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PHYSICO CHEMICAL CHANGES IN BANANA PEEL BIOCOMPOST AND ITS EFFECT ON THE GROWTH OF AMARANTHUS

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Organic farming is described as an agricultural system which brings soil fertility and avoids the use of pesticides or fertilizer which is harmful to the environmental condition. Banana peel are rich in nutrients and minerals which can be used as good composting materials. Composting is the process of producing eco-friendly manure from organic matter. The present study was conducted at Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu to analyse the Physico chemical analysis of raw and composted banana peel and its effect ongrowth and yield parameters in leaves of Amaranthus. The study consists of 5 treatments C- Control, T_1- Composted Banana peel waste (25g), T_2- Composted Banana peel waste (50g), T_3- Composted Banana peel waste (75g), T_4- Composted Banana peel waste (100g).Maximum growth and yield parameters were observed in T_4 treatment when compared to control. Hence, the study concluded that the banana peel bio-compost showed an increase in pH, EC, N, P and K. Lignin and cellulose content decreases in composted banana peel. In the present study, treatment T_4- Composted Banana peel waste (100g) enhanced the growth and yield parameters in leaves of Amaranthus (*Amaranthus spinosus* L.).

Keywords: Amaranthus, Composting Banana peel, Shoot length, *Trichoderma asperelloides*.

Introduction:

Agriculture played an important role in the Indian economy. India is an agricultural countrywhere farmers depend on agriculture for its livelihood. About 35 percent of the country's income is derived from the agricultural sector. Organic agriculture is one of the longest spectra for the production method that is implemented globally for its easy and cheap method. Organic agriculture combines the application of innovation, traditional knowledge and science to benefit the shared environment and promote fair relationships and good quality of life for all involved[1]. Composting is the process of biodegradation of organic matter and the by-product produce at the end is used in sustainable agriculture which provides the nutrients to the plant. Organic farming is the degradation of organic matter into manure which is eco-friendly and also provides sustainable environment.Banana peel is rich source of vitamins, starch, crude protein, crude fat, total dietary fiber, and polyunsaturated fatty acids, particularly linoleic acid and a-linolenic acid, pectin, essential amino acids (leucine, valine, phenylalanine, and threonine), and micronutrients K, P, Ca, Mg^2. Amaranthus (*Amaranthus spinosus* L.), is used as a leafy vegetable and belongs to a family Amaranthaceae. It is cultivated in India, Sri Lanka, and many tropical countries; it is an erect, annual herb growing up to 1.5 m.

Material and Methods:

Collection of Bio Wastes:

The municipal solid waste of banana peel was collected in large amount from the hostel of Avinashilingam Institute for Home Science for Higher Education for Women, Coimbatore, Tamil Nadu. The wastes collected from the hostel were chopped into small pieces, sun dried and stored in gunny bags.

COMPOSTING PROCEDURE

Compost Pit Preparation:

The method used for the composting is pit composting. The process of composting is done in pits with 1 metre depth and 4 square feet wide. In this study, banana peel waste is used. Composting process is followed by the adding microorganism such as *Trichoderma asperelloides* for the biodegradation of the sample. The moisture content in the heap was maintained at about 60-70% by sprinkling water. To accelerate the decomposition process turning was manually done every week during composting. Compost were prepared by mixing the pre-decomposed banana peel waste along with dry cow dung in ratio of 1:2 (1 kg of compost and 2 kg of cow dung.

Evaluation of Compost Maturity:

Physical and chemical assays of raw and composted banana peel were analysed based on standard method. The methods have been proposed for estimating the degree of maturity.

Physical Parameters:

Soil Reaction (pH) and Electrical Conductivity:

Soil reaction in a soil (pH): water suspension ratio of 1: 2.5 was estimated using a glass electrode[3]. The electrical conductivity was measured using a conductivity bridge and expressed as dSm^{-1}.

Chemical Parameters:

1. Total Nitrogen (%) [4]
2. Total Phosphorus (%) [3]
3. Total Potassium (%) [3]
4. Lignin [5]
5. Cellulose[6]

Field Preparation:

Field study experiment is conducted in Koli hills of Namakkal District, Tamil Nadu. The field was ploughed and harrowed thoroughly and prepared a fine tilth. All stubbles and stone were removed. After 2-3 days, the field was levelled and maintained the plot in Random Block Design (RBD). At this stage, a light irrigation was given to the plots to maintain proper moisture content.

Collection of Seeds:

Amaranthus (*Amaranthus spinosus* L.) Var. Co. 2 seeds were collected from Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu. The Viable seeds is selected for field culture experiment.

Treatment Details:

The experiments carried out consist of 5 treatments using bio composted banana peel waste. The treatments were as follows:

C - Control

T_1-Composted Banana peel waste (25g)

T_2-Composted Banana peel waste (50g)

T_3 - Composted Banana peel waste (75g)

T_4 - Composted Banana peel waste (100g)

Vegetative Parameters:

Amaranthus plant were uprooted from the field on 15 DAS,30 DAS and 45 DAS. The following vegetative characters were noted for the study.

1. Root length (cm)
2. Shoot length (cm)
3. Number of leaves

Statistical Analysis:

The data collected in leaves on 15 DAS, 30 DAS and 45 DAS were analyzed statistically.

Results and Discussion

Physico chemical changes:

The physico chemical changes in banana peel biocompost was analysed and

the results are presented in table- 1. The composting process altered both physical and chemical changes in banana peel biocompost due to the presence of microorganism. The physico-chemical parameters such as pH, electrical conductivity, nitrogen, phosphorous, potassium, lignin and cellulose were analysed in raw and composted banana peel to assess the compost maturity.

Parameters	Raw Banana Peel	Composted Banana Peel
pH	6.81	7.03
Electrical Conductivity (milli mhos cm^{-1})	1.08	7.91
N (%)	0.56	7.4
P (%)	0.11	13.6
K (%)	0.44	12.3
Lignin (%)	20.50	12.30
Cellulose (%)	35.60	16.10

Table1. Physico-Chemical Composition of the Raw and Composted Banana Peel

The pH value in raw banana peel is 6.81 and as the decomposition started, it increased to 7.03 in composted banana peel waste. Electrical conductivity is used to measure the nutrient in the form of salt in compost. The EC value of raw banana peel wastes is 1.08 millimhos cm^{-1}which increased to 7.91 millimhos cm^{-1}.

The initial nitrogen content of raw banana peel waste was 0.56 percent and it increased to 7.4 percent in composted banana peel. The total phosphorus content revealed an increasing value from 0.11% to 13.6% in raw and composted banana peel waste. The potassium content also increases from 0.44% (raw banana peel waste) to 12.3% (composted banana peel waste). Lignin contents of raw banana peel were 20.50 % and it was reduced to 12.30 % in composted banana peel.The cellulose content was 35.60 % in raw banana peels which is decreases to 16.10 %.

The pH value of raw corncob is 5.86 and vermicomposted corncob and *Pleurotussajor-caju*(C3) showed an increase of pH (6.88)[7]. The pH and Electrical conductivity were based on garden waste compost being 7.81, 2.46 mS cm^{-1} when compared to vermicompost teas being 7.53, 0.55 mS cm^{-1}.The above studies coincided with our work which showed an increase in pH.

The electric conductivity of Kitchen waste compost was less than 2.6 but it increases as the composting progress being 2.4, 3.8, 4.5, 4.8 and 5.2 on 9, 20, 40, 60 and 80 days and the total phosphorus and potassium increase as the composting progress from 1.44, 0.07 on 9 days and 12.47, 0.13 on 80 days in kitchen waste compost[9].

The total nitrogen, phosphorus and potassium content in MSW compost were reported to be 0.896%, 0.30% and 0.45% respectively[10].

In composting and vermicomposting of *Phumdi* and MSW, nitrogen content in V1-vermicompost of MSW and V2- vermicompost of *Phumdi* are significantly high being 1.5 % than C1- compost of MSW C2- compost of *Phumdi* being 1.4 % and soil (1.07 %). Phosphorus content showed highest value in V2- vermicompost of *Phumdi* (0.81 %) followed by C2- compost of *Phumdi* (0.74 %) and least were recorded in soil (0.1 %). Highest potassium content was recorded in V2- vermicompost of *Phumdi* (0.9 %)and V1- Vermicomost of MSW (0.9 %) whereas least were recorded in soil (0.1 %)[11].

The initial lignin and cellulose content of paddy straw (14.30 and 31.10) decreases in all treatment C- 12.7, 23.5, P+P.s- 8.65, 21.2, P+P.s+T.h- 7.85, 17.4, P+P.s+T.h+A.n- 7.3, 15.95, P+P.s+T.h+A.n+Cg- 3.35, 13.38 respectively[12].

The raw coffee husk is found to be rich in Lignin (9.6) and Cellulose (42.5) as the composting progress gradual changes were found to decrease in 3rd compost Raw coffee husk + Consortium of *Pleurotus florida*, *Pleurotuseous* (APK1) and *Trichoderma viride* + dry cow dung (5t/h) to Lignin (4.6) and Cellulose (9.01)[13].

Biometric Characters:

The present study results showed the effect of manures using different treatments on vegetative and yield parameters of Amaranthus (*Amaranthus spinosus* L.)

Root length and Shoot length:

There is gradual increase in all the treatment (C-T_4). The root length increased significantly on T_4 treatment (6.05 cm, 7.09 cm) when compared to T_3 treatment (5.00 cm and 6.09 cm) and control (2.00 cm and 4.05 cm) on 15 DAS and 30 DAS.The shoot length of the test crops recorded the highest in T_4 treatment (11.05 cm and 17.05 cm) when compared to control (7.00 cm and 11.09 cm) on 15 DAS and 30 DAS as shown in figure- 1.

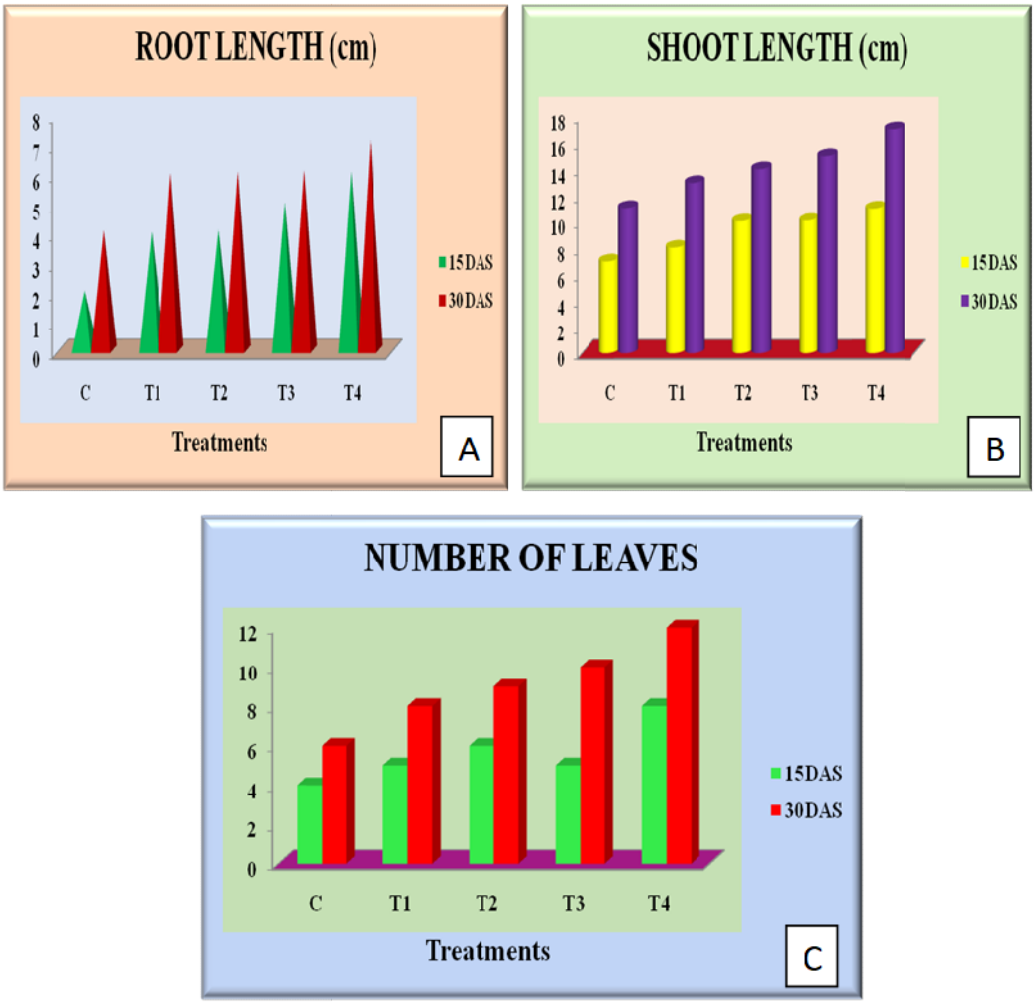


Figure 1. Biometric characters of Amaranthus (*Amaranthus spinosus* L.) on 15 and 30 DAS A) Root length B) Shoot length C) Number of leaves

A significant increase was noted in tap root length of 13.37 cm over control of 12.88 cm in sweet potato with the application of farmyard manure at 20 t ha^{-1}[14].

The significant increased in shoot length (cm) was observed in S4 treatments being vermicompost of *Phumdi* (86.6) followed by other treatment when compared to control (49.6) and root length was significant increase in S4-Vermicompost of *Phumdi* (41) over control (21.3) respectively[11].

Plant height of maize differed significantly in all days respectively. On 45 days, the plant was maximum in compost from pig waste (70.19 cm)

followed by chicken compost (51.40 cm) and control (22.45 cm). The tallest plant on 75 days was observed in pig waste (169.56 cm) when compared to chicken compost (124.47 cm) and shortest was recorded in control (76.99 cm) [15].

In black gram, significant increase in shoot length was observed in T_4 treatment-Fruit Waste + cow dung + *P. eous* + *T. asperelloides* + *eugeniae*(56.50 cm, 58.13 cm and 32.70 cm) followed by T_3 and C- Control (20 cm, 24 cm and 32.70 cm) and the root length also increases in T_4 treatment (12.20 cm, 15.20 cm and 17.10 cm) when compared to control (4.20 cm, 4.80 cm and 5.10 cm) on 15, 35 and 55 DAS [16]. Our findings agree with all the above findings.

Number of leaves:

In Amaranthus plant, the number of leaves increased significantly in T_4 treatment (8 and 12) followed by other treatment and control (4 and 6) on 15 and 30 DAS (Figure-1).

The study observed that treatment M1 (with mulch) + S1 (60 cm x 40 cm) + F1 (40:60:40 NPK kg Ha^{-1}), produced highest number of leaves (26.93) in ornamental sunflower[17].

The study reported that maximum number of leaves under the ear was observed in chicken compost (7.25) followed by pig compost (6.43), and 6.23 for the control[15].

The number of leaves was recorded highest in Ecodrum compost treatment (13.66) amended pot media as followed by coarse (11.66) and other treatments and control (8.66) in Chinese kale[18].

Fresh Weight and Dry Weight

As presented in figure-2, the maximum fresh weight was recorded in T_4 (3.151 g and 4.213 g) against other treatment and control (2.241 g and 3.185 g) on 15 DAS and 30 DAS. Significant increase in dry weight of *Amaranthus*was noted in T_4 treatment (1.113 g and 2.156g) which is followed by T_3 treatment (1.110 g and 2.131 g) over control (0.927 g and 1.183 g) on 15 DAS and 30 DAS.

The fresh weight and dry weight noted maximum in S_M (50% of compost) 8.14 gm, 0.78 gm which is followed by S_H (100% of compost) 7.91 gm, 0.73 gm and S (control) 4.87 gm and 0.41 gm in radish [19].

Maximum increase (81% and 75%) in shoot fresh weight was recorded in T_6 (Combined treatment of *Bacillussubtilis*, *B. thuringiensis* and *B. megaterium* in combination) followed by T_5 (Combined treatment of *B. subtilis*, *B. thuringiensis* and *B. megaterium*), in both the sensitive and tolerant varieties. Maximum increase (77%) in shoot dry weight was recorded in T_6 (Combined treatment of *B. subtilis*, *B. thuringiensis* and *B. megaterium* in combination) for the sensitive variety whereas, in tolerant variety maximum increase (71%) was recorded in T_2[20].

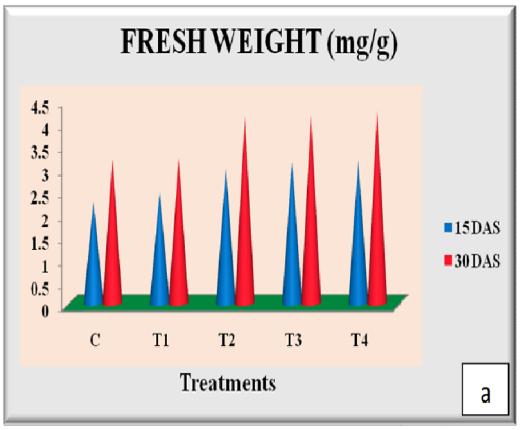
Yield parameters:

Root length, Shoot length and No. of leaves on 45 DAS:

The data presented in figure-3 & 4, showed the root length, shoot length, number of leaves, fresh weight and dry weight of leaves were maximum in T_4 treatment when compared to other treatment and control on 45 DAS. Significant increase in root length (8.3 cm), shoot length (21.05 cm), numbers of leaves (16), fresh weight and dry weight (8.715 g and 3.118 g) was recorded in T_4 treatment when compared to control (5.3 cm, 11.07 cm, 9, 3.298 g and 1.100 g) respectively.

Our studies correlated with the previous studies where an increase in plant height (16.83) was observed with the application of soil + 100% compost peanut shells when compared to control[21].

Shoot length and root length increased significantly in T_4 treatment when compared to control in cowpea due to the application of cocoa shell compost[22].



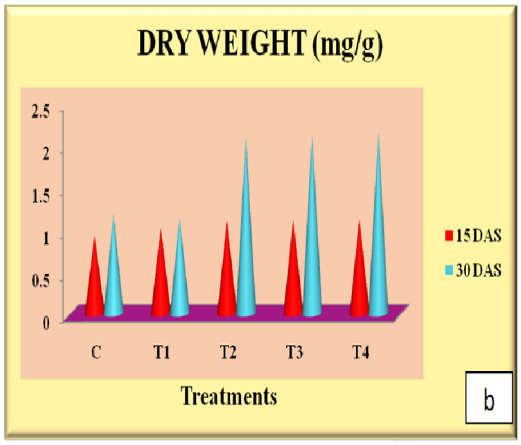


Figure 2. Vegetative parameters of *Amaranthus* (*Amaranthus spinosus* L.) on 15 and 30 DAS
a. Fresh weight b. Dry weight

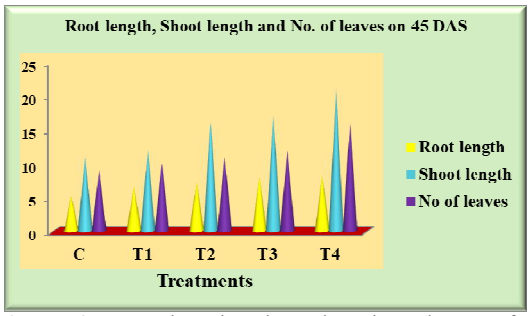


Figure 3. Root length, Shoot length and No. of leaves of *Amaranthus* (*Amaranthus spinosus* L.) on 45 DAS

Maximum number of leaves / plants was noted in T_8 (75% RDF + 12.55 FYM + 12.5% VC) being 97.80 which is followed by T_3 (RDF + 10 tones VC) being 94.00 and by T_9 (50% RDF + 25% FYM + 25% VC) i. e. 93.20 in cucumber[23].

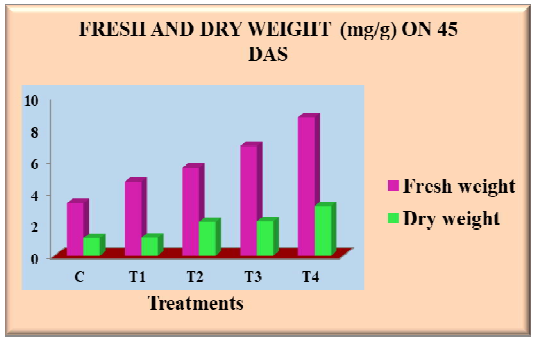


Figure 4: Fresh and Dry weight of *Amaranthus* (*Amaranthus spinosus* L.) on 45 DAS

The findings concluded that the total fresh weight was highest in T_5treatment (6.6 g) and least was observed in T_1 treatment (4.3g), the total dry weight increase significantly in T_6 treatment (2.3 g) followed by T_0 treatment (1.3g) due to the application of vermicomposted weed plants waste using *Eudrilus eugeniae* in brinjal plant[24].

The maximum fresh weight was obtained in T1- kitchen waste compost (KWC) decomposed by *Pseudomonas* sp. (13.00g) followed by T4- kitchen waste compost (KWC) decomposed by *Trichoderma viride 3* (12.88g), T7- Farmyard manure (12.83g) and T9- Control (10.00g). Significant increase in dry weight was noted in T1- kitchen waste compost (KWC) decomposed by *Pseudomonas* sp. (5.55g) followed by T4- kitchen waste compost (KWC) decomposed by *Trichoderma viride*3 (5.50g), T6- kitchen waste compost (KWC) decomposed by TV (5.44g) and T9- Control (4.14) in the crops[25].

The study reported that a maximum fresh weight of Chinese kale was recorded in Market compost (0.276 gms) grown plants followed by Ecodrum (0.271 gms), when compared to control (0.133 gms)[18].

Conclusion

The present study is to provide the possibilities of using the municipal solid waste like banana peel to enhance the crop productivity and sustainable environment.

Degradation of the banana peel was done with the help of *Trichoderma asperelloides* for 90 days. From our results, it has been concluded that physicochemical changes in banana peel biocompost was due to the presence of microorganisms which play a vital role in composting process and application of banana peel biocompost increased the growth of Amaranthus (*Amaranthus spinosus* L.)

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