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EFFECT OF BIOCOMPOSTED VEGETABLE AND GROUNDNUT SHELL WASTE ON THE GROWTH IMPACT OF PIGEON PEA (*CAJANUS CAJAN* (L.) MILL SP.)

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Keywords:

Biochemical parameters, Eudriluseugenia, DAS-days after Sowing and Lignin, Electric conductivity, *Pigeon pea*

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ABSTRACT: Department of Botany, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu, conducted a pot culture experiment for analyzing the effect of bio-composted groundnut shell and vegetable waste on the growth impact of *Pigeon pea* (*Cajanus cajan* (L.) Mill sp. Organic wastes and by-products are renewable forms of resources generated all over the world. The present work explores the potential application of eco-friendly compost from groundnut shell and vegetable wastes. The study mainly deals with the physicochemical properties of raw and composted vegetables and groundnut shell Waste, pH and Electric conductivity, Lignin, Total Nitrogen (N), Total Phosphorous (P), Total Potassium (K), and C: N ratio. Composting was carried out with the help of *Trichoderma asperelloides*, *Pleurotus florida*, and *Eudrilus eugeniae*. The experiments consist of four treatments *viz.*, C control, T1- compost 1 (Vermi-composted groundnut shell and vegetable waste (25g)) T2- compost 2 (Vermi-composted groundnut shell and vegetable waste (50g), T3-compost 3 (Vermi-composted groundnut shell and vegetable waste (75g). Chlorophyll, protein, and carbohydrate content were analyzed in the test crop (*Cajanus cajan* (L.) Millsp.) During 15, 35, 55, and 75 days. The treatment T3- compost 3 consisting of vermicomposted groundnut shell and vegetable waste (75 g) shows significantly increased chlorophyll, protein, and carbohydrate content as compared to the control and T1, T2 treatments. The reuse of groundnut shell and vegetable waste compost can be used as an appropriate method of environment management. Hence, from the present investigation, it was clear that bio-composted groundnut shell and vegetable waste enhanced the biochemical parameters in the leaves of pigeon pea.

INTRODUCTION: Organic farming is followed by many people since it produces eco-friendly compost without the use of any chemical fertilizers. Some people opt for chemical fertilizer which might give a good yield, but it affects human health and pollutes the environment. Organic farming produces healthy plants, maintains soil micro-organisms, and reduces environmental pollution.

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Organic manure can be used as an alternative measure to improve soil fertility, microbial biomass, major nutrients, and it is also an alternative method of crop production that is safe for the environment and public health [1, 2]. We are aware that yearly million tonnes of agricultural wastes are produced in our country, and a major part of wastes untreated leads to environmental pollution.

Intensive use of chemical fertilizers has its side effect on polluting underground water, destroying microorganism and soil fertility in the ecosystem [3]. Compost contains a variable amount of N, P, K, and micronutrients for plant growth. Organic manure and biofertilizers such as vermicompost and nitrogen-fixing bacteria give high-quality yield free of harmful chemicals and account for human safety [4, 5]. It also supplies an abundant amount of organic matter to improve the chemical and physical properties of soil with less quantity of NPK [6].

India is the second-largest vegetables producing country in the world with 146.55 million tonnes of vegetables during the year 2010-2011 [7]. Vegetable waste is one kind of municipal solid organic wastes holding very high moisture (88–94%) and %) and slightly acidic pH thus becoming a nuisance to the environment [8]. Groundnut is a nutritious leguminous crop grown mainly for seed and oil worldwide. Groundnut shells are the leftover product obtained after the removal of groundnut seed from its pod.

This is the abundant agro-industrial waste product that has a very slow degradation rate under natural conditions [9]. Pigeon pea (*Cajanus cajan* (L.) Millsp.) is commonly known as Red gram, belongs to the family Fabaceae.

It is cultivated as human food, and it also has many medicinal properties for the treatment of various diseases and also contains a high level of proteins and important amino acids [10]. The present study is to produce eco-friendly vermin-compost from groundnut shell and vegetable wastes and its effect on chlorophyll, protein, and carbohydrate of Pigeon pea.

MATERIALS AND METHOD:

Collection of Seeds: Seeds of *Cajanus cajan* (L.) Mill sp. was obtained from Tamil Nadu Agricultural University, Coimbatore.

Collection of Bio Wastes: The agro-industrial waste groundnut shell and municipal solid waste of vegetables was collected in large amounts from in and around Coimbatore, Tamil Nadu. The collected wastes were chopped into small pieces. It was sun-dried and stored in gunny bags.

Composting: Composting was done in 1 meter depth and 4 square feet wide pits. It was filled with 50% of groundnut shell + 50% vegetable wastes, *Trichoderma asperelloides,* and *Pleurotus florida*. After pre-decomposition pre-digested material is inoculated with 20 healthy exotic earthworms *(Eudrilus eugeniae)*. After composting, the samples were taken.

Evaluation of Compost Maturity: Physical And Chemical Assays of Composted agro-waste were analyzed based on standard method. The methods have been proposed for estimating the degree of maturity.

1. pH

2. Electric conductivity [11]

3. Lignin [12]

4. Organic carbon (%) [13]

5. Total Nitrogen (%) [14]

6. Total Phosphorus (%) [11]

7. Total Potassium (%) [11]

Pot Culture Experiment:

Treatment Application and Cultivation: The pots were filled with 7 kg of sandy loam soil. The vermicompost was applied to the respective pots. The treatments used are:

C - Control. T_1- Vermicomposted groundnut shell and vegetable waste (25 g). T_2 - Vermicomposted groundnut shell and vegetable waste (50 g). T_3 - Vermicomposted groundnut shell and vegetable waste (75 g). Viable seeds were selected and sown in each pot with three replications. After germination, three healthy plants were maintained per pot. Plant protection measures were followed.

Biochemical Analysis: Biochemical analysis consists of Chlorophyll, protein, and carbohydrate content in leaves.

Chlorophyll: Estimated the Chlorophyll ‘a’, Chlorophyll ‘b’ and total Chlorophyll in leaves on 15, 35, 55 and 75 DAS [15].

Protein: Estimated on 35, 45, and 75 DAS in leaves [16].

Carbohydrate: Estimated on 35, 45, and 75 DAS in leaves [17].

RESULTS AND DISCUSSION: The experiments conducted in pigeon pea (C*ajanus cajan* (L.) Millsp.) using three treatments showed the following results.

Physicochemical Properties of Raw and Composted Vegetables and Groundnut Shell Waste Table 1: The compost's pH indicates the decomposition, degradation, and maturity of the compost. The compost should maintain a neutral value between 6 to 8, which tends to be more acidic on maturation.

The pH value in raw groundnut shell and vegetable waste is 6.5, and as the decomposition started, it increased to 7.2 in composted groundnut shell and vegetable waste. Similarly, an increase in pH was observed [18] in vermicompostedcoirpith + cow dung + panchagavya and composted paddy straw (6.97) as compared to the raw sample (6.35) [19].

Electrical conductivity is used to measure the nutrient in the form of salt in compost. The EC value of raw groundnut shell and vegetable wastes is 2.96 millimhos cm^{-1} which increased to 16.22 millimhos cm^{-1}.

The present result coincides with the result [20] observed an increase in EC from 2.4 dSm-1 to 7.7 dSm-1 at different maturity stages (10, 20, 30, 40, 50 and 60 days) of Municipal Solid Waste Compost (garbage and sewage). A similar result was observed [21], the EC in peanut shell during composting showed a significant increase of 4.30 dS/m compared to a raw sample of 1.38 dS/m.

The lignin content in raw groundnut shell and vegetable wastes was 8.5, and it gets reduced gradually to 4.1 when composting with *Pleurotus florida* and *Trichoderma asperelloides*. The results recorded that lignin content of the raw coirpith was 35.10% and after composting with *Pleurotus florida* it gets reduced to 12.70% [22]. Similar result of increase in total potassium content from 0.61 per cent to 0.81 percent in coirpith composted by *Pleurotu sflorida* [22].

The Initial nitrogen content of raw groundnut shell and vegetable wastes was 1.20 percent, and there is a slight increase to 1.80 percent in composted groundnut shell and vegetable wastes. A similar result observed an increase in total nitrogen content from 1.40 percent to 2.69 percent in poultry droppings wastes amended with bagasse inoculated with the fungal consortium (*Aspergillus flavus, Aspergillus niger, Trichoderma viride,* and *Phanerochaete chrysosporium*) after 30 days of decomposition [23]. Data presented in table-I stated that the total phosphorus content revealed an increasing value from 2.31% to 3.96% in raw and composted groundnut shell and vegetable waste. The present study indicates an increase in total phosphorus content during composting of press mud using bacterial consortium from 0.58% to 1.46% with an incubation period of 49 days [24].

The apparent increase in potassium content might be due to the higher mineralization rate due to enhanced microbial and enzyme activity. As the results are shown in **Table 1**, the potassium content gradually increases from 0.62% (raw groundnut shell and vegetable waste) to 1.24% (composted groundnut shell and vegetable waste).

C: N ratio in raw and composted groundnut shell and vegetable waste showed a gradual decrease from 59.68:1 to 18:1. This is in accordance with the findings [25] reported a drastic reduction in C: N ratio from 27.58 to 13.33 percent in press mud sample inoculated with *Eisenia foetida* after 60 days of decomposition. A decrease in the C: N ratio is due to an increase in the humidification of organic matter as the decomposition progresses.

Biochemical Parameters:

Estimation of Chlorophyll: Chlorophyll 'a', chlorophyll 'b', and 'total' chlorophyll content of pigeon pea leaves is maximum in T_3 (Vermi-composted groundnut shell waste + vegetable waste (75 g) treatment when compared to control (Table-II).

The treatment T_3 (Vermicomposted groundnut shell waste + vegetable waste (75 g) showed the maximum chlorophyll content from 15 DAS to 75 DAS, which ranged from 0.026, 0.028, 0.029, and 0.033 mg/g tissue, followed by T_2 (Vermi-composted groundnut shell waste + vegetable waste (50 g) treatment which have 0.019, 0.022, 0.025 and 0.028 mg/g tissue (Chlorophyll 'a'), 0.019 to 0.024 mg/g tissue of T_3 treatment followed by T_2 treatment of 0.011 and 0.016 mg/g tissue (Chlorophyll 'b') on 15 DAS and 35 DAS.

The equal value of maximum chlorophyll 'b' content is observed in T_3 treatment of 55 DAS and 75 DAS, which is 0.029 mg/g tissue, respectively. The chlorophyll 'b' content in T_2 treatment is slightly increased (0.028 gm/g tissue) in 55 DAS and it decreased (0.022 gm/g tissue) on 75 DAS. The 'total' chlorophyll content increased significantly in T_3 treatment (0.045, 0.052, 0.058 and 0.062 mg/g tissue) followed by T_2 treatment (0.031, 0.036, 0.045 and 0.049 mg/g tissue) on the 15, 35, 55 and 75 DAS. A similar result showed an increase in chlorophyll 'a' and 'total' chlorophyll content of 4.44 and 7.55 mg gm^{-1} tissue with soil of 10.5 pH + sand + farmyard manure at 2:1:1 ratio [26]. Chlorophyll 'b 'content of 3.53 mg/g tissue was maximum with soil pH 9.0. The result reported a remarkable increase in chlorophyll a, chlorophyll b and total chlorophyll from 30 to 60 DAS in cowpea, due to the application of efficient micro-organism Sewage (80t ha^{-1}) incorporated treatment [27].

The finding was positively correlated with an increase in chlorophyll content (0.725 mg / g tissue 0.800 mg /tissue, 0.846 mg / g tissue and 0.635 mg / g tissue) as compared to the control (0.531 mg / g tissue, 0.606 mg / g tissue, 0.708 mg / g tissue and 0.497 mg / g tissue) on 25, 50, 75 and 100 days in groundnut [28].

The study supported [29] that the maximum content of chlorophyll 'a' (0.865, 2.150, 2.850 and 1.750 mg/g fresh weight), chlorophyll 'b' (0.513, 1.433, 2.550 and 0.985 mg/g fresh weight) in groundnut is due to the application of vermicompost (5 t/ha) and *Arbuscular mycor rizhal* fungi at 30, 60, 90 and 120 DAS. A remarkable increase was observed in chlorophyll content in rice variety MR 219 with the application of 50% chemical fertilizer NPK+ *Bacillus spaericus* (UPMB 10) + *Pseudomonas* spp. as compared to the control (no fertilizer) [30]. The maximum increase in T_3 treatment might be due to the solubilisation of plant nutrients due to the application of vermicomposted groundnut shell and vegetable wastes.

Estimation of Protein Table 3: The highest protein content of red gram was noted in treatment T_3 (44.96mg/g, 62.90 mg/g, 74.80 mg/g and 92.93 mg/g) on 15 DAS, 35 DAS, 55 DAS and 75 DAS respectively when compared to the control (37.33 mg/g, 55.86 mg/g, 67.30 mg/g and 83.66 mg/g). The results show that coir pith compost increases the protein (8.81 mg/g) content in *Bauhinia purpurea* [31]. Vermicompost increases the protein content (3.25 mg/g) on 30 DAS in chilli plant [32] and the different fertilizers andcycocel increases the protein (39.179) in mustard [33]. Increased protein (15.28) in Okra (*Abelmoschus esculentus*) is reported in vermicompost [34]. The combined application of biofertilizers, inorganic fertilizers and vermicompost increases protein (2.58) in chilli plant [35]. The present findings coincide with the results of [36] theyfound that the application of composted T_6 - compost 6 (Raw coir pith predigested by using *Pleurotus sajorcaju* and *Eudrilus eugeniae* (5 t/ha) registered maximum protein content in *Glycine max* L. Protein was significantly enhanced due to the application of groundnut shell and vegetable wastes.

Estimation of Carbohydrate: An increase in carbohydrate content was achieved in T_3 treatment (43.100mg/g, 57.90 mg/g, 77.90 mg/g, 92.00 mg/g) on 15 DAS, 35 DAS, 55 DAS and 75 DAS when compared to the control (12.98 mg/g, 37.46 mg/g, 49.56 mg/g and 69.16 mg/g) **Table 4.**

The similar results were observed vermin-composted coir pith and garden soil enhanced the carbohydrates content in the leaves of *Andrographis paniculata* [35]. The application of biofertilizers, inorganic fertilizers and vermicompost increases carbohydrates (3.38) in chilli plant [36]. Vermicomposted Ipomea increases the carbohydrate (3.75) [37] in ladies finger and the application of vermicompost increased carbo-hydrate content (37.80 mg/g) in chillies [38].

A similar result was observed by [39] who reported that the carbohydrate content in *Amaranthus viridis* L. was found to be more in T_2 on the 30^{th} day and T_3 on the 45^{th} day. The increase in carbohydrates content might be due to the enormous amount of nutrients in the vermicomposted groundnut shell and vegetable waste which would have enhanced the carbohydrates content in red gram.

TABLE 1: PHYSICO-CHEMICAL COMPOSITION OF THE RAW AND COMPOSTED VEGETABLE AND GROUNDNUT SHELL WASTES

Parameters	Raw	Composted
pH (%)	6.5	7.2
Electrical Conductivity (%)	2.96	16.22
Lignin (%)	8.5	4.1
Total nitrogen (%)	1.20	1.80
Total phosphorus (%)	2.31	3.96
Total potassium (%)	0.62	1.24
C:N ratio	59.68:1	18:1

TABLE 2: EFFECT OF VERMICOMPOSTED GROUNDNUT SHELL AND VEGETABLE WASTE ON CHLOROPHYLL CONTENT OF *CAJANUS CAJAN* (L.) MILL SP. (15, 35, 55 AND 75 DAS)

Treatments	Chlorophyll'a' (mg/ tissue)				Chlorophyll 'b' (mg/ tissue)				Total'chlorophyll (mg/ tissue)			
C	0.015 ± 0.001	0.015± 0.004	0.017± 0.002	0.018± 0.001	0.003 ± 0.001	0.00± 0.002	0.0± 0.002	0.01± 0.003	0.020± 0.006	0.022± 0.002	0.027± 0.001	0.037± 0.001
T_1	0.018 ± 0.003	0.019 ± 0.002	0.022± 0.003	0.022 ± 0.004	0.005 ± 0.003	0.012± 0.004	0.020± 0.005	0.019± 0.004	0.024± 0.001	0.032± 0.001	0.038 ±0.003	0.042± 0.003
T_2	0.019 ± 0.004	0.022 ± 0.001	0.025± 0.004	0.028 ± 0.001	0.011 ± 0.002	0.016 ±0.003	0.028± 0.001	0.022± 0.005	0.031± 0.002	0.036± 0.004	0.045± 0.004	0.049± 0.004
T_3	0.026 ± 0.005	0.028 ± 0.003	0.029± 0.001	0.033 ± 0.003	0.019 ± 0.004	0.024± 0.006	0.029± 0.003	0.029± 0.001	0.045± 0.004	0.052± 0.003	0.058± 0.002	0.062± 0.005
SEd		0.00006				0.00072				0.00539		
CD (p<0.05)	0.00013				0.00147					0.01097		

TABLE 3: PROTEIN (MG/G TISSUE) CONTENT IN LEAVES OF *CAJANUS CAJAN* (L.) MILL SP.

Treatments	15 DAS	35 DAS	55 DAS	75 DAS
C	37.33 ± 0.208	55.86 ± 0.231	67.30 ± 0.200	83.66 ± 0.252
T_1	40.10 ± 0.265	57.63 ± 0.306	69.46 ± 0.351	86.00 ± 0.200
T_2	43.96 ± 0.208	60.30 ± 0.361	71.26 ± 0.252	87.70 ± 0.200
T_3	44.96 ± 0.252	62.90 ± 0.300	74.80 ± 0.200	92.93 ± 0.208
SEd		0.20817		
CD (p<0.05)		0.42403		

TABLE 4: CARBOHYDRATE (MG/G TISSUE) CONTENT IN LEAVES OF *CAJANUS CAJAN* (L.) MILL SP.

Treatments	15 DAS	35 DAS	55 DAS	75 DAS
C	12.98 ± 0.227	37.46 ± 0.115	49.56 ± 0.306	69.16 ± 0.306
T_1	24.66 ± 0.551	47.13 ± 0.252	61.36 ± 0.153	76.86 ± 0.208
T_2	37.300 ± 0.200	54.20 ± 0.265	67.00 ± 0.300	86.80 ± 0.200
T_4	43.100 ± 0.173	57.90 ± 0.200	77.90 ± 0.361	92.00 ± 0.200
SEd		0.22030		
CD (p<0.05)		0.44875		

CONCLUSION: Bio-compost of vegetable and groundnut shell waste provides a good alternative source to chemical fertilizers, which might also provide an eco-friendly environment. It avoids pollution, improves water holding capacity and soil fertility. The overall goal of waste management is to collect, treat and dispose of the waste using the most economical means available. The present investigation clearly indicates the positive effects of vermicomposted groundnut shell and vegetable waste which reflects an enhancement in the soil nutrients and thus resulted in the increase of biochemical parameters of test crop. The study concludes that among the four treatments, T_3 (75 g vegetable + groundnut shell waste) gave the best results.

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