (20 kg plant^{-1}), (T_4) Mustard cake (15 kg plant^{-1}), (T_5) Poultry manure (15 kg plant^{-1}), (T_6) Pig manure (10 kg plant^{-1}), (T_7) Goat manure (10 kg plant^{-1}) and (T_8) RDF NPK (500 g, 250 g and 450 g plant^{-1}) having three replication in Randomized Block Design (RBD). Result indicated that avocado trees treated with 20 kg vermicompost tree^{-1} (T_2) gave the best result with respect to maximum plant height (9.53 and 10.88 m), span canopy volume (159.16 and 216.07 m^3), trunk girth (55.79 and 56.97 cm), maximum number of flowers shoot^{-1} (73.25 and 80.91), maximum percentage fruit set (46.65 and 48.52%), maximum fruit retention percentage (27.82 and 29.01%), maximum specific gravity (1.16 and 1.30), fruit diameter (6.98 and 6.49 cm), fruit length (9.88 and 9.98 cm), highest seed weight (45.56 and 52.37 g), maximum number of fruits shoot^{-1} (34.18 and 39.25), maximum number of fruits tree^{-1} (236.03 and 242.11), maximum fruit weight (330.27 and 343.93 g) and highest yield (77.98 and 83.26 kg tree^{-1}) as compared to other treatments.

Keywords: Avocado, growth, flowering, fruiting, organic manure

1. Introduction

Avocado (*Persea americana* Miller) also called (Butter fruit or Alligator pear) belonging to the family Lauraceae is a vigorous, subtropical, evergreen, polymorphic tree crop which finds its origin from a broad geographical area stretching from the eastern and central highlands of Mexico through Guatemala to the Pacific coast of Central America (Dreher and Davenport, 2013). It has developed three horticultural races i.e West Indian, Guatemalan and Mexican (Bergh and Lahav, 1996) which are adaptable to a wide range of soil as well as climatic conditions. Avocados are popularly grown in Sikkim, Darjeeling and Kalimpong district of West Bengal (Subba et al., 2023) and are planted on the hill slopes between 800 and 1600 m above mean sea level. Avocado tree grows upto a height of 20 m having large spreading as well as flat topped crown (Subba et al., 2023). The trees are considered as a good preventer of soil erosion and they are mostly grown in high altitude hilly region. The flowers are small, inconspicuous and greenish-yellow in colour. The avocado fruit is considered to be climacteric in nature. The pulp of avocado fruit is rich in fat (30%) and proteins (4%) however the content of carbohydrates is relatively low. Monounsaturated fatty acids make up 71% of avocado oil, followed by polyunsaturated fatty acids at 13% and saturated fatty acids at 16% (Selladurai and Awachare, 2019). The repeated use of chemical fertilizers has led to degradation of soil health causing loss of fertility and has also led to problems like soil pollution. Furthermore, the productivity of the fruit crops has been harshly affected by continuous reduction in the soil fertility. Moreover, the increasing cost of fertilizers coupled with their negative effect on soil health has also led to comprehensive approaches involving the use of organic matter as it is a common practice to improve soil fertility and yield of many fruit crops. Moreover it also checks levels of chemical intervention in soil and also reduces the negative impact on the environment (Singh et

al., 2012). Good quality farmyard manure, vermicompost and other organic manures are the most valuable source of organic matter as they proved to be very useful to the plants as well as soil. Moreover, organic manures also helps in improving physical, chemical as well as biological properties of almost all the soil types by adjusting the soil pH and increasing the solubility production of the plants. Furthermore, the key to the solution of recurrent problems associated with fertilizers scarcity and expensiveness can be effectively tackled with the use of organic source of nutrients. Thus much emphasis should be given on use of organic source of nutrients as it helps to build up soil humus and beneficial microbes besides, it also helps in improving the physical properties of soil, provide regulated supply of nutrients through slow release and thereby increases nutrient availability and use efficiency (Quansah, 2000). Applying organic manure can boost plant roots enzymatic activity and activated respiration, provide nutrients, boost water retention capacity, and increase plant hormones for growth (Antonius et al., 2007) and (Ramansya et al., 2009). It can also reduce production costs and replace some inorganic materials (Juhaeti et al., 2013). Keeping in view the utmost importance of organic manures, an experiment was conducted to determine the effect of organic sources of nutrients on growth, fruiting and yield of avocado in hilly region of West Bengal.

2. Materials and Methods

An experiment was conducted during the month of March to August during 2022–2023 at farmer's field in Kamjer village, Kalimpong, West Bengal which is located between (27^{0}3'9''N) latitude and (88°33'15'' E) longitude, at an altitude of 1075.46 m above mean sea level to determine the effect of organic sources of nutrients on fruiting, yield and quality of avocado variety Reed in Randomized Block Design having eight treatments (T_1) FYM (40 kg plant^{-1}), (T_2) Vermicompost (20 kg plant^{-1}), (T_3) Leaf mould (20 kg plant^{-1}), (T_4) Mustard cake (15 kg plant^{-1}), (T_5) Poultry manure (15 kg plant^{-1}), (T_6) Pig manure (10 kg plant^{-1}), (T_7) Goat manure (10 kg plant^{-1}) and (T_8) RDF NPK (500 g, 250 g and 450 g plant^{-1}) having three replication with two plants replication^{-1}. The morphological parameters were recorded monthly from March to August (2022–2023) before harvesting. The plant height was measured from the base to the tip of the canopy with the help of a bamboo pole, span canopy volume was measured in North-South and East-West direction with the help of measuring tape and the trunk girth was measured at the base (20 cm above the ground) with the help of measuring tape. The different parameters for fruiting characteristics were recorded as per the standard methodology. Total number of flowers shoot^{-1} were recorded by tagging one meter length shoot in North-South and East-West direction and each opened flower was counted. Fruit set percentage was calculated by taking into account the number of initial fruit set and total number of flowers in the panicle. Fruit retention percentage was recorded by dividing the number of fruits panicle^{-1} by number of fruits at initial stage. Specific gravity was calculated by dividing the average fruit mass with the average fruit volume. Fruit diameter, length and peel thickness was recorded by using vernier caliper and calculated by taking the average of ten fruits. Seed weight was calculated by weighing ten numbers of seeds and taking the average of it in each treatment. The total number of fruits shoot^{-1} and total number of fruits tree^{-1} was calculated in each replication. Fruit weight was calculated by taking the average weight of ten fruits. The data on fruit yield was recorded by weighing all the fruits in each treatment at the time of harvesting and was expressed in term of kg tree^{-1}. For statistical analysis, the data were analyzed using statistical applications like OPSTAT and CCS HAU Hissar. Mean separations for different treatment under different parameters were performed using Critical Difference (CD) test (=0.05). Data transformation for percentage data, was made as per Gomez and Gomez (1984).

3. Results and Discussion

3.1. Effect of treatments on morphological parameters

The morphological parameters were significantly influenced by vermicompost application at 20 kg plant^{-1} as compared to other treatments. In terms of plant height, vermicompost (T_2) exhibited promising results in each consecutive months ranging from March to August as compared to other treatments, where plant height recorded in the monthof March was 8.34 and 9.59 m which significantly increased up to 9.53 and 10.88 m (Table 1) in August during the two years of experiment (2022 and 2023).Treatment with leaf mould showed comparatively poor results, exhibiting plant height of 6.10 and 7.46 m during March which slowly increased up to 7.34 and 8.41 m in August thereby manifesting below par results as compared to other respective treatments. The improved morphological parameters in vermicompost treated plants may be attributed to higher amount of nitrogen along with balanced amount of phosphorus as well as potassium. Application of vermicompost improves mobilization of bound nutrients along with physical conditions of the soil which facilitates deeper penetration of the roots thereby enabling higher extraction of nutrients from the soil. This in turn allowed the plant to put up better growth leading to greater plant height. According to Yadav and Kumari (2003) the improvement in plant growth might be due to proper moisture retention capacity and also due to better supply of nutrients due to favourable soil condition created by vermicompost application. Similar result were in close confirmation with the findings of (Ghosh et al., 2014) who concluded that the increase in plant growth with respect to plant height was maximum (0.31 m) in the plants which was treated with vermicompost (20 kg tree^{-1}) in sweet orange.

The highest canopy volume was recorded in avocado trees treated with vermicompost (T_2) (Table 2), where the canopy volume during the month of March was 85.80 and 162.17 m^3 which increased significantly up to 159.16 and 216.07 m^3 in

Table 1: Effect of treatments on plant height (m) of avocado during 2022 and 2023

Treatments	March		April		May		June		July		August	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
T_1	7.53	8.96	7.84	9.04	7.95	9.13	8.18	9.47	8.56	9.79	8.91	9.95
T_2	8.34	9.59	8.60	9.66	8.83	9.95	9.15	10.10	9.37	10.47	9.53	10.88
T_3	6.10	7.46	6.34	7.75	6.53	7.94	6.73	7.99	6.95	8.10	7.34	8.41
T_4	7.69	9.31	8.00	9.39	8.38	9.48	8.63	9.67	8.91	9.96	9.28	10.35
T_5	6.94	8.68	7.41	8.77	7.67	8.88	8.05	9.00	8.46	9.39	8.63	9.67
T_6	6.78	7.69	6.95	7.76	7.05	7.85	7.18	7.91	7.40	8.01	7.63	8.19
T_7	7.07	8.76	7.52	8.85	7.77	8.99	8.09	9.31	8.46	9.67	8.69	9.72
T_8	6.80	8.44	7.25	8.51	7.48	8.59	7.70	8.88	8.05	9.18	8.38	9.38
SEm±	0.99	0.25	0.57	0.24	0.48	0.21	0.37	0.26	0.45	0.26	0.48	0.26
CD (*p*=0.05)	NS	0.75	NS	0.73	NS	0.64	1.13	0.79	1.39	0.81	NS	0.79

T_1: FYM (40 kg plant^{-1}); T_2: Vermicompost (20 kg plant^{-1}); T_3: Leaf mould (20 kg plant^{-1}); T_4: Mustard cake (15 kg plant^{-1}), T_5: Poultry manure (15 kg plant^{-1}); T_6: Pig manure (10 kg plant^{-1}); T_7: Goat manure (10 kg plant^{-1}), T_8: RDF NPK (500, 250, 450 g plant^{-1})

Table 2: Effect of treatments on span canopy volume (m^3) of avocado during 2022 and 2023

Treatments	March		April		May		June		July		August	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
T_1	72.91	129.67	82.84	140.76	91.43	154.56	109.20	167.03	117.46	184.97	126.92	192.26
T_2	85.80	162.17	98.80	177.41	119.08	188.45	133.36	196.70	148.02	205.51	159.16	216.07
T_3	58.48	118.38	69.88	122.27	81.59	135.52	93.64	148.23	100.40	162.39	110.19	175.14
T_4	77.73	136.47	91.45	148.03	100.24	160.71	112.29	173.49	120.21	185.13	131.19	194.50
T_5	64.05	124.78	76.97	131.87	86.31	139.71	96.27	153.00	108.07	165.95	118.33	182.13
T_6	56.09	102.90	61.72	107.33	64.85	118.63	69.70	132.56	87.29	144.28	96.97	164.11
T_7	65.18	128.13	77.20	136.93	88.83	150.78	100.80	165.18	115.63	181.87	124.33	191.51
T_8	59.66	118.72	71.62	126.78	84.32	139.55	95.70	149.41	105.14	163.06	114.96	178.23
SEm±	19.39	18.29	10.61	10.19	8.23	9.26	8.01	16.10	10.95	11.46	6.21	12.56
CD (*p*=0.05)	NS	NS	NS	31.20	25.22	28.37	24.52	NS	NS	NS	19.03	NS

T_1: FYM (40 kg plant^{-1}); T_2: Vermicompost (20 kg plant^{-1}); T_3: Leaf mould (20 kg plant^{-1}); T_4: Mustard cake (15 kg plant^{-1}), T_5: Poultry manure (15 kg plant^{-1}); T_6: Pig manure (10 kg plant^{-1}); T_7: Goat manure (10 kg plant^{-1}), T_8: RDF NPK (500, 250, 450 g plant^{-1})

August during both the years while, pig manure (T_6) recorded the minimum canopy volume over the month as compared to other treatments where the canopy volume was 56.09 and 102.90 m^3 in March, reaching up to 96.97 and 164.11 m^3 in August during 2022 and 2023. Similar results were recorded by (Ghosh et al., 2014) who concluded that in sweet orange the increase in plant growth with respect to plant spread was highest North-South (0.28 m) and East-West (0.31 m) in the plants which was treated with vermicompost at 20 kg tree^{-1}.

The maximum trunk girth was recorded in vermicompost (T_2) treated avocado trees, where the trunk girth during the month of March was 54.75 and 55.92 cm, which increased to 55.79 and 56.97 cm in August during 2022 and 2023, respectively whereas the minimum trunk girth over the month was recorded in avocado trees treated with pig manure (T_6) where the trunk girth was 46.28 and 47.11 cm in March, which increased to 46.98 and 48.13 cm in August during 2022 and 2023, respectively (Table 3). Maximum trunk girth observed in avocado tree treated with vermicompost might be due to improved soil fertility, release of macro and micro nutrients and also due to release of vital plant growth promoting substances which might have reflected in enhancing the growth of trunk girth among the different organic manures. The probable effect of vermicompost on plant growth also might be due to the fact that beside improving the various physico-chemical as well as the biological aspects of soil system, it also altered various activities of enzymes

Table 3: Effect of treatments on trunk girth (cm) of avocado during 2022 and 2023

Treatments	March		April		May		June		July		August	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
T_1	52.01	52.98	52.15	53.05	52.32	53.21	52.55	53.44	52.78	53.67	52.93	53.98
T_2	54.75	55.92	54.96	56.14	55.18	56.56	55.29	56.79	55.42	56.92	55.79	56.97
T_3	47.05	48.03	47.23	48.18	47.35	48.39	47.58	48.82	47.76	49.46	47.93	49.92
T_4	52.50	53.85	52.80	53.96	52.99	54.06	53.17	54.23	53.38	54.48	53.58	54.91
T_5	49.99	51.14	50.20	51.61	50.39	51.89	50.50	52.07	50.68	52.25	50.87	52.46
T_6	46.28	47.11	46.48	47.23	46.60	47.36	46.75	47.71	46.91	47.98	46.98	48.13
T_7	51.13	52.67	51.36	52.85	51.52	53.03	51.70	53.23	51.90	53.49	52.36	53.82
T_8	48.42	49.68	48.60	49.91	48.79	50.15	48.91	50.61	49.16	51.82	49.34	51.97
SEm±	2.63	2.61	1.77	3.01	1.94	1.96	0.87	1.65	1.71	2.96	1.83	1.42
CD (*p*=0.05)	NS	NS	NS	NS	NS	NS	2.67	5.06	5.24	NS	NS	4.34

T_1: FYM (40 kg plant^{-1}); T_2: Vermicompost (20 kg plant^{-1}); T3: Leaf mould (20 kg plant^{-1}); T_4: Mustard cake (15 kg plant^{-1}), T_5: Poultry manure (15 kg plant^{-1}); T_6: Pig manure (10 kg plant^{-1}); T_7: Goat manure (10 kg plant^{-1}), T_8: RDF NPK (500, 250, 450 g plant^{-1})

in plants such as peroxidase and catalase, which ultimately promotes cell elongation, shoot and root growth along with carbohydrate metabolism (Gupta and Sangma, 2017).

3.2. Effect of treatments on reproductive parameters

The maximum number of flowers per shoot (73.25 and 80.91) were recorded with the application of vermicompost (T_2) while the minimum numbers of flowers shoot^{-1} (59.22 and 69.96) were recorded by RDF NPK (T_8) during 2022 and 2023, respectively (Table 4). More number of flowers shoot^{-1} registered in vermicompost treated avocado trees might be due to higher availability of phosphorus as vermicompost is rich in beneficial microbes that helped in improving phosphorus availability, which was certainly the most responsible element for stimulating stronger bud, flower and fruit development (Gupta and Sangma, 2017). The results were in close confirmation with the findings of Naik and Babu (2007) who concluded that the maximum number of flowers shoot^{-1} (5.00) was observed in guava trees treated with vermicompost.

The maximum percentage of fruit set (46.65 and 48.52 %) was observed in avocado trees treated with vermicompost (T_2) (Table 4) while the lowest percentage of fruit set (40.50 and 41.05%) was observed in RDF NPK (T_8) during 2022 and 2023, respectively. The highest fruit set percentage might be due to the presence of B group vitamins, plant hormones as well as chemical exudates which was released during the biological activity of vermicompost in the soil. These finding were in concordance with those recorded by Naik and Babu (2007) who reported highest fruit set percentage (91.50%) in guava cv L-49 with the application of vermicompost. Vermicompost (T_2) registered the maximum fruit retention percentage (27.82 and 29.01%) while minimum fruit retention percentage (20.97 and 21.88%) at harvest was recorded in RDF NPK (T_8) during 2022 and 2023), respectively. Increased fruit retention due to

Table 4: Effect of treatments on reproductive parameters of avocado during 2022 and 2023

Treat-ments	Total no. of flowers shoot^{-1}		Fruit set (%)		Fruit retention (%)	
	2022	2023	2022	2023	2022	2023
T_1	68.74	76.06	44.83 (6.77)	46.85 (6.92)	25.60 (5.16)	26.83 (5.27)
T_2	73.25	80.91	46.65 (6.89)	48.52 (6.98)	27.82 (5.36)	29.01 (5.45)
T_3	63.95	73.66	42.02 (6.56)	43.20 (6.65)	22.99 (4.90)	23.97 (5.00)
T_4	70.59	78.86	45.98 (6.84)	47.70 (6.94)	26.68 (5.24)	27.88 (5.35)
T_5	65.55	75.17	43.54 (6.67)	45.25 (6.80)	24.90 (5.07)	26.64 (5.26)
T_6	60.24	72.45	41.35 (6.50)	42.03 (6.56)	22.06 (4.79)	23.69 (4.97)
T_7	64.16	74.87	42.19 (6.57)	44.01 (6.70)	23.43 (4.93)	24.91 (5.09)
T_8	59.22	69.96	40.50 (6.44)	41.05 (6.48)	20.97 (4.65)	21.88 (4.78)
SEm±	1.73	2.28	3.08	4.67	2.16	2.26
CD (*p*=0.05)	5.30	NS	NS	NS	NS	NS

T_1: FYM (40 kg plant^{-1}); T_2: Vermicompost (20 kg plant^{-1}); T_3: Leaf mould (20 kg plant^{-1}); T_4: Mustard cake (15 kg plant^{-1}), T_5: Poultry manure (15 kg plant^{-1}); T_6: Pig manure (10 kg plant^{-1}); T_7: Goat manure (10 kg plant^{-1}), T_8: RDF NPK (500, 250, 450 g plant^{-1})

Table 5: Effect of treatments on physical characters of avocado fruits during 2022 and 2023

Treatments	Specific gravity		Fruit diameter (cm)		Fruit length (cm)		Peel thickness (cm)		Seed weight (g)	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
T_1	1.13	1.25	6.35	6.22	9.09	9.18	0.16	0.16	41.15	48.22
T_2	1.16	1.30	6.98	6.49	9.88	9.98	0.18	0.19	45.56	52.37
T_3	1.09	1.13	5.92	5.99	8.05	7.97	0.16	0.16	38.24	44.31
T_4	1.08	1.10	6.70	6.25	9.29	9.59	0.19	0.20	42.18	50.78
T_5	1.05	1.07	5.99	6.01	8.91	8.39	0.17	0.17	35.33	42.50
T_6	1.12	1.16	5.83	5.86	8.02	7.88	0.16	0.16	30.76	37.14
T_7	1.09	1.12	5.29	5.80	7.52	7.04	0.17	0.17	32.60	38.30
T_8	1.11	1.14	6.24	6.12	7.72	7.75	0.16	0.16	34.19	41.31
SEm±	0.06	0.07	0.11	0.28	0.14	0.24	0.01	0.01	1.43	1.75
CD (*p*=0.05)	NS	NS	0.34	NS	0.44	0.72	0.02	0.02	4.39	5.35

T_1: FYM (40 kg plant^{-1}); T_2: Vermicompost (20 kg plant^{-1}); T_3: Leaf mould (20 kg plant^{-1}); T_4: Mustard cake (15 kg plant^{-1}), T_5: Poultry manure (15 kg plant^{-1}); T_6: Pig manure (10 kg plant^{-1}); T_7: Goat manure (10 kg plant^{-1}), T_8: RDF NPK (500, 250, 450 g plant^{-1})

application of vermicompost might be due to improved soil health and nutrient availability, which facilitated proper tree growth and better fruit development.

3.3. Effect of treatments on physical parameters

The maximum specific gravity (1.16 and 1.30) was observed in vermicompost (T_2) while the minimum specific gravity (1.05 and 1.07) was recorded in poultry manure (T_5) during 2022 and 2023, respectively. However, leaf manure (T_3) and goat manure (T_7) were at par to each other (Table 5).The maximum fruit diameter (6.98 and 6.49 cm) was obtained in vermicompost (T_2) while goat manure (T_7) recorded the minimum fruit diameter (5.29 and 5.80 cm) during 2022 and 2023, respectively. Vermicompost might have an indirect role for increasing fruit diameter and fruit length through improved soil health and better uptake of nutrients. However, similar results were found with the findings of Rahman et al. (2018) who concluded that the widest fruit (31.9 mm) was observed from vermicompost application that was followed by mustard oil cake (30.0 mm) in strawberry. The maximum fruit length (9.88 and 9.98 cm) was noted in vermicompost (T_2) whereas the minimum fruit length (7.52 and 7.04 cm) was recorded in goat manure (T_7) during 2022 and 2023, respectively. The increase in fruit length due to vermicompost application might be due to its growth promoting substances that helped in increasing fruit size and shape. The results were in conformity with the findings of (Rahman et al., 2018) who reported maximum fruit length (4.8 cm) from vermicompost application which was followed by mustard oil cake (4.0 cm) in strawberry.

The thickest peel (0.19 and 0.20 cm) was recorded in mustard cake (T_4) while the least peel thickness (0.16 and 0.16 cm) was recorded in FYM (T_1), leaf manure (T_3) and pig manure (T_6) and RDF NPK (T_8) during 2022 and 2023, respectively. However, the peel thickness of FYM (T_1), leaf manure (T_3), and pig manure (T_6) and RDF NPK (T_8) treated plants were at par to each other (0.16 cm) and poultry manure (T_5) and goat manure (T_7) were also at par to each other (0.17 cm). The maximum seed weight (45.56 and 52.37 g) was registered in vermicompost (T_2) while the lowest seed weight was recorded in pig manure (T_6) (30.76 and 37.14 g) during 2022 and 2023, respectively (Table 5).

3.4. Effect of treatments on yield parameters

The maximum number of fruits shoot^{-1} (34.18 and 39.25) were recorded with the application of vermicompost (T_2) while the lowest number of fruits shoot^{-1} (23.75 and 28.72) were recorded in RDF NPK (T_8) during 2022 and 2023, respectively (Table 6). The present data were in close conformity with the report of (Naik and Babu, 2007) who recorded the highest number of fruits shoot^{-1} (4.00) with the application of vermicompost while the least was observed under control (1.25) in guava.

However, the avocado trees treated with vermicompost (T_2) registered the maximum number of fruits tree^{-1} (236.03 and 242.11) whereas goat manure (T_7) registered the minimum number of fruits tree^{-1} (189.00 and 195.00) during 2022 and 2023, respectively. The increase in number of fruits tree^{-1} by vermicompost application might be due to improvement in porosity and internal drainage of soils, nutrient content of the soil as well as conservation of water which in turns leads to lower fruit drop and higher number of fruits tree^{-1}. The observation was fairly consistent with the prior report of (Naik and Babu, 2007) who concluded that the highest number of fruits tree^{-1} (204.00) were observed with the application of vermicompost in guava cv L-49.

The maximum fruit weight (330.27 and 343.93 g) was obtained with vermicompost (T_2) treatment while goat manure (T_7)

Table 6: Effect of treatments on yield parameters of avocado during 2022 and 2023

Treatments	Number of fruits shoot^{-1}		Number of fruits tree^{-1}		Fruit weight (g)		Yield (kg tree^{-1})	
	2022	2023	2022	2023	2022	2023	2022	2023
T_1	30.79	35.63	220.29	225.12	315.68	324.09	69.51	72.88
T_2	34.18	39.25	236.03	242.11	330.27	343.93	77.98	83.26
T_3	26.83	31.70	198.68	203.08	301.31	313.43	59.88	63.63
T_4	32.43	37.67	227.27	231.25	320.68	339.27	72.91	78.42
T_5	28.59	33.88	207.63	212.74	303.89	319.34	63.09	67.94
T_6	24.90	30.42	192.03	197.00	298.78	308.03	57.38	60.69
T_7	26.92	32.71	189.00	195.00	296.94	302.35	56.13	58.96
T_8	23.75	28.72	214.60	218.41	312.90	319.80	67.16	69.85
SEm±	1.82	3.61	5.15	6.32	2.54	1.95	1.87	1.79
CD (*p*=0.05)	5.58	NS	15.77	19.36	7.77	5.98	5.72	5.49

recorded the lowest fruit weight (296.94 and 302.35 g) during 2022 and 2023, respectively. The overall increase in fruit quality might be due to better supply of micronutrients and hormone stimulation which ultimately helped in improving cell division and elongation and fruit weight (Choudhary et al., 2022). However, the highest fruit weight obtained, might be due to the fact that the application of vermicompost reduces the C:N ratio which is, therefore, responsible for the maximum fruit weight. According to (Rahman et al., 2018), the maximum fruit weight (383.7 g) was also recorded from vermicompost application which was followed by mustard oil cake (339.3 g) in strawberry. The maximum yield (77.98 and 83.26 kg tree^{-1}) was obtained in avocado trees treated with vermicompost (T_2) (Table 6) while goat manure (T_7) recorded the lowest yield (56.13 and 58.96 kg tree^{-1}) during 2022 and 2023, respectively. The maximum yield obtained might be due to the fact that vermicompost application greatly improved the physical, chemical as well as biological properties of the soil. Moreover it was also rich source of macro and micronutrients in plant available form such as nitrates, phosphate and exchangeable calcium and soluble potassium thereby it facilitated easy and quick uptake. Similar result were found with the finding result by (Naik and Babu, 2007) who reported the highest yield (40.25 kg) with the application of vermicompost in guava cv L-49. According to Rahman et al. (2018), the highest yield (11.0 t ha^{-1}) was also obtained from vermicompost application which was followed by mustard oil cake (9.8 t ha^{-1}) in strawberry.

4. Conclusion

With respect to the compilation of readings obtained during the study, it could be concluded that vermicompost have emerged as best organic manure for better growth, better yielding characters and quality aspects of avocado.

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