

Results and Discussion

The present chapter describes the results and discussions of microbial population during biocomposting, physicochemical parameters, FTIR and SEM characteristics of raw and biocomposted cocoa shell Waste (CSW) and jack fruit peel waste (JFPW) as well as their effect on the biometric and biochemical characteristics, antibacterial, antioxidant, mineral composition and phytochemical analyses of selected test crops *Vigna unguiculata* (L.) Walp. Var. Co CP 7, *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc. Var. NS-621, *Clitoria ternatea* L. and *Amaranthus tricolor* L. Var. Arun. The results of the current research on “Effect of Biocomposted Cocoa Shell and Jack Fruit Peel Waste on Certain Crop Plants and Soil Fertility” are discussed under the following headings in four phases of experimental studies as previously mentioned in chapter 3 (Materials and methods). The current chapter provides the significant outcomes of this research (Tables 1-41 & Figures 1-25).

PHASE I

4.1 MICROBIAL POPULATION

4.1.1 Microbial Population during 30, 60 and 90 Days of Biocomposting

The eight distinct biocompost combinations were generated using agroindustrial waste from cocoa shell waste (CSW) and jack fruit peel waste (JFPW). The following biocomposted treatments were used for microbial population analysis

C - Control, (without treatment), C₁- Raw CSW + *Eudrilus eugeniae* 5t/ha⁻¹(T₁), C₂- Raw CSW + 20 g *Pleurotus eous* + *Eudrilus eugeniae* 5t/ha⁻¹ (T₂), C₃- Raw CSW + 20 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (T₃), C₄-Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (T₄), C₅- Raw Jack fruit peel + *Eudrilus eugeniae* 5t/ ha⁻¹ (T₅), C₆- Raw JFPW + 20 g *Pleurotus eous* + *Eudrilus eugeniae* 5t/ ha⁻¹ (T₆), C₇ - Raw JFPW + 20 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (T₇), C₈- Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (T₈).

The results from the examination of the total microbial populations (bacteria, fungi, and actinomycetes) in the waste from cocoa shells and jack fruit peels determined the quality of biocompost. Figure 1-3 displays 30 to 90 days of microbial fluctuation in each biocomposting unit.

Bacterial population

The overall changes in the bacterial population were recorded in 30, 60, and 90 days as shown in Figure 1. The beginning of mesophilic phase at 30 days revealed that C₈ (4.84×10^7 CFU g⁻¹), had higher total bacterial counts followed by C₄ (3.83×10^7 CFU g⁻¹) than the control (1.12×10^7 CFU g⁻¹). On the 60th days, C₈ (6.33×10^7 CFU g⁻¹) outperformed followed by C₄ (5.76×10^7 CFU g⁻¹) than in the control (1.41×10^7 CFU g⁻¹) in terms of outstanding bacterial load in the thermophilic phase. The bacterial population appeared to have slightly declined during the maturation period, which lasted from 90 days. The highest populations of bacteria were seen in the C₈ (4.77×10^7 CFU g⁻¹) and C₄ (2.95×10^7 CFU g⁻¹) groups, which outperformed the control (1.10×10^7 CFU g⁻¹) as shown in Figure-1.

Fungal population

In comparison to the control (0.21×10^4 CFU g⁻¹) on the 30th day, the total fungal count in C₈ (0.92×10^4 CFU g⁻¹) were significantly greater in the mesophilic phase followed by C₄ (0.79×10^4 CFU g⁻¹). The thermophilic phase showed a significant increase in C₈ (1.38×10^4 CFU g⁻¹) on the 60th day followed by C₄ (1.12×10^4 CFU g⁻¹) as compared to the control (0.31×10^4 CFU g⁻¹). Figure-2 illustrates the fungal population which reduced in C₈ (0.78×10^4 CFU g⁻¹) and C₄ (0.66×10^4 CFU g⁻¹) compared to the control (0.18×10^4 CFU g⁻¹) during the maturation phase on 90 days.

Actinomycetes population

Figure -3 showed C₈ had the greatest actinomycetes population (0.50×10^2 CFU g⁻¹), on the 30th day, followed by C₄ (0.45×10^2 CFU g⁻¹), as compared to the control (0.14×10^2 CFU g⁻¹) in the mesophilic phase. When compared to the control (0.18×10^2 CFU g⁻¹) on the 60th day of the thermophilic phase, a significant number of actinomycetes were identified in C₈ (0.61×10^2 CFU g⁻¹) and C₄ (0.57×10^2 CFU g⁻¹). The population of actinomycetes decreased from 90th days, and the highest population of actinomycetes was found in C₈ (0.42×10^2 CFU g⁻¹), followed by C₄ (0.38×10^2 CFU g⁻¹), over control (0.13×10^2 CFU g⁻¹) in the maturation phase.

Temperature is the primary factor influencing microbial activity and other physicochemical changes in composting material. Decomposable materials temperature changed the temperature spectrum. When a heap has different communities of decomposers that constitute a typical succession of three temperature phases (Mesophilic, Thermophilic and maturation phase or cooling phase), during this period the temperature in the heap fluctuates.

Figure - 1
Impact of Biocomposting on Bacterial Population

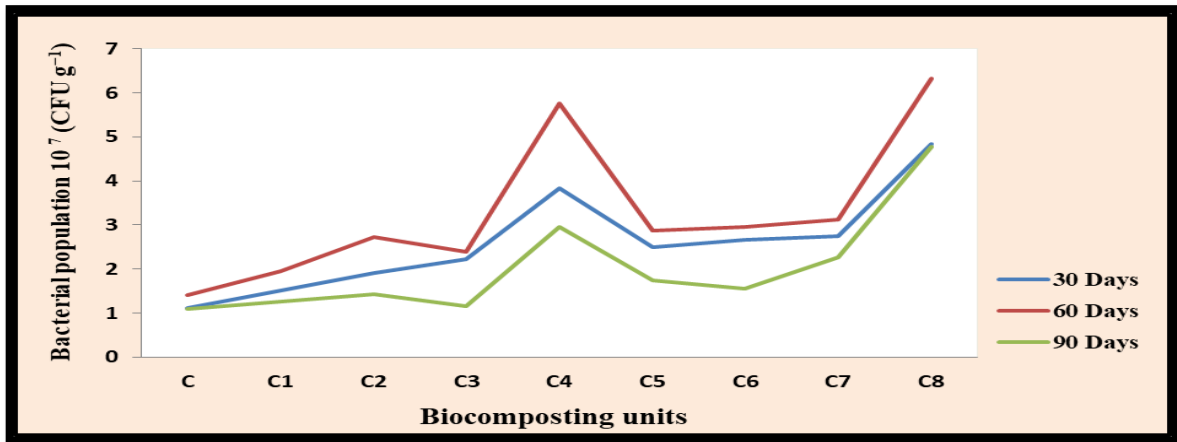


Figure - 2
Impact of Biocomposting on Fungal Population

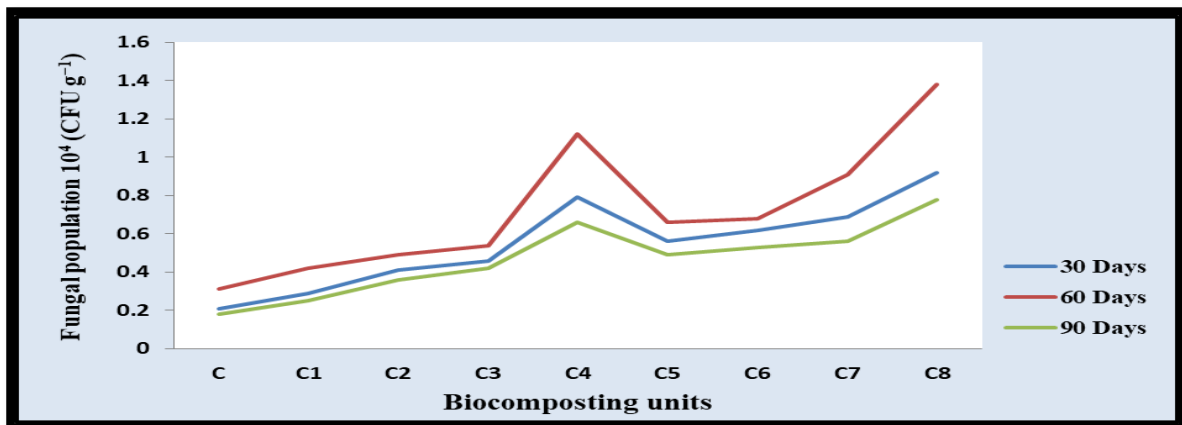
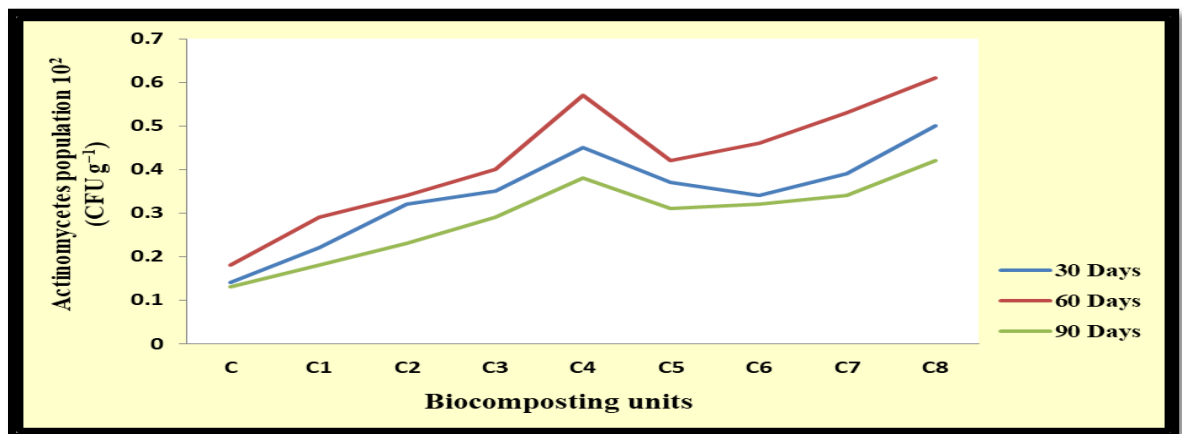


Figure - 3
Impact of Biocomposting on Actinomycetes Population



Aerobic composting had a greater bacterial population than vermicomposting. The largest population in aerobic composting was likely owing to the inclusion of a microbial consortium culture dominated by bacterial isolates. Fungi populations, like bacterial counts, have dropped with time. However, in contrast to bacterial population trends, a lower number of fungal colonies were seen under aerobic composting, presumably due to competition with a greater bacterial population. Similar to fungi, vermicomposting produced a greater population of actinomycetes than aerobic composting (Chander *et al.*, 2018).

Microorganisms are essential part of biodiversity and play a significant role in structuring and functioning of the ecosystem in the environment. The total microbial population of vermicompost was found to have significantly higher in treatment T₄ (600(g) TW + 100 (g) CD + 300(g) KW) and T₃ (500(g) TW + 100(g) CD + 400(g) KW) than in T₂ and T₁ (Emperor and Kumar, 2015). The higher soil microbial population in treatments receiving organic nutrient inputs as compared to other treatments (Aher *et al.*, 2018).

Similar observations were made by many earlier researchers (Chandna *et al.*, 2013) in agricultural by products; Sridevi *et al.*, (2016) in water hyacinth compost; Mushan *et al.*, (2014) in tendu leaf litter; Sakthivigneswari and Vijayalakshmi (2017) in coir pith; Sequeira and Chandrasekar, (2015) in municipal solid waste and Bharadwaj, (2020) in farm yard waste.

The number of bacteria, fungus and actinomycete was noticeably raised from 0 through 30 days, 30 through 60, and it was decreased from days 60 through 90. The micronutrient levels of the C₈ and C₄ biocompost have been increased which would have the microbial population. From the results of the current investigation is evident that combined application (C₈&C₄) of CSW and JFPW biocompost boosted the microbial load of the biocompost. Microorganisms produce mineral complex substances that interact with the soil available nutrients for plants and then break them down into a variety of bioactive compounds as part of a secondary metabolism.

4.1.2 Physico-chemical composition of the raw and biocomposted CSW and JFPW

Lignin, cellulose, pH, electric conductivity (EC), organic Carbon (C), total nitrogen (N), total Phosphorus (P), total potassium (K), calcium (Ca), magnesium (Mg) and C: N ratio were analyzed in raw cocoa shell, jack fruit peel (Control) and different combination of eight biocomposting units (C₁,C₂,C₃,C₄,C₅,C₆,C₇ &C₈).

Lignin and Cellulose

Lignin and cellulose contents of raw cocoa shell and jack fruit peel waste were 43.6%, 45.2% and 32%, 28.5% respectively. It was reduced to 15.10%, 13.00% and 13.40%, 11.24%. This drastic reduction was maximum in C₈ (Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (T₈)) as depicted in Table - 1.

Lignin and cellulose are organic substances that occur naturally in all plants. Lignin is most prevalent complex heteropolymer which is deposited in the walls of some specialised plant cells as a result of secondary cell wall biosynthesis. Cellulose is made up of a lengthy chain of glucose molecules that are mostly joined together by glycosidic linkages. It is a complex carbohydrate or polysaccharide, that is insoluble and difficult to digest. As a result its complicated structural makeup and natural disintegration takes a long time.

Based on the findings of the current study, significant decrease in lignin content is caused by the combined action of lignocellulolytic microflora, earthworms and *Pleurotus* species in the decomposition process, and the resulting biocompost serves as a good source of plant nutrients for long-term agricultural production and soil structure.

Similar findings were corroborated by Kumar and Ganesh, (2012), who observed a decrease in lignin and cellulose content in the treatment inoculated with coirpith (1 kg) + *Phanerochaete chrysosporium* (5 ml) + cow dung (5%) + panchagavya as compared to the baseline value. Muthurayar and Dhanarajan, (2013) recorded least cellulose and lignin contents in the T₁ (Coir pith + Cow dung + Vegetable market waste + Poultry waste + Mixed microbial culture (*Trichoderma viridae* + *Pleurotus sajarcaju*)) treatment after a composting for 12 weeks. The result is also on par with Arumugam *et al.*, (2018), who reported earth worms and a variety of hydrolytic bacteria in their guts disassemble lignin and cellulose, which helps grind the meal mixture and causes gradual deterioration.

Jaybhaye and Satish, (2016) have also reported that significant difference in lignin and cellulose, after composting with fungal bioinoculants in different combinations (Paddy straw + *Pleurotus sajor-caju* + *Trichoderma harzrzianum* + *Apergillus niger* + *Chaetomium globossum*). Similar observations were obtained by Thenmozhi (2015); Zhang *et al.*, (2019); and Prashija and Parthasarathi, (2020).

pH and Electrical conductivity (EC)

The parameters pH and EC play an important role in determining the chemical behaviour of metal ions. All biocomposted treatments have higher pH values than the control (Table 1). The trend was moving upward from acidic to just about neutral. The biocompost C₈ and C₄ achieved the highest pH values of 6.71 and 6.55, followed by other treatments and the control respectively.

When comparing raw cocoa shell (3.43 dSm⁻¹) to raw jack fruit peel (5.21 dSm⁻¹), it can be shown that the electrical conductivity (EC) value of the biocompost C₈ - Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ progressively dropped to 2.50 dSm⁻¹ and 2.26 dSm⁻¹. The quantity of salt-form nutrients in the biocompost is determined by electrical conductivity.

The existence of calciferous glands may be responsible for the compost's minor pH elevation, and the transit of cocoa shell and jackfruit peel waste through the earthworms gut is also responsible for the breakdown of heavy particles into smaller ones. The pH change might be caused by the mineralization of proteinaceous elements during vermicomposting. Vermicompost pH fluctuates dynamically and is influenced by the substrate.

The pH of the soil is much different and higher after compost treatments than it was before. After the application of compost, the pH increased in the majority of the treatments. The breakdown of organic materials releases K⁺, Ca²⁺, and Mg²⁺ as well as OH into the soil, which leads to a modest elevation in soil pH following compost addition (Das and Dkhar, 2012).

The EC (Electrical Conductivity) measurement plays a significant role in determining the acceptability and safety of compost for agricultural applications. It displays variations in salt content and mineral ions concentration. The creation of mineral ions during earthworm consumption and excretion, as well as the presence of bacteria in the vermicompost, are the major causes of the drastic reduction in electrical conductivity. This significant reduction in conductivity can be caused by the high concentration of soluble decomposition by microbial activity and mineralization.

The increase of pH from acidic to neutral in later stages could be due to the production of nitrogenous compounds and decomposition of organic acids (Li *et al.*, 2011). Arumugam *et al.* (2018), revealed that vermicompost with bacterial consortium (VCB) had a

higher pH level after 12 weeks of the vermicomposting period. The final vermicompost's EC level has greatly grown from the starting level (VC) in 19 weeks and from (VCB) in the first 12 weeks of the process. Similar results were made by studies carried out by Kumar and Ganesh, (2012); Jaybhaye and Satish, (2016); Rashad *et al.*, (2010); Sundaram and Vincent, (2017); Erana *et al.*,(2019); Karanja *et al.*,(2019) and Bharadwaj (2020).

Organic Carbon

The organic carbon content of the raw and biocomposted cocoa shell and jackfruit peel is displayed in Table -1. The combined decomposition action of *Pleurotus* species and earth worms could reduce the organic carbon content of raw cocoa shell and jackfruit peel waste. The current study found that the organic carbon content of all biocomposts decreased after biodegradation. A significant decrease in organic carbon was observed in the biocomposting units C₈ 9.80% compared to the initial value of 30.42%. The eight distinct biocomposting combinations were found to have less organic carbon in their end products than the control.

Compost reaches maturity when its organic carbon content varies. The ultimate result of the composting process will be stable compost if the carbon concentration degrades more quickly. The total organic carbon decreases during the process, showing the rate of decomposition of organic matter, as a result of the loss of carbon in the form of CO₂ generated by the joint activity of microbes and earthworms. The simultaneous digestion of cocoa shell and jackfruit peel waste by *Pleurotus eous*, *Pleurotus florida*, and *Eudrilus eugeniae* showed a decrease in the organic carbon content of biocomposting units.

This work is in harmony with the findings of Theradimani *et al.*, (2018) who reported the inoculation of coir waste with six *Pleurotus* spp., antagonists and biofertilizers reduced the organic carbon content. The maximum reduction in organic carbon content of coconut coir pith was brought by the inoculation of *Pleurotus djamor*. The result is also on par with Pandey *et al.*, (2012) who determined that sugar bagasse treated with urea and hot water along with *Pleurotus citrinopileatus* decreased the carbon content. This result was coincided with the report of Rashad *et al.*, (2010); Viji and Neelananarayanan, (2014); Varma *et al.*, (2015); Sivakumar and Karthikeyan, (2016); Patil, *et al.*, (2019); Karanja *et al.*, (2019) and Karpagavalli *et al.*, (2020).

Nitrogen

The maximum increase in nitrogen (1.62% and 1.59%) was noticed in the biocompost C₈ and C₄ produced by raw jack fruit peel and cocoa shell waste by using *Pleurotus eous*, *Pleurotus florida* and *Eudrilus eugeniae* followed by the other treatments and control. A perusal of data in Table-1 revealed the total nitrogen content in the end product of all the biocompost was higher than control.

Total nitrogen in compost is made up of organic and inorganic types of nitrogen, ammonium nitrogen (NH₄-N), and nitrate nitrogen (NO₃-N). A higher total nitrogen concentration with each step of degradation suggests a quicker rate of organic conversion. The reduction in carbon substrate caused by the breakdown of organic matter, which results in CO₂ release, can be attributed to the incremental increase in total nitrogen content during composting. The overall nitrogen concentration significantly increased during the vermicomposting process, possibly as a result of the organic matter being mineralized. This nitrogen is a crucial ingredient for plants to develop (Liu *et al.*, 2014).

Total nitrogen was found to be increased significantly with better results of prepared compost over farm yard manure (Bharadwaj 2020). The present observation is positively correlated with the findings of Theunissen *et al.*, (2010); Selvamuthukumaran and Neelanarayanan, (2012) and Indumathi (2017).

Each biocomposting units showed a rise in total nitrogen content caused by mineralization of organic waste by microorganisms as well as an increase in nutrients. By boosting the nitrogen mineralization of the biocompost, earthworms nitrogen transformations in manure may be able to keep the mineral nitrogen in the nitrate form. The quantity of nitrogen produced by the earthworm-mediated nitrogen mineralization of waste was significantly increased by the worm inoculation of agricultural waste (Cocoa shell and Jack fruit peel).

Phosphorus

The highest phosphorus content (1.40 % and 1.36 %) was achieved in the biocompost C₈ (Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ followed by biocompost C₄- Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ as compared to the raw cocoa shell and raw jack fruit peel waste (Table - 1).

Table - 1

Selected Physico-chemical Parameters Analysis of Raw and Biocomposted Cocoa Shell Waste and Jack Fruit Peel Waste

Physico-chemical composition	Raw CSW	Raw JFPW	Biocomposting Units							
			C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇	C ₈
Lignin (%)	43.6	45.2	19.14	18.50	18.23	15.10	18.12	17.60	16.5	13.00
Cellulose (%)	32	28.5	17.52	17.20	15.00	13.40	16.28	16.53	16.00	11.24
pH	6.04	4.66	6.30	6.34	6.41	6.55	6.18	6.26	6.38	6.71
EC (dS m ⁻¹)	3.43	5.21	2.57	2.92	2.85	2.50	3.42	3.43	3.40	2.26
Organic Carbon (%)	25.58	30.42	14.30	14.25	11.47	11.30	11.44	19.80	14.43	9.80
Nitrogen (%)	0.41	0.48	0.62	0.77	0.70	1.59	0.72	0.85	0.88	1.62
Phosphorus (%)	0.15	0.17	0.34	0.33	0.40	1.36	0.45	0.49	0.52	1.40
Potassium (%)	0.63	0.58	1.33	1.26	1.28	1.62	1.36	1.51	1.41	3.27
Calcium (%)	0.93	0.85	1.90	1.94	1.02	3.68	2.13	2.41	2.78	4.80
Magnesium (%)	0.42	0.39	1.62	1.66	1.74	3.54	1.82	1.86	1.95	3.81
C:N ratio	62:1	63:1	23:1	18:1	16:1	7:1	15:1	23:1	16:1	6:1

Where C-Control (without treatment), C₁ (Raw CSW+*E. eugeniae* 5 t/ha⁻¹), C₂ (Raw CSW+20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), C₃ (Raw CSW+ 20g *P.florida*+*E. eugeniae* 5 t/ha⁻¹), C₄ (Raw CSW+10 g *P. eous* +10 g *P.florida*+*E. eugeniae* 5 t/ha⁻¹), C₅ (Raw JFPW+ *E. eugeniae* 5 t/ha⁻¹), C₆ (Raw JFPW+20 g *P. eous*+ *E. eugeniae* 5t/ha⁻¹), C₇ (Raw JFPW+20 g *P. florida* + *E. eugeniae* 5t/ha⁻¹), C₈ (Raw JFPW +10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

These results agreed with the findings of Gogoi *et al.*, (2018) who reported that the enriched compost had the greatest available soil phosphorus status. It is possible that this is due to the action of organic acids by phosphate-solubilizing bacteria, which function as a chelating agent and form stable complexes with the abundant Fe and Al in acid soils, releasing phosphorus from Fe and Al clutches into the soil solution. Dey *et al.*, (2019), reported highest phosphorus content in vermicompost of Phumdi and vermicompost of MSW.

The present result coincides with the result of Huang *et al.*, (2017), who obtained raw and vermicomposted fresh fruits and vegetables. The phosphorus contents of raw banana peels increased in vermicomposted banana peels over control. This is in accordance with the findings of Sultana *et al.*, (2021) who reported different types of amended MSW compost under anaerobic conditions released highest phosphorus.

Similar increase in total phosphorus content was revealed by Muthurayar and Dhanarajan, (2013); Prabha *et al.*, (2015) and Zhan *et al.*, (2021). The action of microbial phosphatases during the biocomposting period in the gut microbiota as well as the presence of phosphate-solubilizing bacteria in worm castings are the primary causes of the release of phosphorus in an accessible form.

Potassium

It is evident from Table-1 that the initial total potassium (TK) content showed an increasing trend in different biocompost treatments as compared to the Control. A significant increase in potassium content (3.27% and 1.62%) was recorded in the biocompost C₈ and C₄ treatments followed by other treatments and control.

The result is also on par with Oluchukwu *et al.*, (2018) who observed that increased potassium content in sawdust compost. These results agreed with the findings of Chaudhary and Mishra, (2018) who reported that potassium is a crucial nutrient for plants and it boosts plant development due to the effect of composting process. The present observation is in accordance with the findings of Shyamala and Belagali, (2012); Patil *et al.*, (2019) and Bharadwaj (2020).

Calcium and Magnesium

Calcium (4.80%, 3.68%) and magnesium (3.81%, 3.54%) were found in the maximum amount in raw Jack fruit peel waste, followed by raw cocoa shell waste predigested with 10 g *Pleurotus eous*, 10 g *Pleurotus florida* and *Eudrilus eugeniae* (C₈ and C₄), as depicted in Table -1.

Manohara *et al.*, (2017) indicate that calcium, one of the elements necessary for the growth of microorganisms, at the beginning of the composting process dropped and by the 60th day, it was increased. Biswas (2014) has reported that vermicompost and greencompost treatment showed highest Ca and Mg. The increased uptake of nutrients may be due to the higher availability of the combined application of organic manure and bioinoculants. Similar results were positively correlated with the findings of Velmourougane and Raphae, (2012); Chander *et al.*, (2018) and Karanja *et al.*, (2019).

Calcium oxalate crystal found in digested fungal hyphae is converted by earthworms to calcium bicarbonate, which is then ingested in cast materials. This makes more calcium available in the compost. During the research period, the content of calcium and magnesium increased. The increased amount of inorganic calcium and magnesium in worm cast was considered to be predominantly caused by gastrointestinal processes related to calcium and magnesium metabolism.

C: N ratio

The C: N ratio is regarded as a crucial sign of compost maturity. The criteria are typically used to assess the agronomic grade and maturity of compost. The results were depicted in Table-1. A significant reduction of C: N ratio was observed in the biocompost C₈ followed by biocompost C₄ predigested by using 10 g *Pleurotus eous*, 10 g *Pleurotus florida* and *Eudrilus eugeniae*. C: N ratio was narrowed down from 63:1 to 6:1 in C₈ followed by 62:1 to 7:1 in C₄ respectively.

The low C: N ratio indicated the stabilization and maturity of each biocomposting units. As compost is formed, the C: N ratio has substantially dropped. The C: N ratio is measure of appropriate maturity when it is less than 20. As microbial activity is influenced by the C/N ratio, it is a crucial element in composting.

The organic material carbon content was used by earthworms as a source of energy. The compost is also recycling nitrogen at the same time. As a result of the earthworm casting during this process, biocompost will transform into an organic fertiliser by enhancing the macronutrients N, P and K. However, the quality of the raw organic waste utilised determines the C/N ratio (Londhe & Bhosale, 2015). The present result coincides with the result of Muthurayar and Dhanarajan, (2013) who obtained a drastic reduction in C: N ratio during

degradation of coir pith, vegetable waste and poultry waste with cow dung. Nalluri and karri, (2018) found that C/N ratio in the groundnut shell compost treatments were much lower than control. The present finding coincides with the result of Gebeyehu and Kibret, (2013); Kim *et al.*, (2018); Owis *et al.*, (2016) and Indumathi (2017).

4.1.3 Fourier Transform-Infrared (FT-IR) Spectrum Analysis

The results of FTIR Spectroscopy showed the presence of alcohol, alkene, alkane, halocompound, aromatic compound, esters, carboxylic acid etc. The FTIR analysis is presented in Table 2-11 and Figure 4. The peak values, absorption bands and functional groups of raw and biocomposted CSW and JFPW spectrum showed different characteristic strong bands.

CSW: FT-IR spectrum of CSW showed the peaks at 3595–3865 cm^{-1} were due to OH stretching vibrations which indicates the presence of alcohol; the bands at 1843 cm^{-1} were attributed to the C-H bending vibration in aromatic compound; The peak at 2978 cm^{-1} and 2885 cm^{-1} appeared to be due to C-H stretching vibration of alkane. The peak at 1388 cm^{-1} indicates aldehyde due to the presence of C-H bending. The FT-IR bands at 995 cm^{-1} , 948 cm^{-1} and 817 cm^{-1} , were attributed to C=C bending in alkene. The peaks that appeared at 1705 cm^{-1} and 1751 cm^{-1} might be due to the C=O stretching which is caused by the presence of aliphatic ketone and esters. The bands at 1265 cm^{-1} , 1165 cm^{-1} , 1064 cm^{-1} , 1311 cm^{-1} , 1342 cm^{-1} , and 671 cm^{-1} , 555 cm^{-1} due to the stretching vibrations in C-N, C-O, O-H, C=O and C-Br which indicates aromatic amine, tertiary alcohol, primary alcohol, phenol, alcohol and halo compound respectively. The functional groups of spectral peaks are listed in Tabel -2 & Figure - 4.

JFPW: FT-IR spectrum of JFPW showed a strong peak at 3842, 3726 and 3633 cm^{-1} (O-H stretching) was indicated in alcohol. C=O stretching was attributed to conjugated aldehyde at 1681 cm^{-1} , C=C stretching was attributed to conjugated alkene at 1627 cm^{-1} , Nitro compound (N-O stretching) were found in bands at 1543 and 1519 cm^{-1} . The alkane C-H stretching peak at 2978 and 2893 cm^{-1} , carboxylic acid at 1373 cm^{-1} and the aromatic amine bond at 1249 cm^{-1} . The presence of halo compound indicates peak at 555 cm^{-1} and 671 cm^{-1} due to C-Br stretching (Table -3 & Figure - 4).

Table - 2

FTIR Characterization of Cocoa Shell Waste (CSW)

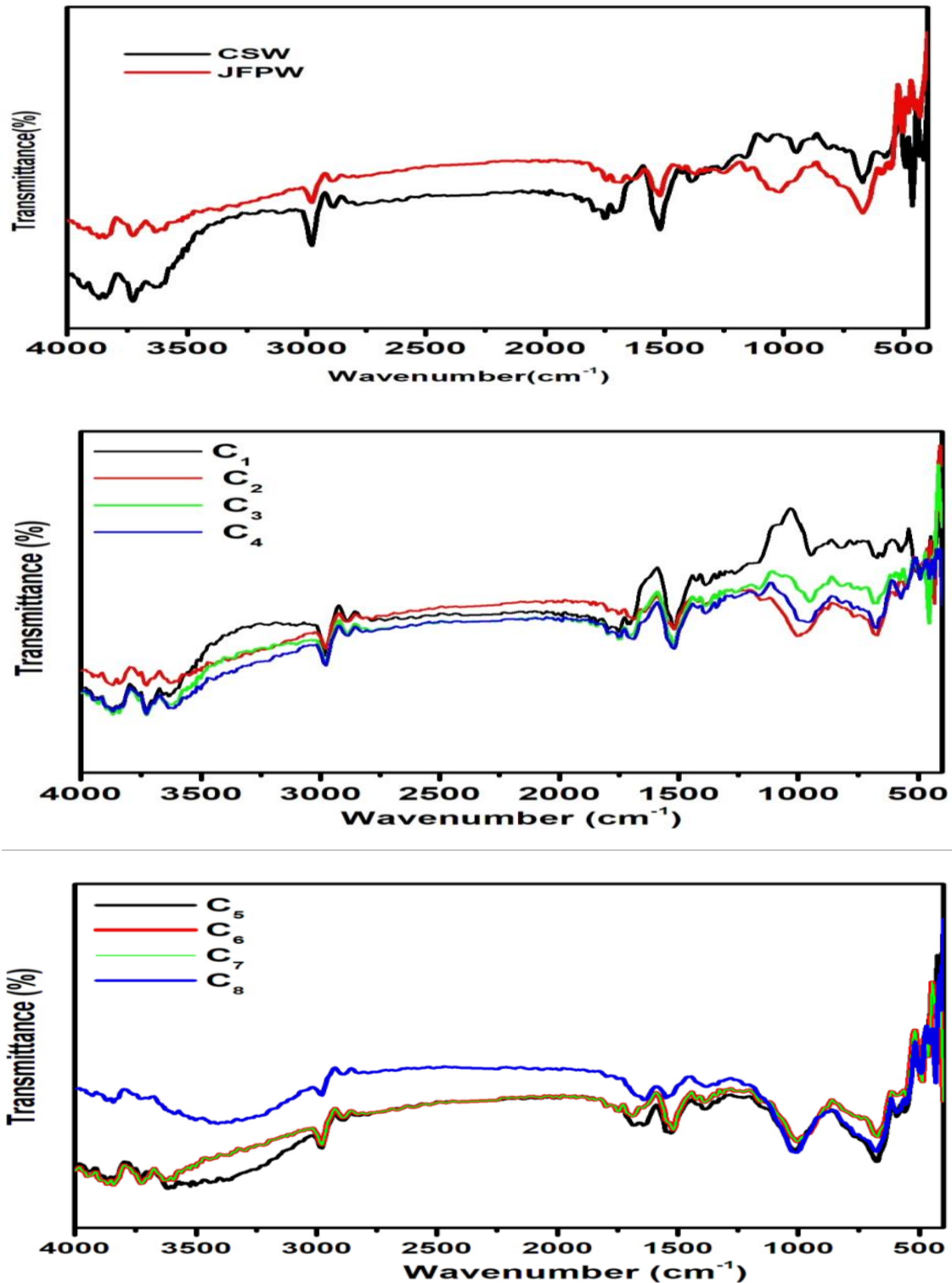
CSW		
Wavenumber (cm ⁻¹)	Functional group Assigned	Compounds
3865,3726 & 3595	O-H stretching	Alcohol
2978 & 2885	C-H stretching	Alkane
1843	C-H bending	Aromatic compound
1797	C=O stretching	Acid halide
1751	C=O stretching	Esters
1705	C=O stretching	Aliphatic ketone
1519	N-O stretching	Nitro compound
1427	C-H bending	Alkane
1388	C-H bending	Aldehyde
1342	O-H bending	Alcohol
1311	O-H bending	Phenol
1265	C-N stretching	Aromatic amine
1165	C-O stretching	Tertiary alcohol
1064	C-O stretching	Primary alcohol
995,948,817 & 740	C=C bending	Alkene
671 & 555	C-Br stretching	Halo compound

Table - 3

FTIR Characterization of Jack Fruit Peel Waste (JFPW)

JFPW		
Wavenumber (cm ⁻¹)	Functional group Assigned	Compounds
3842, 3726 & 3633	O-H stretching	Alcohol
2978 & 2893	C-H stretching	Alkane
1797	C=O stretching	Acid halide
1743	C=O stretching	Esters
1681	C=O stretching	Conjugated
1627	C=C stretching	Conjugated
1543 & 1519	N-O stretching	Nitro compound
1373	O-H bending	Carboxylic acid
1249	C-O stretching	Aromatic Amine
1157	C-O stretching	Ester
1018	CO-O-CO stretching	Anhydride
810	C=C bending	Alkene
671 & 555	C-Br stretching	Halo compound

Figure - 4
 FTIR Spectra of Raw and Biocomposted Cocoa Shell Waste (CSW) and Jack Fruit Peel Waste (JFPW)



C₁ (Biocompost 1): C₁ absorption band showed O-H stretching at 3865 and 3726 cm⁻¹ in alcohol, N-H stretching at 2978 and 2885 cm⁻¹ found in amine salt, C-H bending at 1751 cm⁻¹ in aromatic compound, The alkene give rise to four C=C bending bands at 948 cm⁻¹, 817 cm⁻¹, 671 cm⁻¹ and 648 cm⁻¹. The peak at 1712 cm⁻¹ can be attributed to C=O stretching of conjugated anhydride. The band at 1519 cm⁻¹ showed characteristics of nitro compounds due to N-O stretching. C-H bending vibration was obtained at 1427 cm⁻¹ and 1388 cm⁻¹ which indicates alkane and aldehyde. Hence the band at 1342 cm⁻¹ can be attributed to O-H bending of carboxylic acid. The peak at 1288 cm⁻¹ was assigned to C-N stretching of aromatic amine and C-I stretching indicates halo compound at 570 cm⁻¹(Table - 4 & Figure - 4).

C₂ (Biocompost 2): The FTIR spectrum of C₂ shows three peaks in the region at 3842 cm⁻¹, 3726 cm⁻¹ and 3595 cm⁻¹ which can be attributed to O-H stretching of alcohol. Similarly, O-H stretching at 2978 cm⁻¹ represents the presence of carboxylic acid. N-H stretching was attributed to amine salt at 2885 cm⁻¹, C-H bending at 1797 cm⁻¹, C=O stretching at 1689 cm⁻¹ showed conjugated acid. N-O stretching at 1519 cm⁻¹ was found in nitro compound and C-H bending at 1388 cm⁻¹ in alkane. The peak at 1157 cm⁻¹ is due to the vibration of C-F stretching of fluoro compound. The presence of CO-O-CO stretching was confirmed by the presence of peak at 1002 cm⁻¹ in anhydride and C=C bending at 671 cm⁻¹. C-Br stretching at 594 and C-I stretching at 555 cm⁻¹ attributed to halo compound (Table -5 & Figure - 4).

C₃ (Biocompost 3): C₃ represents O-H stretching vibration at 3865, 3726 and 3618 cm⁻¹ was found in alcohol. Alkane peaks at 2978 and 2885 cm⁻¹ (C-H stretching). C=O stretching band at 1751 cm⁻¹ and 1705 cm⁻¹ obtained in conjugated anhydride and carboxylic acid. The band at 1519 cm⁻¹ found N-H bending in amine. The C-H bending at 1388 cm⁻¹ and C-F stretching at 1165 cm⁻¹ were identified by alkane and fluoro compound. C=C bending was attributed to alkene at 956, 817 and 686 cm⁻¹, C-Br stretching at 578 and 574 cm⁻¹ represents halo compound (Table - 6 & Figure - 4).

C₄ (Biocompost 4): C₄ FTIR peaks show the presence of alcohol in O-H stretching at 3618-3896 cm⁻¹, C=O stretching vibration of peaks at 1797 cm⁻¹ and 1751 cm⁻¹, 1165 cm⁻¹ (C-O stretching) responsible for conjugated acid halide peak and esters. Alkane peaks at 2885-2978 cm⁻¹ attributed to C-H stretching. The band at 1689 cm⁻¹ is due to C=N stretching of

imine/oxime. The bands at 671,771,817 and 956 cm^{-1} are due to C=C bending of alkene, the halo compound peak at 570 cm^{-1} (C-Br stretching), and the band at 1519 cm^{-1} is assigned to nitro compound attributed to N-O stretching. The presence of aldehyde at 1388 cm^{-1} is due to C-H bending (Table - 7& Figure - 4).

C₅ (Biocompost 5): FTIR spectrum of C₅ detecting O-H stretching bands at 3865, 3726, 3618 and 2978 cm^{-1} indicate the presence of alcohol. The bands at 2893 and 1643 cm^{-1} is due to C-H stretching representing alkane, N-O stretching obtained from nitro compound at 1527 cm^{-1} , C-H bending at 1388 cm^{-1} found in aldehyde and C-N stretching at 1010 cm^{-1} assigned to amine. The peaks at 678 cm^{-1} are due to C-Br stretching at 594 cm^{-1} , 563 cm^{-1} is due to C-I stretching indicating the presence of halo compounds, respectively (Table - 8 & Figure- 4).

C₆ (Biocompost 6): C₆ represents broad band at 3842, 3726 and 3726 cm^{-1} is due to three O-H stretching vibrations which are caused by the presence of alcohol. The peak at 2978 cm^{-1} is due to the stretching vibration of N-H found in amine salt, C-H stretching at 2885 cm^{-1} obtained alkane, C=O stretching was attributed to acid halide, esters and conjugated acid at 1797, 1743 and 1689 cm^{-1} respectively. N-O stretching at 1519 cm^{-1} was found in nitro compound and C-H bending at 1388 cm^{-1} in alkane. The presence of anhydride in CO-O-CO stretching at 1002 cm^{-1} and C-Br stretching at 671 cm^{-1} and C-I stretching at 555 cm^{-1} was found in halo compound (Table - 9 & Figure - 4).

C₇ (Biocompost 7): FTIR spectrum of C₇ peak at 3618 cm^{-1} , 3726 cm^{-1} and 3865 cm^{-1} were ascribed to the O-H stretching of alcohol. The peak at 2885 and 2978 cm^{-1} are due to the vibration of the C-H stretching of alkane. The presence of nitro compound was confirmed by the peak at 1543 and 1519 cm^{-1} (N-O stretching). The peak at 995, 956 and 771 cm^{-1} was due to the presence of C=C bending of alkene groups. The peak at 1681 cm^{-1} and 1388 cm^{-1} confirmed the presence of conjugated acid and aldehyde (Table -10 & Figure - 4).

C₈ (Biocompost 8): The FTIR spectrum of C₈ showed a broad band at 3379 -3842 cm^{-1} due to O-H stretching vibration which is caused by the presence of alcohol. Alkane peaks at 2885 and 2978 cm^{-1} (C-H stretching). A peak at 1010 cm^{-1} was attributed to the vibrations of C-N stretching in amine. The peak at 1550 cm^{-1} (N-O stretching) was found only in nitro compound. The C-Br stretching at 555 and 594 cm^{-1} observed halo compound. The peak at 1643 (C=C stretching) and 678 cm^{-1} (C=C bending) showed alkene (Table -11& Figure -4).

The obtained results demonstrated the elimination of the respected bands as a result of the breakdown of lignin and cellulose. FT-IR study of C₈ and C₄ revealed considerable differences than in C₁, C₂, C₃, C₅, C₆ and C₇ bands. FT-IR spectra analysis of raw and Biocomposted CSW and JFPW showed some similar functional groups with different wavelength of peaks. FT-IR spectra showed the common absorption bands and corresponding functional group are found in all biocomposted samples. But intensities of functional groups were found to be varied from each other. Various organic components are present in all spectra, significant differences can be observed in C₄ (Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹) and C₈ (Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹) peaks.

FTIR is a best tool for the comprehensive evaluation of the compositional, functional, and behavioural characteristics of organic materials which provide by most effective, quick and reliable complex characteristics of raw and biocomposted cocoa shell and jackfruit peel waste.

Lim and Wu (2015) stated that Fourier transform infrared (FT-IR) spectroscopy was used to analyse the absorbance intensity change, stability of vermicompost, and identify chemical functional groups of substances. According to Srivastava *et al.*, (2020), the finding indicates the stability and maturity of MSW vermicompost. They noticed the removal of polysaccharides, carbohydrates and aliphatic methylene from the original waste mixture.

Our conclusion was similar with Hussain *et al.*, (2015), who showed a substantial decrease in peak intensity and a decrease in phenolic content. Similar findings have been supported by Deka *et al.*, (2011), El Ouaqoudi *et al.*, (2015), Rajiv *et al.*, (2013); Sundarraaj and Ranganathan, (2017). This conclusion was consistent with the findings of Soobhany *et al.*, (2017), who discovered peaks of alkyl halides and polysulfide groups in compost and vermicompost samples, which were more intense in vermicompost samples.

Table - 4

FTIR Characterization of Biocomposting unit C₁ (Biocompost 1)

C ₁ (Biocompost 1)		
Wavenumber (cm ⁻¹)	Functional group Assigned	Compounds
3865&3726	O-H stretching	Alcohol
2978&2885	N-H stretching	Amine salt
1751	C-H bending	Aromatic compound
1712	C=O stretching	Conjugated anhydride
1519	N-O stretching	Nitro compound
1427	C-H bending	Alkane
1388	C-H bending	Aldehyde
1342	O-H bending	Carboxylic acid
1288	C-N stretching	Aromatic amine
948,817,671&648	C=C bending	Alkene
570	C-I stretching	Halo compound

Table -5

FTIR Characterization of Biocomposting unit C₂ (Biocompost 2)

C ₂ (Biocompost 2)		
Wavenumber (cm ⁻¹)	Functional group Assigned	Compounds
3842, 3726&3595	O-H stretching	Alcohol
2978	O-H stretching	Carboxylic acid
2885	N-H stretching	Amine salt
1797	C-H bending	Aromatic compound
1689	C=O stretching	Conjugated acid
1519	N-O stretching	Nitro compound
1388	C-H bending	Alkane
1157	C-F stretching	Fluoro compound
1002	CO-O-CO stretching	Anhydride
671	C=C bending	Alkene
594	C-Br stretching	Halo compound
555	C-I stretching	Halo compound

Table - 6

FTIR Characterization of Biocomposting unit C₃ (Biocompost 3)

C ₃ (Biocompost 3)		
Wavenumber (cm ⁻¹)	Functional group Assigned	Compounds
3865,3726&3618	O-H stretching	Alcohol
2978&2885	C-H stretching	Alkane
1797	C=O stretching	Acid halide
1751	C=O stretching	Conjugated anhydride
1705	C=O stretching	Carboxylic acid
1519	N-H bending	Amine
1388	C-H bending	Alkane
1342	O-H bending	Alcohol
1165	C-F stretching	Fluoro compound
956,817&686	C=C bending	Alkene
578&574	C-Br stretching	Halo compound

Table -7

FTIR Characterization of Biocomposting unit C₄ (Biocompost 4)

C ₄ (Biocompost 4)		
Wavenumber (cm ⁻¹)	Functional group Assigned	Compounds
3896,3865,3842&3618	O-H stretching	Alcohol
2978&2885	C-H stretching	Alkane
1797	C=O stretching	Conjugated acid
1751	C=O stretching	Esters
1689	C=N stretching	Imine/Oxime
1519	N-O stretching	Nitro compound
1388	C-H bending	Aldehyde
1342	O-H bending	Alcohol
1165	C-O stretching	Ester
956,817,771&671	C=C bending	Alkene
570	C-Br stretching	Halo compound

Table - 8

FTIR Characterization of Biocomposting unit C₅ (Biocompost 5)

C ₅ (Biocompost 5)		
Wavenumber (cm ⁻¹)	Functional group Assigned	Compounds
3865,3726,3618&2978	O-H stretching	Alcohol
2893	C-H stretching	Alkane
1643	C=C stretching	Alkene
1527	N-O stretching	Nitro compound
1388	C-H bending	Aldehyde
1010	C-N stretching	Amine
678	C-Br stretching	Halo compound
594&563	C-I stretching	Halo compound

Table - 9

FTIR Characterization of Biocomposting unit C₆ (Biocompost 6)

C ₆ (Biocompost 6)		
Wavenumber (cm ⁻¹)	Functional group Assigned	Compounds
3842,3726&3633	O-H stretching	Alcohol
2978	N-H stretching	Amine Salt
2885	C-H stretching	Alkane
1797	C=O stretching	Acid halide
1743	C=O stretching	Esters
1689	C=O stretching	Conjugated acid
1519	N-O stretching	Nitro compound
1388	C-H bending	Alkane
1002	CO-O-CO stretching	Anhydride
671	C-Br stretching	Halo compound
555	C-I stretching	Halo compound

Table -10

FTIR Characterization of Biocomposting unit 7 (Biocompost 7)

C ₇ (Biocompost 7)		
Wavenumber (cm ⁻¹)	Functional group Assigned	Compounds
3865,3726&3618	O-H stretching	Alcohol
3865,3726&3618	O-H stretching	Alcohol
2978&2885	C-H stretching	Alkane
1681	C=O stretching	Conjugated Acid
1543	N-O stretching	Nitro compound
1519	N-O stretching	Nitro compound
1388	C-H bending	Aldehyde
1342	O-H bending	Alcohol
1072	C-O stretching	Secondary alcohol
995,956&771	C=C bending	Alkene
671	C-Br stretching	Halo compound
578,555&501	C-I stretching	Halo compound

Table -11

FTIR Characterization of Biocomposting unit 8 (Biocompost 8)

C ₈ (Biocompost 8)		
Wavenumber (cm ⁻¹)	Functional group Assigned	Compounds
3842&3379	O-H stretching	Alcohol
2978&2885	C-H stretching	Alkane
1643	C=C stretching	Alkene
1550	N-O stretching	Nitro compound
1010	C-N stretching	Amine
678	C=C bending	Alkene
594&555	C-Br stretching	Halo compound

4.1.4 Scanning Electron Microscopy (SEM) Analysis

SEM analysis was used to compare and visualise the surface morphological characterization of eight biocomposting units and raw materials (cocoa shell and jackfruit peel waste). The topographical and compositional features of the control (CSW & JFPW) and C₁ to C₈ biocomposting units are revealed using this power full magnification method. Raw and biocomposed CSW and JFPW were subjected to SEM examination, and the resultant SEM images are shown in Figures -5 & 6.

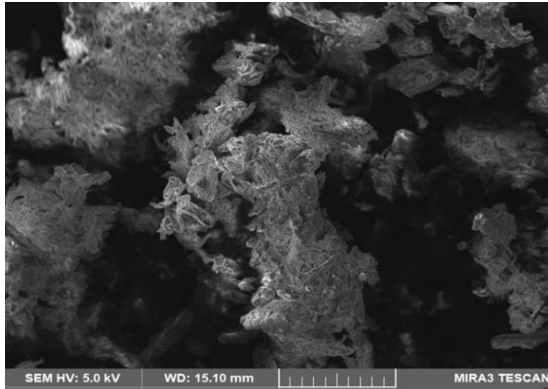
SEM examination shows the surface morphology of CSW and JFPW biocomposting (C₁ to C₈) processes before and after. As seen in Figure 5, CSW and JFPW (control) are encrusting a thick matrix of cellulose, hemicelluloses, lignin, pectin, protein, and starch. SEM micrographs of C₁ to C₈ show uneven, rough, porous, spherical, unsmooth, fractured, and heterogeneous filamentous formations.

Greater surface modifications were verified in biocompost C₈ (Raw Jack Fruit Peel (JFPW) + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹) closely followed by biocompost C₄ (Raw Cocoa Shell (CSW) + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹). During the bioconversion processes, C₁, C₂, C₃, C₄, C₅, C₆, C₇ & C₈ showed significant surface morphological modification, which may be due to the biodegradation and microbial decomposition of raw cocoa shell and jack fruit peel waste by the better activity of different combinations of microorganisms. Microorganisms prefer a permeable and ruptured surface for better and faster action.

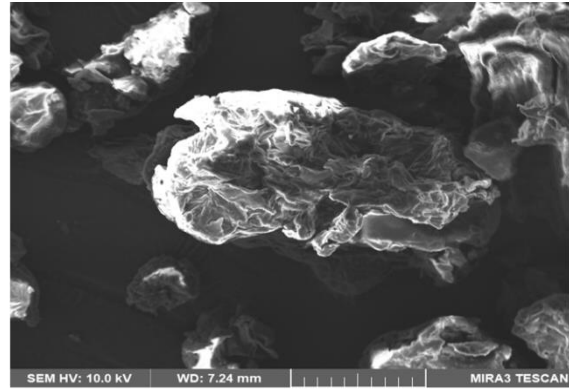
The ultimate stage of composting heterogeneous surfaces results in the formation of various-sized crystal-like parts. The most dramatic changes in physical appearance occur throughout the various stages of microbial breakdown of CSW and JFPW. The study discovered that the particle size of microbial consortium-applied biocomposting units (C₄ and C₈) was smaller than that of other biocomposting units and controls (CSW and JFPW). C₈ and C₄ determined that the combined activity of *Pleurotus eous*, *Pleurotus florida* and *Eudrilus eugeniae* was the reason for complete biodegradation of CSW and JFPW.

Figure - 5

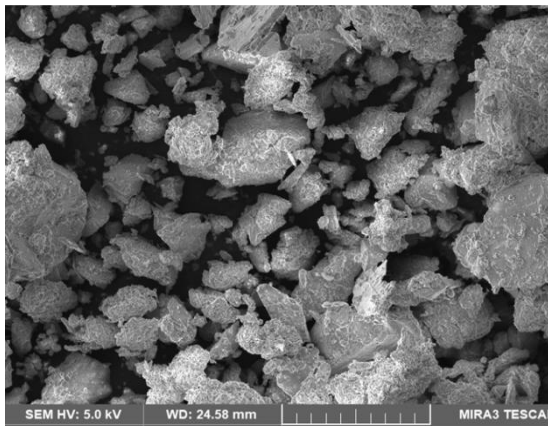
Scanning Electron Microscopy (SEM) of Raw Cocoa Shell Waste (CSW), Raw Jack Fruit Peel Waste (JFPW) and Biocomposting Unit C₁, C₂, C₃ and C₄



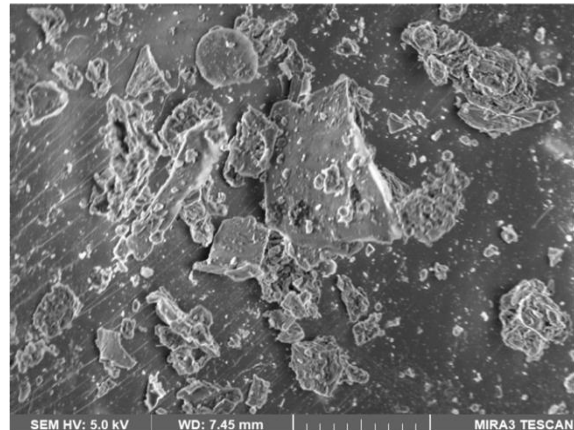
SEM image of CSW



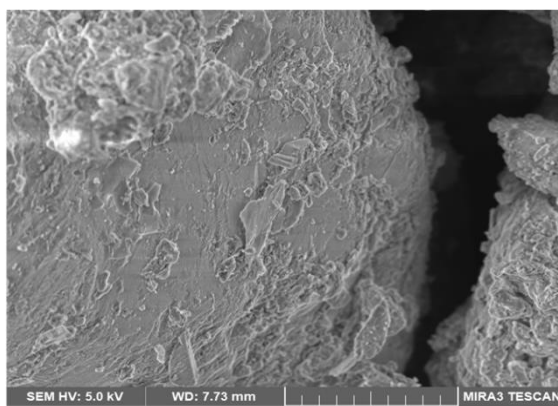
SEM image of JFPW



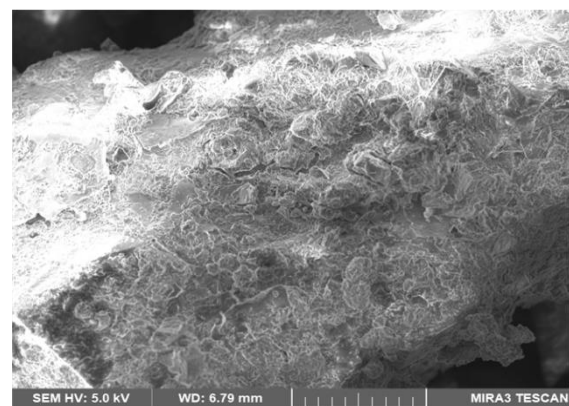
SEM image of Biocomposting unit C₁



SEM image of Biocomposting Unit C₂

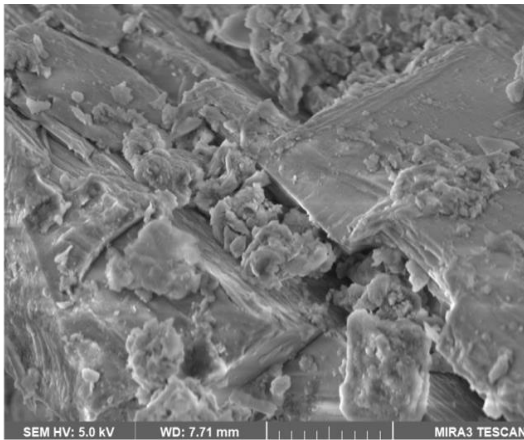
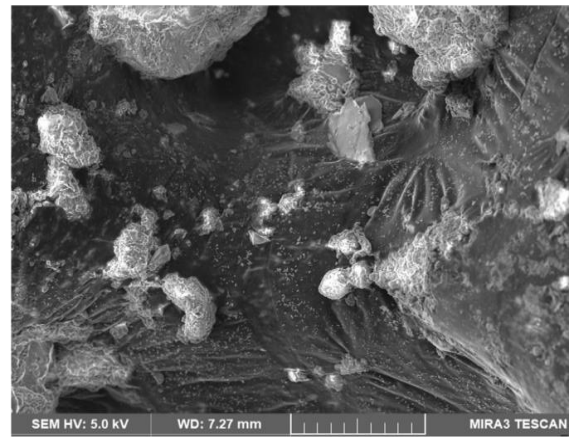
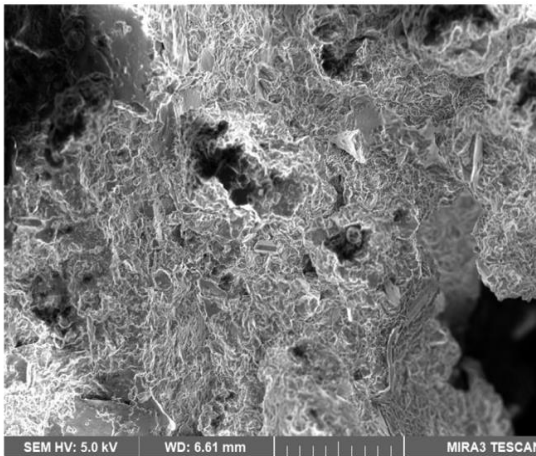
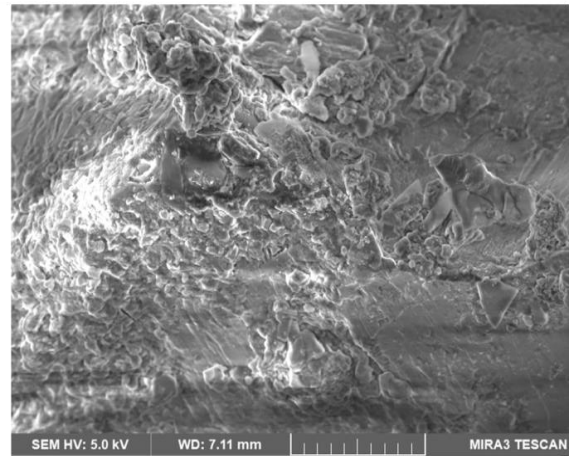


SEM image of Biocomposting unit C₃



SEM image of Biocomposting unit C₄

Figure - 6

Scanning Electron Microscopy (SEM) of Biocomposting Unit C₅, C₆, C₇ and C₈SEM image of Biocomposting Unit C₅SEM image of Biocomposting Unit C₆SEM image of Biocomposting Unit C₇SEM image of Biocomposting Unit C₈

The SEM analysis was used to determine compost maturity and quality. It clearly indicated that biodegradation and mineralization occurred after the composting of CSW and JFPW. The micrographs of each biocomposted units revealed strong disaggregated material as compared to that of the raw CSW and JFPW which showed contiguous structures. The SEM images clearly reflect the mineralization of CSW and JFPW.

SEM analysis was used by Unuofin and Mnkeni, (2014) to confirm the level of humification in vermicomposts produced using a mix of cow manure and waste paper. The current result is supported by Lim *et al.*, (2014) who used SEM to determine textural changes in palm oil mill effluent supplemented with soil or rice straw when *Eudrilus eugeniae* was present. Bhat *et al.*, (2014) used scanning electron microscopy to identify surface

modifications in cow dung and press mud sludge with *Eisenia fetida*. The final vermicompost tests supported the greater frequency of surface changes, which pointed to the mineralization of organic wastes.

Bhat *et al.*, (2015) similarly recognized the surface changes in the pre and post-vermicompost samples of sugar beet mud and pulp in the presence of *Eisenia fetida* using the SEM technique. Lim and Wu, (2016) used SEM technique to determine the vermicompost maturity of decanter cake obtained from palm oil mill. Similar observations were reported by Li *et al.*, (2011); Senthil Kumar *et al.*, (2014); Rajpal *et al.*, (2014) and Hussain *et al.*, (2016 b) in surface morphology of pre and post-vermicomposted organic wastes. The SEM images reveal signs of earthworm degradation of the organic substrates. Earthworms devour and crush their food in their gizzards. The substrate is further disaggregated in the earthworm's gut by enzymes and bacteria.

PHASE II

4.2 POT CULTURE EXPERIMENT ON TEST CROPS

A pot culture experiment was carried out with *Vigna unguiculata* L. Walp. Var.Co (CP) 7 (Cowpea), *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc Var.NS-621 (Yardlong Bean), *Clitoria ternatea* L. (Shankhpushpi) and *Amaranthus tricolor* L. Var. Arun (Red amaranth) as the test crops to assess the efficacy of biocomposted cocoa shell and jack fruit peel waste as manure. The impact of biocomposts on test crops was evaluated with control. Biometric characters (vegetative), biochemical analysis, yield parameters and leghaemoglobin content of chosen crops as determined by different intervals of time (Days After Sowing) were recorded and statistically investigated. The physico-chemical parameters of the soil were examined both before and after the test crop was harvested.

4.2.1 BIOMETRIC CHARACTERS

4.2.1.1 Efficiency of biocomposted cocoa shell and jack fruit peel waste on vegetative parameters of test crops

4.2.1.1(a) Root length

Vigna unguiculata L. Walp. Var.Co (CP) 7 (Cowpea)

Root length of the cowpea was measured at various stages (25 to 45 DAS). The findings of the pot culture experiment indicated that the root length increased significantly at

treatment T₈ - Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) which was followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (biocompost 4) on 25 DAS (20.63 cm, 18.13 cm), on 35 DAS (32.73cm, 28.86 cm) and 45 DAS (39.23, 30.10 cm) as compared to the control (5.71cm,10.76 cm, 14.73 cm) respectively (Table-12 &Plate - 9).

***Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc. Var.NS-621(Yardlong bean)**

Among different treatment combinations, it was observed that the root length was significantly increased by the treatments T₁-T₈ while root length was varied from 30 to 90 DAS. The maximum root length was obtained in treatment T₈ (21.35 cm, 23.17 cm, 27.66 cm) followed by treatment T₄ (19.23 cm, 21.12 cm, 22.57 cm) and the lowest root length was observed in Control (9.00 cm, 10.6 cm, 12.4 cm) on 25 DAS,50 DAS and 75 DAS. The comparative performances of different treatments are shown in the Table -14 and Plate -10.

***Clitoria ternatea* L (Shankpushpi)**

The treatment T₈ –Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) followed by T₄ Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (biocompost 4) showed an increase in root length on all the three days examined, 30 DAS (12.3 cm, 8.9 cm), 60 DAS (23.9 cm, 22.5 cm) and 90 DAS (29.5 cm, 28.8 cm). The lowest root length was attained in Control (2.5 cm, 5.5 cm, 10.5 cm) as compared to the other treatments as shown in Table -16 & Plate-11.

***Amaranthus tricolor* L. Var. Arun (Red amaranth)**

There was a progressive increase in root length from 25 to 35 DAS in all the treatments (T₁ to T₈) as presented in Table -18 and Plate -12 . The treatment T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) showed an increase in root length was evaluated on 25 DAS (22.87cm) and 35 DAS (26.07 cm) when compared to the other treatments. Control (5.20 cm and 6.43 cm) had the lowest root length.

The results agree with those of Abbiramy and Ross, (2012), who discovered that applying vermicomposted coir pith, enhanced the root length of *Abelmoschus esculentus*. Rahman *et al.*, (2012) indicate that treatment biocompost (3kg/pot) +NPK (T₁) application produced the highest root length of chili. Application of vermicompost increased root length

of plants (Joshi *et al.*, 2015). This result is in with agreement of Indumathi (2017) who reported increased root length in green gram with the application of microbial inoculum added compost than in the control. The current findings are in accordance with the results of Selvam and Kumar (2022), who discovered that the root length of treated rice plants increased significantly in all T₁, T₂, T₃, T₄ and T₅ when compared to banana spathe compost (BSC), NPK, and control.

4.2.1.1 (b) Shoot length

***Vigna unguiculata* L. Walp. Var. Co (CP) 7 (Cowpea)**

There was a gradual increase in shoot length observed in all the treatments (T₁-T₈). Among the treatments, the maximum shoot length was registered at T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (Biocompost 8) and followed by T₄–Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (Biocompost 4) on 25 DAS (70.73 cm, 67.93 cm), 35 DAS (167.50 cm and 112.13 cm) and 45 DAS (175.83cm, and 119.30cm,) respectively when compared with the Control (13.93 cm, 35.23 cm, 50.23 cm) as presented in Table - 13 & Plate -9.

***Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc. Var. NS-621 (Yardlong bean)**

A significant increase in shoot length of (92.18 cm, 122.17 cm and 135.58 cm) was recorded in T₈ followed by T₄ (86.22 cm, 120.66 cm, 130.52 cm) when compared to the Control (23.17 cm, 71.13 cm, 78.24 cm) on 25, 50 and 75 DAS. The findings were displayed in Table-14 & Plate-10.

***Clitoria ternatea* L (Shankpushpi)**

The T₁-T₈ treatments significantly influenced the shoot length of *Clitoria ternatea* L was noted from 30 to 90 DAS as compared to Control (Table -16 & Plate -11). Among the treatments a significant increase in shoot length was registered at T₈ - Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) which was followed by T₄– Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ in three sampling days 30 (55.7 cm, 53.2 cm), 60 (119.3cm, 101.7cm) and 90 (182.3 cm, 179.7 cm) DAS respectively. Lowest shoot length was observed in control treatment (19.2 cm, 47.8 cm, 74.3cm) on 30, 60 and 90 days after sowing respectively.

***Amaranthus tricolor* L. Var. Arun (Red amaranth)**

A significant increase in shoot length of Red amaranth was registered from 25 to 35 DAS in all the treatments over the control as shown in Table -18 & Plate -12. Among the treatments significant shoot length was observed in T₈ (Biocompost 8)–Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ followed by T₄ (Biocompost 4) – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ on 25 DAS (14.07 cm, 12.87cm) and 35 DAS (29.07cm, 22.00 cm) when compared to the Control (4.63 cm and 7.43 cm).

The findings of this study are consistent with those of Getnet and Raja (2013), who reported that the addition of vermicompost considerably improved plant height. The outcome is comparable to that of Alwaneen (2016), who discovered that *vinca rosa* plant height grew significantly as the proportion of vermicompost in the soil increased. The present finding is in conformity with Omid *et al.*, (2017) who revealed that application of 75% composted peanut shells enhanced the shoot length of Canopy.

Similar findings were obtained by Ndiso *et al.*, (2018) who discovered that applying farmyard manure and their interactions significantly increased shoot length of cowpea and maize. The results were positively correlated with the findings of Gayathri and Malathi, (2019a) who reported that application of different bio-fertilizers promoted the shoot length in *Amaranthus viridis*.

4.2.1.1(c) Number of Leaves

***Vigna unguiculata* L. Walp.Var. Co (CP) 7 (Cowpea)**

An appreciable increase in the number of leaves/plant were recorded in all the treatments (T₁ to T₈) from 25 to 45 DAS as shown in Table - 12 & Plate - 9. A substantial increase in the number of leaves/plant were recorded in T₈ - Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) and T₄ Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (biocompost 4) on 25 DAS (26.46, 20.50) and 35 DAS (33.53, 28.83). The maximum number of leaves were shown on 45 DAS at T₈ (37.50) followed by T₄ (34.50) respectively. Lowest number of leaves were noted in control as compared to other treatments on 25 (10.50), 35 (12.50) and 45 (14.46) DAS.

***Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc. Var. NS-621 (Yardlong bean)**

The highest number of leaves were shown in T₈ - Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) followed by T₄ Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (biocompost 4) on 25 DAS (19.65, 18.00), 50 DAS (29.50, 27.57) and 75 DAS (37.54, 35.26). Minimum number of leaves were noted in control on 25 (8.00), 50 (12.24) and 75 (17.00) DAS as shown in Table -14 & Plate -10.

***Clitoria ternatea* L (Shankpushpi)**

As shown in table 16, there was a noticeable rise in the number of leaves/plant in all of the treatments (T₁ to T₈) from 30 to 90 DAS (Plate -11). Number of leaves were more in T₈ Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) and T₄ Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (biocompost 4) on 30 (35.04, 27.62) and 60 DAS (146.16, 132.11). An appreciable increase in the number of leaves/plant was recorded at 90 DAS (249.24, 231.15) as compared to control (9.04, 24.10, 83.14) respectively.

Similarly maximum number of branches in Shankpushpi was noticed on 30 DAS (11.34, 11.23), 60 DAS (14, 13.04) and 90 DAS (21.20,19.23) at treatments T₈ followed by T₄. The minimum number of branches was noticed in control (2.19, 3.00, and 10.00) at 30, 60 and 90 days after sowing (DAS).

***Amaranthus tricolor* L. Var.Arun**

A substantial increase in the number of leaves/plants was recorded in the treatment at T₈- Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) which was followed by T₄- Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (biocompost 4) on 25 DAS (10.97,8.80) and 35 DAS (14.03,11) when compared to control (4.70,5.93) respectively (Table -18 & Plate -12).

The present result is in accordance with Olabiyi and Oladeji, (2014) who observed that neem compost application enhanced number leaf per plant in okra. Gopinathan and Prakash, (2014) reported that the effect of vermicompost with biofertilizers (T₄) showed significantly high performance in number of leaves per plant in *Lycopersicum esculentum*.

The outcome is in line with the findings of Verma *et al.*, (2018), who discovered that the maximum number of leaves per plant were observed in cowpea following application of

treatment T9 (Vermicompost @ 5 t/ha+ RDF-100%) at 90 DAS, while the minimum leaves per plant were observed application of treatment combination T1 (FYM @ 20 t/ha + No fertiliser). The present result is in accordance with Sekhar *et al.*, (2020) the maximum number of branches in *Vigna radiata* L. was observed by application of T₅ [N (20 Kg ha⁻¹) + K (20 Kg ha⁻¹) + PSB] whereas the lowest value was observed in T₁ (Control) at 60 DAS.

The current observation is consistent with the conclusions of Rekha *et al.*, (2018) in chilly plant, Dhanraj *et al.*, (2018) in *Clitoria ternatea* L. and Al-Sabbagh *et al.*, (2020) in Chinese Kale.

4.2.1.1 (d) Number of nodules

***Vigna unguiculata* L. Walp.Var.Co (CP) 7 (Cowpea)**

The impact of biocompost on the number of nodules in *Vigna unguiculata* (L.) Walp were observed from 25,35 & 45 DAS.Number of nodules showed a significant increase up to 35 DAS and reduced gradually on 45 DAS. Maximum number of nodules were recorded in T₈ Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) followed by T₄ Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 4) on 25 DAS (14.00, 13.04) respectively. Highest numbers of nodules were found at T₈ and T₄ on 35 DAS (21.20, 19.23) and 45 DAS (11.34, 11.23) as compared to the control (3.00, 10.00 and 2.19) as presented in Table -13.

***Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc. Var. NS-621 (Yardlong bean)**

The greatest number of nodules were recorded at T₈ (biocompost 8)–Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) followed by T₄ treatments Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 4) on 25 DAS (27.46, 24.13), on 50 DAS (33.00, 30.00) and 75 DAS (25.00, 21.00) as compared to the Control (9.00, 15.00, 8.35). Number of nodules showed a significant increase up to 50 DAS after that it was declined. The results were depicted in Table -15.

Similar work was also carried out by Espiritu, (2011) who recorded that the application composted coir pith inoculated with 0.5% *Azotobacter* + 0.5% *Trichoderma harzianum* V/W significantly increased the number of nodules in mung bean. Devi *et al.*, (2013) found that combined inoculation of 75% RDF with vermicompost at the rate of 1t/ha and PSB significantly increased the number of nodules in soybean.

The present finding coincides with the result of Lal *et al.*, (2014) who observed the application of phosphorus and sulphur fertilizer registered higher number of nodules in chickpea. Premalatha *et al.*, (2017) who confirmed significantly higher number of nodule in the treatment of 100% leaf litter compost with 75% leaf litter compost. Sekhar *et al.*, (2020) have also observed application of T₅ [N (20 Kg ha⁻¹) + K (20 Kg ha⁻¹) + PSB] recorded maximum number of nodules in green gram.

4.2.1.1 (e) Number of flowers/plant

***Vigna unguiculata* L. Walp. Var. Co (CP) 7 (Cowpea)**

An appreciable increase in the number of flowers/plant was observed on 45 DAS as shown in Table-19. Number of flowers/plant showed a significant increase in T₈ - Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) and T₄ - Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 4) on 45 DAS (12.00, 10.00) as compared to the control (4.00) respectively.

***Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc. Var. NS-621**

An appreciable increase in the number of flowers/plant was observed on 65 DAS as elucidated in Table -20. The number of flowers/plant was maximum in combined application of biocompost T₈ -Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) followed by T₄ - Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 4) on 65 DAS (21.00, 19.00) as compared to the control (8.00).

***Clitoria ternatea* L**

At the time of flowering stage the maximum number of flowers/plant was noticed at T₈-Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (32) followed by T₄-Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (30). The minimum number of flowers/plants was noticed in control (8) at 90 days after sowing (DAS) as depicted in Table - 21.

The application of vermicompost showed increase in number of flowers/plant in Marigold plants (Sangwan *et al.*, 2010b), *Hibiscus esculentus* (Vanmathi and Selvakumari, 2012), and *Lycopersicon esculentu* (Sarawathy and Prabhakaran, 2014). This is also in line with the findings of Sakthivigneswari and Vijayalakshmi (2016a), who discovered that the

combination application of who found that combined application of predigested coirpith+earthworm+ *Pleurotus sajor-caju* (T₆) showed an increasing number of flowers per plant in black nightshade.

The present finding is in conformity with Nalluri and Karri, (2018) who reported that application of groundnut shell compost promoted the highest number of flowers in brinjal plant T₂ treatment. Similar result was observed by Chaudhary and Mishra, (2019). They found application of T₂ (40% KWC + 60% soil) and T₃ (60% KWC + 40% soil) significantly increased the number of flowers in tomato plant.

4.2.1.1 (f&g) Fresh weight and Dry weight of Crop plants

***Vigna unguiculata* L. Walp.Var.Co (CP) 7 (Cowpea)**

The remarkable increase in the fresh weight of cowpea was recorded in treatments T₈ -Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (Biocompost 8) which was followed by T₄ -Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (Biocompost 4) at 25 DAS (10.076 g, 7.195 g),35 DAS (12.146 g, 8.186 g) and maximum fresh weights were noted at 45 DAS (14.047 g, 12.555 g) respectively. The fresh weight of plants of different treatments was significantly variable (Table -13). The minimum fresh weight of plant was observed in C (Control) at 25 DAS (1.053 g), 35 DAS (1.077g) and 45 DAS (1.856 g) respectively. A significant increase in dry weight was maximum in T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (Biocompost 8), and T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (Biocompost 4) on 25 DAS (1.744 gm, 1.277 g), on 35 DAS (1.854g, 1.465g) and 45 DAS (2.827 g, 2.254 g) days after sowing as compared to the Control (0.494 g, 0.604 g,0.819 g).

***Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc. Var. NS-621 (Yardlong bean)**

A significant increase in fresh weight of Yardlong bean was in T₈ -Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (Biocompost 8) followed by T₄ –Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (Biocompost 4) on 25 DAS (5.491g, 5.136 g), on 50 DAS (9.811 g, 7.371g) and 75 DAS (32.516 g, 28.460g) as compared to the control (2.288g, 3.276g, 8.165 g). The highest dry weight content was registered in the treatment T₈ and T₄ on 25 DAS (0.855g, 0.796g), 50

DAS (1.489 g, 1.130 g) and 75 DAS (3.020 g, 2.187g) over control (0.293 g, 0.638 g, 0.977 g) as indicated in Table -15.

***Clitoria ternatea* L (Shankpushpi)**

The maximum fresh weight of shankpushpi was registered in the treatment T₈ on 30 DAS, 60 DAS and 90 DAS (1.751g, 12.049 g, 27.587 g) followed by T₄ (1.382 g, 8.545 g, 24.409 g). The minimum fresh weight content was observed in control (0.315 g, 1.268 g, 4.083 g). The maximum dry weight content was recorded in T₈ (0.418 g, 2.252 g, 6.639 g) followed by T₄ (0.340 g, 1.710 g, 6.478g) when compared to the control (0.074 g, 0.249 g, 0.917 g) on 30, 60 and 90 DAS respectively (Table -17).

***Amaranthus tricolor* L. Var.Arun (Red amaranth)**

A remarkable increase in the fresh and dry weight of red amaranth plant was observed from 25 to 35 DAS in all the treatments (from T₁ to T₈) shown in Table -18. Plant fresh weight was increased in T₈ followed by T₄ on 25 DAS (2.271 g, 1.499g) and 35 DAS (8.085g, 6.736 g) days after sowing when compared to the control (0.268g, 0.919 g). Maximum dry weight was noted in T₈ (0.438g, 1.122g) which was followed by T₄ (0.330g, 0.832 g) when compared to the control (0.047g, 0.066 g) on 25 and 35 DAS respectively.

Previous studies have also shown that biocompost enhanced the fresh and dry weight in various crops. Sivakumar and Karthikeyan, (2016) discovered that the application of vermicomposted weed plant waste on brinjal caused an increase in fresh weight and dry weight content. The current study is consistent with the result of Omidi *et al.*, (2017), who found that 75% of composted peanut shells increased the fresh and dry weight of the canopy.

Baliah and Muthulakshmi, (2017) found that using enriched vermicompost boosted plant fresh weight and dry weight in *Abelmoschus esculentus* (L.) Moench. The present finding is in conformity with Nhu *et al.*, (2018) who found that application of the liquid organic fertilizer prepared from fruit wastes substrate and *Klebsiella oxytoca* could enhance fresh weight and dry weight of *Brassica integrifolia*. Similar results were obtained by Jandaghi *et al.*, (2020) who concluded that applying higher amount of chicken manure tea (up to 50%) results in a considerable rise in the fresh and dry weights of *Cucumis sativus* on 40, 65 and 90 days.

The pot culture experiments have shown that the different vegetative parameters of cowpea, yardlong bean, shankpushpi and Red amaranth are all higher in pots supplied with soil-enriched biocompost this might be due to uptake of readily available nitrogen, phosphorous, potassium, calcium, and magnesium in the T₁-T₈ biocompost and its associated microbes. The increase in length might be due to presence of humic acids in biocompost. Along with the beneficial effects of humic acids on plant growth and productivity, these effects may be primarily attributable to the hormone-like functions that humic acids perform as a result of their participation in cellular respiration, photosynthesis, oxidative phosphorylation, protein synthesis, and other enzymatic processes.

Nitrogen significantly has a greater impact on plant height. In plants, the element nitrogen serves as the primary building block of several significant compounds. The vegetative stage requires a comparatively high amount of nitrogen. For the plant to perform photosynthesis, the leaf is a vital organ. A greater number of leaves results in increased photosynthesis. The largest amount of leaves were produced to the nitrogen in biocompost. The addition of biocompost may have enhanced the biological characteristics of the soil and boosted the activity of beneficial bacteria, which enhanced root nodules.

Phosphorus promotes proper root development and aids in the development of flowers, seeds, fruits, and pods. Potassium is required for the proper growth of flowers, fruits, and pods, assuring appropriate size, colour, and quantity. Calcium is a crucial component of cell membrane structure and is required for the development of new cells. The process of plant photosynthesis will ultimately have an impact on the fresh weight of the plant. The fresh weight of plant is influenced by the absorption of nutrients by plants. An increase in plant development and growth is evidenced by an increase in plant dry weight.

Among eight biocompost treatments taken for this study, T₈ -Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (Biocompost 8) and T₄- Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹(Biocompost 4) enhanced the growth characteristics when compared to other treatments and control. This significant influence on growth characters might have been due to the enhancement of uptake of available nutrients and the microbial population favored by the addition of biocomposted cocoa shell and jack fruit peel. This might have improved vegetative growth of test crops.

PLATE – 9

Effect of CSW and JFPW Biocompost on Vegetative Parameters (25 to 45 DAS) of Cowpea (*Vigna unguiculata* (L.) Walp. Var. Co (Cp) 7)

C-Control (Without treatment), T₁ (Raw CSW+ *E. eugeniae* 5t/ha⁻¹), T₂ (Raw CSW+20 g *P. eous*+ *E. eugeniae* 5t/ha⁻¹), T₃ (Raw CSW+ 20g *P. florida*+ *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW+10 g *P. eous* +10 g *P. florida*+ *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW+ *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW+20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW+20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW +10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

Table – 12

Influence of Biocomposted CSW and JFPW on Vegetative Parameters of *Vigna unguiculata* (L.) Walp

Treatments	Root length (cm)			Shoot length (cm)			Number of leaves		
	25 DAS	35 DAS	45 DAS	25 DAS	35 DAS	45 DAS	25 DAS	35 DAS	45 DAS
C	5.71	10.76	14.73	13.93	35.23	50.23	10.50	12.50	14.46
T ₁	8.60	12.16	16.83	27.63	53.13	64.13	12.50	15.46	18.50
T ₂	10.23	14.83	18.50	28.50	54.10	70.50	14.50	16.43	19.467
T ₃	11.03	16.03	20.03	30.13	76.50	85.83	17.22	19.50	22.53
T ₄	18.13	28.86	30.10	67.93	112.13	119.30	20.50	28.83	34.50
T ₅	13.23	17.63	20.03	30.50	76.03	90.23	15.50	22.53	27.46
T ₆	14.03	18.23	20.50	47.23	84.83	113.93	16.43	25.46	25.40
T ₇	14.23	22.06	26.23	53.93	90.00	117.50	19.50	23.50	27.50
T ₈	20.63	32.73	39.23	70.73	167.50	175.83	26.46	33.53	37.50
SED		0.47761			0.47271			0.42076	
CD (0.05)		0.95754			0.94773			0.84357	
CD (0.01)		1.27610**			1.26303**			1.12421**	

** Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control, (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P. eous* + 10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW + *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW + 10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

Table -13
Effect of Biocomposted CSW and JFPW on Vegetative Parameters of *Vigna unguiculata* (L.) Walp.

Treatments	Number of Nodules			Plant Fresh Weight (gm)			Plant Dry Weight (gm)		
	25 DAS	35 DAS	45 DAS	25 DAS	35 DAS	45 DAS	25 DAS	35 DAS	45 DAS
C	3.00	10.00	2.19	1.053	1.077	1.856	0.494	0.604	0.819
T ₁	4.48	11.17	3.00	2.586	3.484	5.166	0.514	0.818	1.045
T ₂	6.24	13.35	5.00	2.817	3.626	5.944	0.754	0.893	1.291
T ₃	8.14	14.61	6.03	5.805	6.734	7.015	1.164	1.116	1.294
T ₄	13.04	19.23	11.23	7.195	8.186	12.555	1.277	1.465	2.254
T ₅	9.25	15.04	7.15	4.445	5.457	6.791	0.946	0.985	1.033
T ₆	10.76	17.00	8.06	6.140	7.843	9.177	0.936	1.113	1.334
T ₇	11.18	17.37	9.35	6.395	7.013	8.367	1.009	1.189	1.308
T ₈	14.00	21.20	11.34	10.076	12.146	14.047	1.744	1.854	2.827
SED		0.27622			0.00145			0.00136	
CD (0.05)		0.55378			0.00292			0.00272	
CD (0.01)		0.73801**			0.00434**			0.00366**	

**Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control, (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P. eous* + 10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW + *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW + 10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

PLATE – 10

Impact of CSW and JFPW Biocompost on Vegetative Parameters (25 to 75 DAS) of Yardlong bean
(*Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc Var. NS-621)



C-Control (Without treatment), T₁ (Raw CSW+ *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW+20 g *P. eous*+ *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW+ 20g *P. florida*+ *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW+10 g *P. eous* +10 g *P. florida*+ *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW+ *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW+20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW+20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW +10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

Table -14

Influence of Biocomposted CSW and JFPW on Vegetative Parameters of *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc

Treatments	Root length (cm)			Shoot length (cm)			Number of leaves		
	25 DAS	50 DAS	75 DAS	25 DAS	50 DAS	75 DAS	25 DAS	50 DAS	75 DAS
C	9.00	10.6	12.4	23.17	71.13	78.24	8.00	12.24	17.00
T ₁	11.16	12.73	13.35	35.14	86.39	92.17	10.33	14.42	24.15
T ₂	12.7	14.32	15.43	49.33	97.74	104.36	11.40	17.48	26.35
T ₃	14.5	15.54	17.12	60.53	106.18	109.15	13.21	19.37	29.18
T ₄	19.23	21.12	22.57	86.22	120.66	130.52	18.00	27.57	35.26
T ₅	15.13	16.28	18.30	64.12	111.87	117.23	14.57	20.66	27.21
T ₆	15.29	17.26	19.35	69.48	112.54	119.42	15.61	21.59	30.16
T ₇	16.34	18.22	20.61	71.35	116.36	121.70	16.50	23.12	32.00
T ₈	21.35	23.17	27.66	92.18	122.17	135.58	19.65	29.50	37.54
SED		0.27992			0.50322			0.27459	
CD (0.05)		0.56120			1.00890			0.55052	
CD (0.01)		0.74790**			1.34455**			0.73367**	

**Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW+10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW+ *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW+ 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW + 10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

Table -15

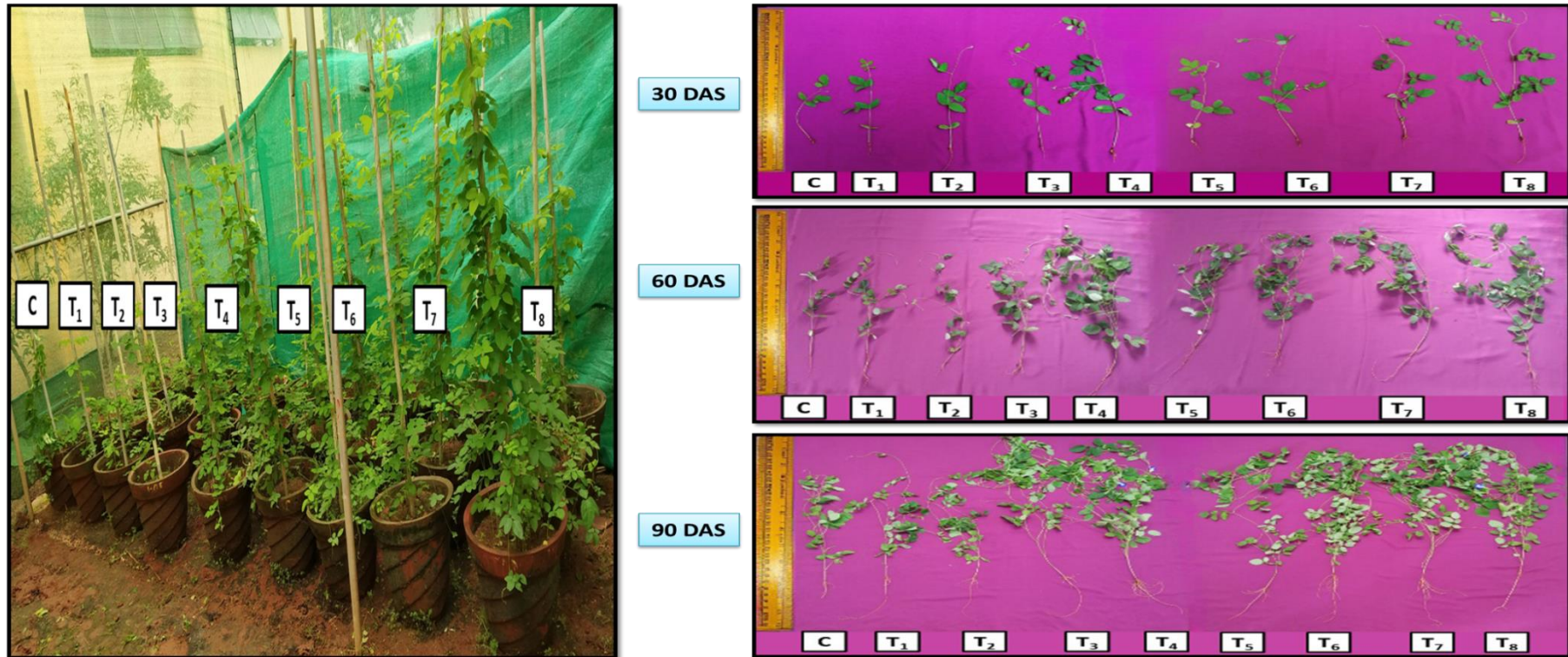
Efficiency of Biocomposted CSW and JFPW on Vegetative Parameters of *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc

Treatments	Number of Nodules			Plant Fresh Weight (g)			Plant Dry Weight (g)		
	25 DAS	50 DAS	75 DAS	25 DAS	50 DAS	75 DAS	25 DAS	50 DAS	75 DAS
C	9.00	15.00	8.35	2.288	3.276	8.165	0.293	0.638	0.977
T ₁	11.06	19.00	10.54	3.164	4.004	13.157	0.424	0.827	1.232
T ₂	15.32	21.00	12.25	3.825	4.320	15.208	0.467	0.880	1.523
T ₃	17.00	24.00	15.00	4.282	5.097	17.349	0.489	0.944	1.588
T ₄	24.13	30.00	21.00	5.136	7.371	28.460	0.796	1.130	2.187
T ₅	17.06	25.00	16.00	4.415	5.701	18.238	0.562	0.968	1.706
T ₆	18.43	26.00	18.00	4.422	5.797	20.564	0.574	0.989	1.960
T ₇	19.10	28.00	19.00	4.640	5.906	22.183	0.639	1.012	1.989
T ₈	27.46	33.00	25.00	5.491	9.811	32.516	0.855	1.489	3.020
SED		0.28048			0.09072			0.00096	
CD (0.05)		0.56232			0.18189			0.00193	
CD (0.01)		0.74940**			0.24240**			0.00257**	

**Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control, (Without treatment) T₁ (Raw CSW+E. eugeniae 5 t/ha⁻¹), T₂ (Raw CSW+20 g P. eous+E. eugeniae 5 t/ha⁻¹), T₃ (Raw CSW+ 20g P.florida+E. eugeniae 5 t/ha⁻¹), T₄ (Raw CSW+10 g P. eous +10 g P.florida+E. eugeniae 5 t/ha⁻¹), T₅ (Raw JFPW+ E. eugeniae 5 t/ha⁻¹), T₆ (Raw JFPW+20 g P. eous+ E. eugeniae 5t/ha⁻¹), T₇ (Raw JFPW+20 g P. florida + E. eugeniae 5 t/ha⁻¹), T₈ (Raw JFPW +10 g P. eous +10 g P. florida + E. eugeniae 5 t/ha⁻¹)

PLATE – 11

Effect of CSW and JFPW Biocompost on Vegetative Parameters (30 to 90 DAS) of Shankhpushpi (*Clitoria ternatea* L)

C-Control, (Without treatment), T₁ (Raw CSW+ *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW+20 g *P.eous*+ *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW+ 20g *P. florida*+ *E.eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW+10 g *P. eous* +10 g *P. florida*+ *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW+ *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW+20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW+20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW +10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

Table -16

Influence of Biocomposted CSW and JFPW on Vegetative Parameters of *Clitoria ternatea* L.

Treatments	Root length (cm)			Shoot length (cm)			Number of leaves		
	30 DAS	60DAS	90 DAS	30 DAS	60DAS	90 DAS	30 DAS	60DAS	90 DAS
C	2.5	5.5	10.5	19.2	47.8	74.3	9.04	24.10	83.14
T ₁	3.8	8.3	18.4	29.5	53.3	77.5	15.09	34.15	87.17
T ₂	4.3	9.5	23.6	32.3	54.5	79.3	16.12	40.05	105.10
T ₃	4.5	10.6	24.3	34.5	56.1	132.6	18.07	47.13	149.05
T ₄	8.9	22.5	28.8	53.2	101.7	179.7	27.62	132.11	231.15
T ₅	4.7	12.3	24.6	41.2	63.5	149.8	19.08	60.14	161.20
T ₆	4.10	16.4	25.5	46.8	68.8	155.7	21.06	79.12	168.18
T ₇	6.4	18.5	26.7	50.3	84.2	162.2	23.13	81.18	176.31
T ₈	12.3	23.9	29.5	55.7	119.3	182.3	35.04	146.16	249.24
SED		0.15428			0.08165			0.10231	
CD (0.05)		0.30932			0.16370			0.20511	
CD (0.01)		0.41223**			0.21816**			0.27335**	

**Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida*+*E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW +10 g *P. eous* +10 g *P.florida* +*E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW + *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW + 10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

Table -17

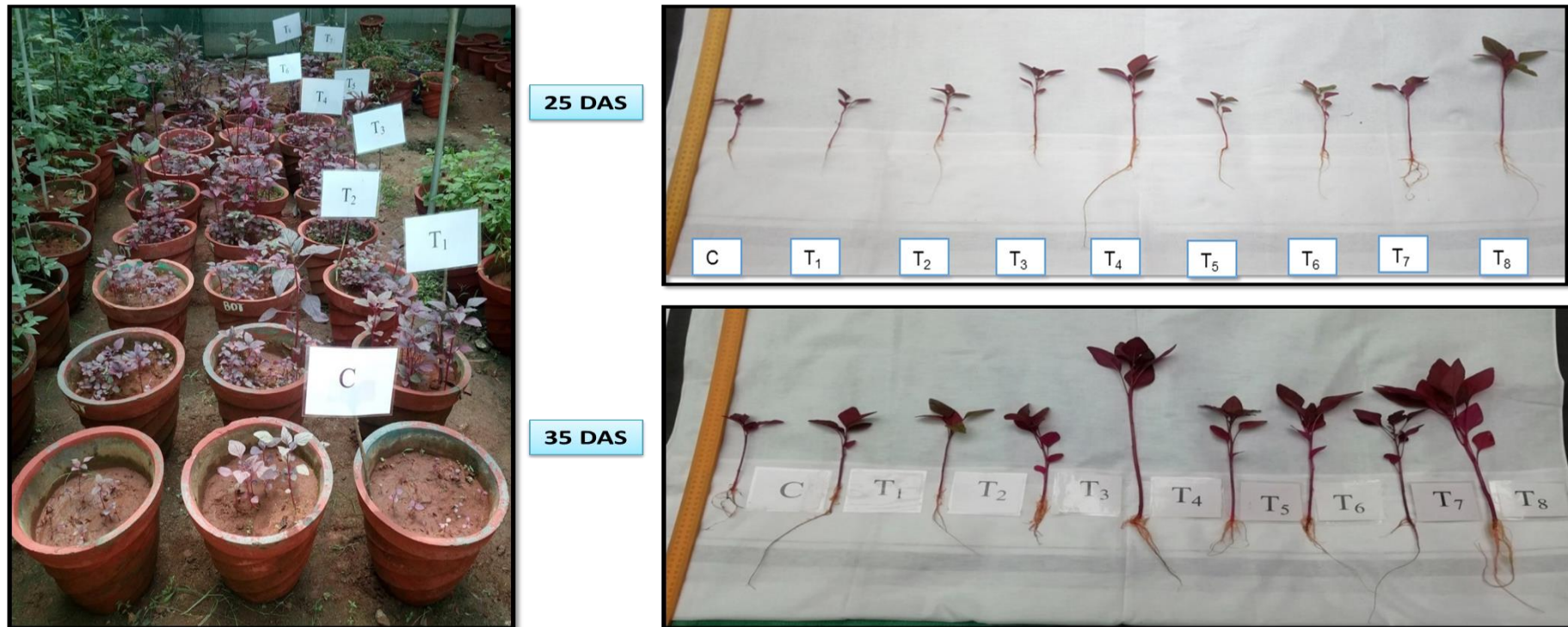
Impact of Biocomposted CSW and JFPW on Vegetative Parameters of *Clitoria ternatea* L.

Treatments	Number of Branches			Plant Fresh Weight (gm)			Plant Dry Weight (gm)		
	30 DAS	60DAS	90 DAS	30 DAS	60DAS	90 DAS	30 DAS	60DAS	90 DAS
C	2.19	3.00	10.00	0.315	1.268	4.083	0.074	0.249	0.917
T ₁	3.00	4.48	11.17	0.510	1.456	6.318	0.110	0.290	2.009
T ₂	5.00	6.24	13.35	0.531	1.893	6.660	0.115	0.363	2.737
T ₃	6.03	8.14	14.61	0.804	2.942	11.112	0.151	0.525	3.506
T ₄	11.23	13.04	19.23	1.382	8.545	24.409	0.340	1.710	6.478
T ₅	7.15	9.25	15.04	0.807	3.296	14.763	0.154	0.723	4.089
T ₆	8.06	10.76	17.00	0.945	3.854	18.790	0.215	0.820	4.796
T ₇	9.35	11.18	17.37	1.061	5.758	20.772	0.234	1.123	5.089
T ₈	11.34	14.00	21.20	1.751	12.049	27.587	0.418	2.252	6.639
SED		0.07800			1.00082			0.0081	
CD (0.05)		0.15639			2.00164			0.0162	
CD (0.01)		0.20842**			2.00218**			0.00215**	

**Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P. eous* + 10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW + *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW + 10 g *P. eous* + 10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

PLATE -12

Effect of CSW and JFPW Biocompost on Vegetative Parameters (25 & 35 DAS) of Red Amaranth (*Amaranthus tricolor* (L.))

C-Control (Without treatment), T₁ (Raw CSW+ *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW+20 g *P.eous*+ *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW+ 20g *P.florida*+ *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW+10 g *P. eous* +10 g *P. florida*+ *E.eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW+ *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW+20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW+20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW +10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

Table -18

Efficacy of Biocomposted CSW and JFPW on the Vegetative Parameters of *Amaranthus tricolor* (L.)

Treatments	Root length (cm)		Shoot length (cm)		Number of Leaves		Fresh weight (g)		Dry weight (g)	
	25 DAS	35 DAS	25 DAS	35 DAS	25 DAS	35 DAS	25 DAS	35 DAS	25 DAS	35 DAS
C	5.20	6.43	4.63	7.43	4.70	5.93	0.268	0.919	0.047	0.066
T ₁	8.20	9.54	6.77	12.73	6.47	7.53	0.407	2.274	0.076	0.112
T ₂	10.17	14.20	7.10	18.63	6.77	7.82	0.708	3.350	0.125	0.438
T ₃	14.10	20.43	9.57	16.97	7.58	8.73	0.919	2.420	0.226	0.398
T ₄	16.73	24.40	12.87	22.00	8.80	11.00	1.499	6.736	0.330	0.832
T ₅	9.93	17.77	6.63	8.50	6.13	7.70	1.304	1.499	0.139	0.330
T ₆	11.70	16.40	8.73	11.70	7.63	8.40	0.672	1.329	0.099	0.298
T ₇	13.93	18.77	9.93	17.70	7.97	9.67	1.329	2.711	0.297	0.473
T ₈	22.87	26.07	14.07	29.07	10.97	14.03	2.271	8.085	0.438	1.122
SED	1.00964		1.34500		1.20741		0.00293		0.00128	
CD (0.05)	2.04788		2.72808		2.48214		0.00594		0.00259	
CD (0.01)	2.74596**		3.65802**		3.57294**		0.00797**		0.00347**	

**Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P. eous* + 10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW+ *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW + 10 g *P. eous* + 10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

4.3.1 Influence of Different Treatment of Biocompost on Yield Parameters of Test Crop

4.3.1 (a) *Vigna unguiculata* L. Walp. Var. Co (CP) 7 (Cowpea)

The pot culture experiment of cowpea revealed that the maximum number of pods/plant (21.00,17.00), number of seed/pod (20,18), length of pod (16.50 cm, 13.86 cm), weight of seed/pod (1.68 g, 1.43g), pod fresh weight (5.711g, 4.243 g) and pod dry weight (2.398 g, 1.969 g) were recorded in treatments T₈ -Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) and T₄ -Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (biocompost4) as compared to control (7.00, 8.00, 8.70cm, 0.715 g, 1.140g and 0.784g) at 65 days after sowing (DAS) as presented in Table -19 and Plate -13.

4.3.1 (b) *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc. Var. NS-621 (Yardlong bean)

The experimental observation of Yardlong beans recorded a remarkable rise in the number of pods/plant (28.00, 26.00, 9.00), number of seed/pod (24.00,22.00,11.00), length of pod (48.60cm, 40.70cm, 20.60 cm), weight of seed/pod (1.919g, 1.757g,0.883), pod fresh weight (6.796g, 5.439g, 1.184g) and pod dry weight (2.707g, 2.651g, 0.852g) was noted in T₈ - Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (biocompost 4) over the other treatments and Control as shown in Table -20 & Plate -13.

4.3.1 (c) *Clitoria ternatea* L. (Shankpushpi)

Shankpushpi recorded a substantial increase in number of pods/plant (29.00,27.00), number of seed/pod (9.31,8.27), length of pod (10.85cm,10.50cm),weight of seed/pod (1.155g,1.147g),pod fresh weight (2.230 g, 2.051g) and pod dry weight (0.673g, 0.650 g) were examined at treatment T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ and followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹(biocompost4) on 120 DAS as compared to the control (7.00, 5.23, 7.14cm, 0.556g, 1.475g and , 0.268 g) respectively . The data presented in Table -21 & Plate -13.

4.3.1 (d) *Amaranthus tricolor* L. Var. Arun

An appreciable number of leaves/plant (31.9, 26.5, 12.4), root length (29.4cm, 25.6 cm, 15.2 cm), Shoot length (77.3 cm, 63.7 cm, 22.2 cm), fresh weight (31.208 g, 18.512g, 2.561g) and Dry weight (6.245g, 3.036g, 0.551g) were superior in the treatment T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ which was followed by T₄ – Raw CSW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (biocompost4) on 50 DAS when compared to the control as depicted in Table-22 & Plate -13.

Similar results were positively correlated with the findings of Sundaram and Vincent (2017) who observed that the maximum increase in number of leaves, number of pods, length of pods, number of seeds and weight of seeds per pod in cowpea were noted in T₂ (2kg Sludge (S) + 2kg Cow dung (CD) (1:1)) and T₅ (2kg Sludge(S) + 1kg CP + 1kg CD (2:1:1)). Similar outcomes were positively associated with Dhanraj *et al.*, (2018) who noticed that *Bradyrhizobium japonicum* + *Pseudomonas fluorescens* with RDF (T₁₀) treatment improved the number of pods per plant, length of pod, weight of pod and seed weight in *Clitoria ternatea* L.

These findings were found in line with the work of Nasar *et al.*, (2019) who showed that the application of compost and charcoal combination significantly increases the yield and yield attributes of wheat. These findings were found in line with the work of Cahyono *et al.*, (2020) observed that the application of a compost dosage at 50 t ha⁻¹ increased pineapple yield as compared to the control. Hamza *et al.*, (2021) obtained higher yield in *Clitoria ternatea* with addition of poultry manure + eggshell fertilizer as compared with control and poultry manure alone.

The present finding is in conformity with that of Hema *et al.*, (2022) who concluded that maximum increase in number of pods, length of the pod, number of seeds/pod, weight of the seeds/pod, fresh weight of the pod and dry weight of the pod in moth bean was recorded in T₆ (Pre decomposed coffee husk, consortium of *Pleurotus eous*, *P. florida*, *Trichoderma asperelloides* and *Eisenia fetida*).

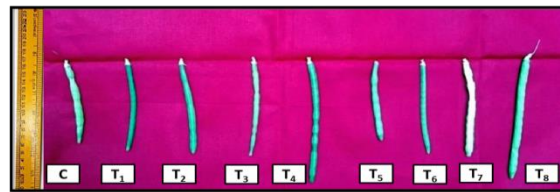
Similar results were supported by observations Biswas, (2014) in *Rumex acetosella* L., Vijayalakshmi and Gayathri, (2017) in chilli plant, Verma *et al.*, (2018) in cowpea, Sekhar *et al.*, (2020) in greengram and Sherinlincy *et al.*, (2020) in *Amaranthus tricolor* L.

PLATE - 13

Impact of Biocomposted Cocoa Shell and Jack Fruit Peel Waste on Yield Parameters of Test Crop



65 DAS



Vigna unguiculata (L.) Walp Var. Co (CP) 7
(Cowpea)



90 DAS



Vigna unguiculata subsp. *sesquipedalis* (L.)
Verde Var. NS-621 (Yardlong bean)



120 DAS



Clitoria ternatea L.
(Shankpushi)



50 DAS



Amaranthus tricolor L. Var. Arun
(Red amaranth)

Table - 19
Yield Parameters of *Vigna unguiculata* (L.) Walp (Cowpea) Influenced by Biocomposted CSW and JFPW

Treatments	Yield Parameters (65 DAS)						
	Number of flowers/plants (45 DAS)	Number of pods/plant	Number of Seed/pod	Pod length (cm)	Weight of seed/pod (g)	Pod Fresh weight (g)	Pod Dry weight (g)
C	4.00	7.00	8.00	8.700	0.715	1.140	0.784
T ₁	7.00	9.00	13.00	9.60	0.858	1.802	0.914
T ₂	6.00	8.00	11.00	12.00	0.791	2.154	0.990
T ₃	8.00	11.00	9.00	10.60	0.826	2.185	1.396
T ₄	10.00	17.00	18.00	13.86	1.436	4.243	1.969
T ₅	6.00	13.00	16.00	9.83	1.292	2.358	1.548
T ₆	7.00	12.00	10.00	10.80	1.186	1.674	0.829
T ₇	9.00	15.00	14.66	11.60	1.294	3.841	1.821
T ₈	12.00	21.00	20.00	16.50	1.680	5.711	2.398
SED	0.8165	0.8165	0.8749	0.8635	0.0016	0.0008	0.0005
CD (0.05)	1.7154	1.7154	1.8381	1.8142	0.0034	0.0017	0.0013
CD (0.01)	2.3506**	2.3506**	2.5187**	2.4860**	0.0047**	0.0024**	0.0019**

**Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control, (Without treatment) T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P. eous* +10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW + *E. eugeniae* 5 t/ha-1), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW +10 g *P. eous* + 10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

Table - 20

Yield Parameters of *Vigna unguiculata subsp. sesquipedalis* (L.) Verdc Influenced by Biocomposted CSW and JFPW

Treatments	Yield Parameters (90 DAS)						
	Number of flowers/plants (65 DAS)	Number of pods/plant	Number of Seed/pod	Pod length (cm)	Weight of seed/pod (g)	Pod Fresh weight (g)	Pod Dry weight (g)
C	8.00	9.00	11.00	20.60	0.883	1.184	0.852
T ₁	11.00	14.00	12.00	23.80	0.994	2.188	0.648
T ₂	13.00	16.00	14.00	25.30	0.969	2.638	0.980
T ₃	16.00	18.00	16.00	26.30	0.981	2.571	1.403
T ₄	19.00	26.00	22.00	40.70	1.757	5.439	2.651
T ₅	12.00	19.00	15.00	27.37	1.309	2.854	1.477
T ₆	15.00	21.00	16.00	28.20	1.523	2.945	1.830
T ₇	17.00	23.00	17.00	30.50	1.569	2.987	1.853
T ₈	21.00	28.00	24.00	48.60	1.919	6.796	2.707
SED	0.8315	0.8165	0.8749	0.8336	0.0008	0.1574	0.1414
CD (0.05)	1.7469	1.7154	1.8381	1.7513	0.0017	0.3306	0.2971
CD (0.01)	2.3938**	2.3506**	2.5187**	2.3998**	0.0024**	0.4531**	0.4071**

**Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control, (Without treatment) T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW+20 g *P. eous*+*E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P. eous* + 10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW + *E. eugeniae* 5 t/ha-1), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW+ 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW + 10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

Table - 21
Yield Parameters of *Clitoria ternatea* L. Influenced by Biocomposted CSW and JFPW

Treatments	Yield Parameters (120 DAS)						
	Number of flowers/plants (90 DAS)	Number of pods/plant	Number of Seed/pod	Pod length(cm)	Weight of seed/pod (g)	Pod Fresh weight (g)	Pod Dry weight (g)
C	8	7	5.23	7.14	0.556	1.475	0.268
T ₁	18	14	6.01	8.43	0.676	1.632	0.380
T ₂	20	17	6.47	8.62	0.784	1.641	0.397
T ₃	23	19	7.04	8.57	0.786	1.662	0.412
T ₄	30	27	8.27	10.50	1.147	2.051	0.650
T ₅	23	18	7.42	9.00	0.654	1.888	0.482
T ₆	25	20	7.56	9.44	0.667	1.974	0.485
T ₇	27	22	7.51	9.64	0.788	1.987	0.520
T ₈	32	29	9.31	10.85	1.155	2.230	0.673
SED	0.8165	0.7253	0.0082	0.2723	0.0052	0.0005	0.0008
CD (0.05)	1.7154	1.5263	0.0172	0.5720	0.0110	0.0062	0.0017
CD (0.01)	2.3506**	2.1472**	0.0235**	0.7839**	0.0150**	0.0073**	0.0024**

**Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P. eous* + 10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW + *E. eugeniae* 5 t/ha-1), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW + 10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

Table -22

Yield Parameters of *Amaranthus tricolor* (L.) Influenced by CSW and JFPW Biocompost

Treatments	Yield Parameters (50 DAS)				
	Root length(cm)	Shoot length (cm)	Number of leaves	Fresh weight (g)	Dry weight (g)
C	15.2	22.2	12.4	2.561	0.551
T ₁	19.3	28.4	14.6	3.929	0.728
T ₂	21.5	32.8	16.8	5.021	1.040
T ₃	20.0	35.6	18.3	8.564	1.588
T ₄	25.6	63.7	26.5	18.512	3.036
T ₅	20.4	40.0	20.2	8.856	1.880
T ₆	21.8	41.9	22.7	11.496	2.498
T ₇	22.7	56.5	19.1	11.792	2.109
T ₈	29.4	77.3	31.9	31.208	6.245
SED	1.3618	1.3171	1.2761	0.0013	0.0012
CD (0.05)	2.8611	2.7672	2.6810	0.0027	0.0014
CD (0.01)	3.9206**	3.7919**	3.6737**	0.0037**	0.0028**

**Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P. eous* +10 g *P.florida*+*E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW+ *E. ugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous*+ *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW+20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW + 10 g *P. eous* + 10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

PHASE III

4.4 BIOCHEMICAL CHARACTERS

4.4.1 Impact of biocomposted CSW and JFPW on Protein content in Leaves of Test Crops

4.4.1 (a) *Vigna unguiculata* L. Walp. Var. Co (CP) 7 (Cowpea)

The results of the experimental investigation on cowpea revealed that the protein content in the leaves of all treatments (T₁-T₈) increased from 25 to 35 DAS and after that protein content declined to 45 DAS. The results are displayed in Table-23. Among the treatments, T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) recorded the highest level of protein content of 56.04 mg/g tissue and 73.10 mg/g tissue followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (biocompost 4) of 51.83 and 65.41 mg/g tissue on 25 and 35 DAS and after that the protein content of the leaves steadily decreased to 67.51 mg/g tissue and 56.48 mg/g tissue on 45 DAS over the control treatment (30.56, 45.62, 35.36 mg/g tissue).

Table - 23

Impact of Biocomposted CSW and JFPW on Protein content in leaves of Cowpea

Treatments	Protein (mg/g tissue)		
	25 DAS	35 DAS	45 DAS
C	30.56	45.62	35.36
T₁	33.51	52.46	42.87
T₂	35.26	53.88	46.97
T₃	40.27	57.08	43.89
T₄	51.83	65.41	56.48
T₅	43.68	54.00	45.48
T₆	46.28	60.09	51.92
T₇	41.83	61.83	47.70
T₈	56.04	73.10	67.51
SED		1.30829	
CD (0.05)		2.62297	
CD (0.01)		3.49560**	

** Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous*+ *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW+ 20g *P.florida*+*E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW+10 g *P. eous* +10 g *P.florida*+*E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW+ *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW+20 g *P. eous*+ *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW+20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW +10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

4.4.1 (b) *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc Var.NS-621 (Yardlong bean)

Protein analysis of Yardlong bean recorded an increasing trend in protein content observed in the leaves of all the treatments from 25 to 50 DAS and after that, there was a decrease in its content on 75 DAS. The results were shown in Table-24. Among the treatments, T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (Biocompost 8) registered maximum protein content of 82.11 and 96.08 mg/g tissue followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (Biocompost 4) registered 79.53 and 90.33 mg/g tissue on 25 and 50 DAS and after that the protein content of the leaves declined gradually to 87.00 mg/g tissue 82.12 mg/g tissue on 75 DAS as compared to the Control (57.16, 75.27, 61.35 mg/g tissue).

Table -24**Impact of Biocomposted CSW and JFPW on Protein content in leaves of Yardlong bean**

Treatments	Protein (mg/g tissue)		
	25 DAS	50 DAS	75 DAS
C	57.16	75.27	61.35
T ₁	64.18	79.42	69.23
T ₂	69.05	81.16	72.33
T ₃	74.67	85.68	79.45
T ₄	79.53	90.33	82.12
T ₅	66.27	83.51	74.20
T ₆	70.35	86.35	76.06
T ₇	73.19	88.35	77.29
T ₈	82.11	96.08	87.00
SED		0.27489	
CD (0.05)		0.55112	
CD (0.01)		0.73447**	

** Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW +10 g *P. eous* +10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW + *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW +10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

4.4.1 (c) *Clitoria ternatea* L. (Shankhpushi)

Protein analysis of Shankhpushi results were shown in Table-25. An increasing trend in protein content was observed in the leaves of all the treatments from 30, 60 and 90 DAS. Among the treatments, T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) registered maximum protein content followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (biocompost 4) at 30 DAS (77.17, 72.62 mg/g tissue) and 60 DAS (88.26, 86.80 mg/g tissue) after that the protein content of the leaves declined gradually on 90 DAS (79.26, 76.71 mg/g tissue) as compared to the control (37.45, 54.35, 40.26 mg/g tissue).

Table -25

Influence of Biocomposted CSW and JFPW on Protein content in leaves of Shankhpushi

Treatments	Protein (mg/g tissue)		
	30 DAS	60DAS	90 DAS
C	37.45	54.35	40.26
T ₁	46.63	61.26	56.81
T ₂	49.17	65.99	58.63
T ₃	55.99	69.53	61.26
T ₄	72.62	86.80	76.71
T ₅	58.26	71.81	63.17
T ₆	61.99	75.62	66.26
T ₇	65.35	78.62	69.08
T ₈	77.17	88.26	79.26
SED		0.32676	
CD (0.05)		0.65512	
CD (0.01)		0.87307**	

** Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW+ 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P. eous* +10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW + *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW +10 g *P. eous* + 10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

4.4.1 (d) *Amaranthus tricolor* L. Var. Arun (Red amaranth)

Protein content of Red amaranth was observed in the leaves of all the treatments T₁-T₈ from 25 to 35 DAS. The results were shown in Table - 26. Among the treatments, T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) registered maximum protein content of 73.57 and 85.21 mg/g tissue followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (biocompost 4) registered 60.42 and 81.05 mg/g tissue on 25 and 35 DAS as compared to the Control (28.70, 30.95 mg/g tissue).

Table -26
Influence of Biocomposted CSW and JFPW on Protein content
in leaves of Red amaranth

Treatments	Protein (mg/g tissue)	
	25 DAS	35 DAS
C	28.70	30.95
T ₁	38.06	47.51
T ₂	49.16	50.42
T ₃	47.53	64.20
T ₄	60.42	81.05
T ₅	55.86	77.23
T ₆	55.23	56.88
T ₇	58.41	74.64
T ₈	73.57	85.21
SED	1.67107	
CD (0.05)	3.38947	
CD (0.01)	4.54486**	

** Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P. eous* + 10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW + *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW +10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

4.4.2 Biocomposted CSW and JFPW Effect on Carbohydrate content in leaves of Test crops

4.4.2 (a) *Vigna unguiculata* L. Walp. Var. Co (CP) 7 (Cowpea)

An increasing trend in carbohydrate content was noticed in all the treatments from 25 to 35 DAS and after that, there was a decrease in its content (Table - 27). Among the treatments, carbohydrate content in leaf was increased significantly in T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) which ranged from 72.82 to 87.97 mg/g tissue followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (biocompost 4) which ranged from 67.50 to 82.25 mg/g tissue on 25 and 35 DAS and declined to 78.21 and 72.55 mg/g tissue on 45 DAS against the control (the increase was from 42.12 to 64.21 mg/g tissue on 25 and 35 DAS and declined to 49.89 mg/g tissue on 45 DAS).

4.4.2 (b) *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc Var.NS-621 (Yardlong bean)

The experimental study of carbohydrate in Yardlong bean leaves is inferred from Table-28. The carbohydrate content in leaves showed a gradual increase up to 25-50 DAS and declined gradually to 75 DAS thereafter in all the treatments.

Among the treatments, T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ registered maximum carbohydrate content of 78.57 mg/g tissue and 96.23 mg/g tissue followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ of 74.19 mg/g tissue and 89.66 mg/g tissue on 25 and 50 DAS and after that the carbohydrate content declined gradually to 84.67 mg/g tissue and 75.49 mg/g tissue on 75 DAS as compared to the control 49.15 mg/g tissue, 66.08 mg/g tissue, 54.22 mg/g tissue respectively.

4.4.2 (c) *Clitoria ternatea* L. (Shankhpushi)

In shankhpushi carbohydrate content increased significantly in T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ which ranged from 74.22 mg/g tissue to 86.37 mg/g tissue followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ which ranged from 71.05 mg/g tissue to 82.21 mg/g tissue on 30 and 60 DAS respectively and declined to 83.64 mg/g tissue and 78.71 mg/g tissue on 90 DAS against the control (the increase was from 35.14 mg/g tissue to 49.37 mg/g tissue and declined to 42.14 mg/g tissue) as shown in Table -29.

Table -27

Effect of biocomposted CSW and JFPW on Carbohydrate Content in Leaves of Cowpea

Treatments	Carbohydrate (mg/g tissue)		
	25 DAS	35 DAS	45 DAS
C	42.12	64.21	49.89
T ₁	50.34	71.20	60.08
T ₂	57.18	74.86	65.18
T ₃	56.08	75.73	63.92
T ₄	67.50	82.25	72.55
T ₅	51.80	73.21	62.08
T ₆	58.00	80.23	66.13
T ₇	59.46	70.21	63.37
T ₈	72.82	87.97	78.21
SED		1.30670	
CD (0.05)		2.61978	
CD (0.01)		3.49134**	

** Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW +10 g *P. eous* + 10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW+ *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW + 10 g *P. eous* + 10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

Table -28
Effect of Biocomposted CSW and JFPW on Carbohydrate content in leaves of Yardlong bean

Treatments	Carbohydrate (mg/g tissue)		
	30 DAS	60DAS	90 DAS
C	49.15	66.08	54.22
T ₁	56.44	73.36	69.20
T ₂	65.26	78.62	70.48
T ₃	67.00	84.51	73.51
T ₄	74.19	89.66	75.49
T ₅	58.47	76.38	70.59
T ₆	66.38	80.57	73.81
T ₇	69.91	88.34	76.14
T ₈	78.57	96.23	84.67
SED		0.27180	
CD (0.05)		0.54493	
CD (0.01)		0.72623**	

** Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control, (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida*+*E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P. eous* +10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW + *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW + 10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

4.4.2 (d) *Amaranthus tricolor* L. Var. Arun (Red amaranth)

The carbohydrate content in red amaranth leaves showed a gradual increase on 25 and 35 DAS in all the treatments as presented in Table-30. The highest carbohydrate content was observed in T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (67.75 mg/g tissue to 74.27 mg/g tissue) followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ on 25 and 35 DAS (66.17 mg/g tissue to 68.12 mg/g tissue) as compared the control (35.03 mg/g tissue, 46.73 mg/g tissue).

A similar result was determined by Zodape *et al.*, (2010) who showed that the application of 15% seaweed (*Kappaphycus alvarezii*) extract increased the protein and carbohydrate of green gram than control. Present results coincides with the results of Chaudhari *et al.*, (2013) who reported that the application of 100% recommended dose nitrogen through vermicompost amended with jivamurt improved the protein content of summer green gram at 15 and 30 DAS.

The present finding was positively correlated with the findings of Abbiramy and Ross, (2012) who observed maximum protein content due to the effect of vermicompost prepared by *Eudrilus eugeniae* and *Lampito mauritii* on *Abelmoschus esculentus* leaf. Badar *et al.*, (2015a) revealed increased maximum protein and carbohydrate (JUR2 -Bradyrhizobia sp) content in cowpea.

The present finding was supported by Reghuvaran and Ravindranath, (2014) who revealed that the application of composted coir pith considerably enhanced the carbohydrate content of *Lycopersicon esculentum*, *Abelmoschus esculentus* and *Momordica charantia* as compared to the plants cultivated in soil. Similar work was performed by Kannahi and Ramya, (2015) in *Lycopersicum esculentum* L. Sakthivigneswari and Vijayalakshmi, (2018) recommended that application of the treatment T₆ - (Raw coirpith predigested by using *Pleurotus sajor-caju* and *Eudrilus eugeniae* (5t/ha) enhanced the protein and carbohydrate in *Glycine max* L. (Merill).

Table -29
Efficiency of Biocomposted CSW and JFPW on Carbohydrate content in Leaves of Shankpushpi

Treatments	Carbohydrate (mg/g tissue)		
	30 DAS	60 DAS	90 DAS
C	35.14	49.37	42.14
T ₁	46.52	57.91	54.63
T ₂	54.19	61.41	58.57
T ₃	58.13	64.15	62.51
T ₄	71.05	82.21	78.71
T ₅	62.07	67.22	65.68
T ₆	65.79	71.70	68.42
T ₇	68.86	73.57	73.24
T ₈	74.22	86.37	83.64
SED		0.80154	
CD (0.05)		1.31262	
CD (0.01)		2.47903**	

** Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW+E. eugeniae 5 t/ha⁻¹), T₂ (Raw CSW+20 g P. eous+E. eugeniae 5 t/ha⁻¹), T₃ (Raw CSW+ 20g P.florida+E. eugeniae 5 t/ha⁻¹), T₄ (Raw CSW+10 g P. eous +10 g P.florida+E. eugeniae 5 t/ha⁻¹), T₅ (Raw JFPW+ E. eugeniae 5 t/ha⁻¹), T₆ (Raw JFPW+20 g P. eous+ E. eugeniae 5t/ha⁻¹), T₇ (Raw JFPW+20 g P. florida + E. eugeniae 5 t/ha⁻¹), T₈ (Raw JFPW +10 g P. eous +10 g P. florida + E. eugeniae 5 t/ha⁻¹)

Table -30

Efficiency of Biocomposted CSW and JFPW on Carbohydrate content in leaves of Red amaranth

Treatments	Carbohydrate (mg/g tissue)	
	25 DAS	35 DAS
C	35.03	46.73
T ₁	43.76	56.48
T ₂	49.03	54.23
T ₃	53.01	60.10
T ₄	66.17	68.12
T ₅	52.26	55.72
T ₆	44.15	57.28
T ₇	57.14	66.56
T ₈	67.75	74.27
SED	1.65886	
CD (0.05)	3.36471	
CD (0.01)	4.51166**	

** Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P. eous* + 10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW + *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW+20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW + 10 g *P. eous* + 10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

4.4.3 Effect of CSW and JFPW Biocompost on Chlorophyll content in Leaves of Test Crops

4.4.3 (a) *Vigna unguiculata* (L.) Walp. Var. Co (CP) 7 (Cowpea)

Chlorophyll a, chlorophyll b and total chlorophyll content of Cowpea leaves increased significantly up to 35 DAS and then gradually declined after that in all the treatments (from T₁ to T₈) when compared with Control (Figure -7).

The treatment T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ showed highest chlorophyll content from 25 to 35 DAS which ranged from 0.389 to 0.813 mg/g tissue followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ which ranged from 0.357 to 0.539 mg/g tissue (chlorophyll a), 0.617 to 0.974 mg/g tissue followed by 0.546 to 0.919 mg/g tissue (chlorophyll b), 2.322 to 3.673 mg/g tissue followed by 2.302 to 3.450 mg/g tissue (total chlorophyll) and it was decreased gradually to 0.515 followed by 0.406 mg/g tissue (chlorophyll a), 0.730 followed by 0.557 mg/g tissue (chlorophyll b), 2.855 followed by 2.505 mg/g tissue (total chlorophyll) on 45 days after sowing. The least chlorophyll content was registered in control.

4.4.3 (b) *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc Var.NS-621 (Yardlong bean)

Chlorophyll a, chlorophyll b and total chlorophyll content of Yardlong Bean leaves increased significantly up to 50 DAS and then gradually declined after that in all the treatments (from T₁ to T₈) when compared with Control (Figure -8).

Among the treatment T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹, registered maximum chlorophyll content from 25 to 50 DAS which ranged from 0.826 to 0.915 mg/g tissue followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ which ranged from 0.753 to 0.849 mg/g tissue (chlorophyll a), 0.894 to 0.937 mg/g tissue followed by 0.831 to 0.907 mg/g tissue (chlorophyll b), 2.588 to 4.933 mg/g tissue followed by 2.339 to 4.734 mg/g tissue (total chlorophyll) and it decreased gradually to 0.852 mg/g tissue followed by 0.760 mg/g tissue (chlorophyll a), 0.899 mg/g tissue followed by 0.858 mg/g tissue (chlorophyll b), 2.641 followed by 2.460 mg/g tissue (total chlorophyll) on 75 DAS. The least amount of chlorophyll was recorded in Control treatment.

Figure -7
Impact of Biocomposted CSW and JFPW on Chlorophyll a, b, and Total Chlorophyll content in Cowpea Leaves

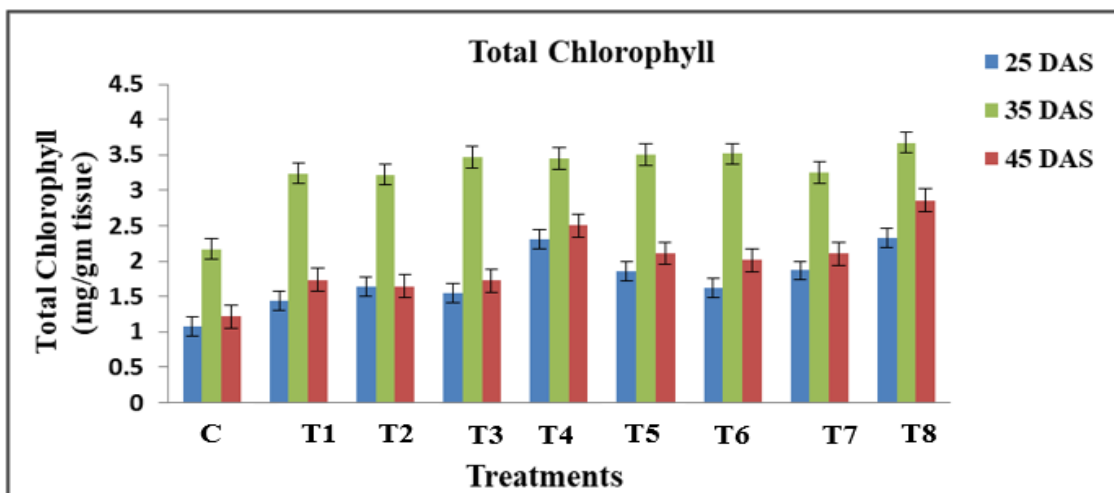
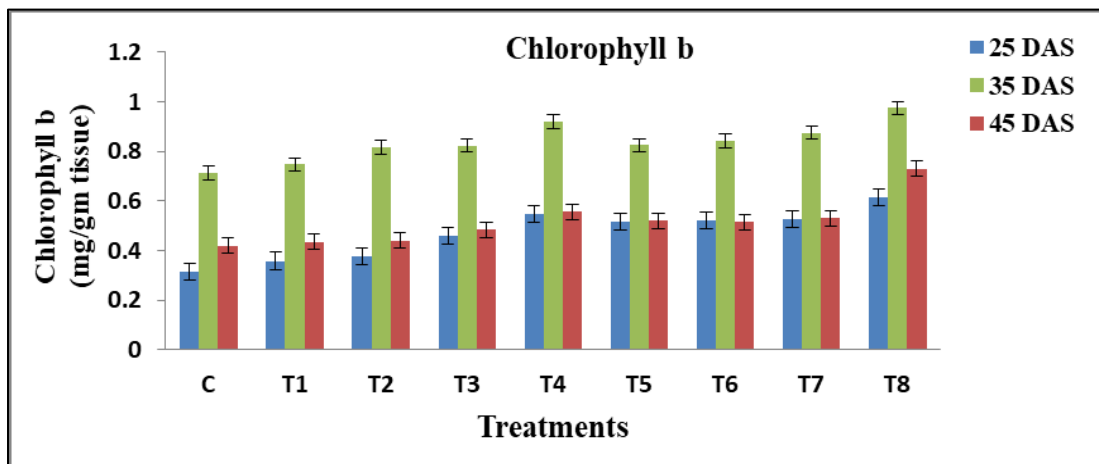
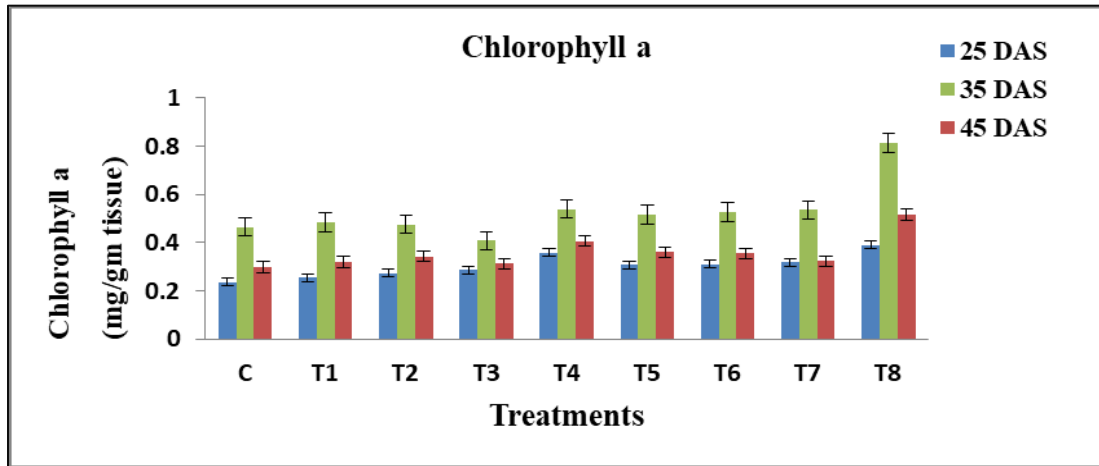
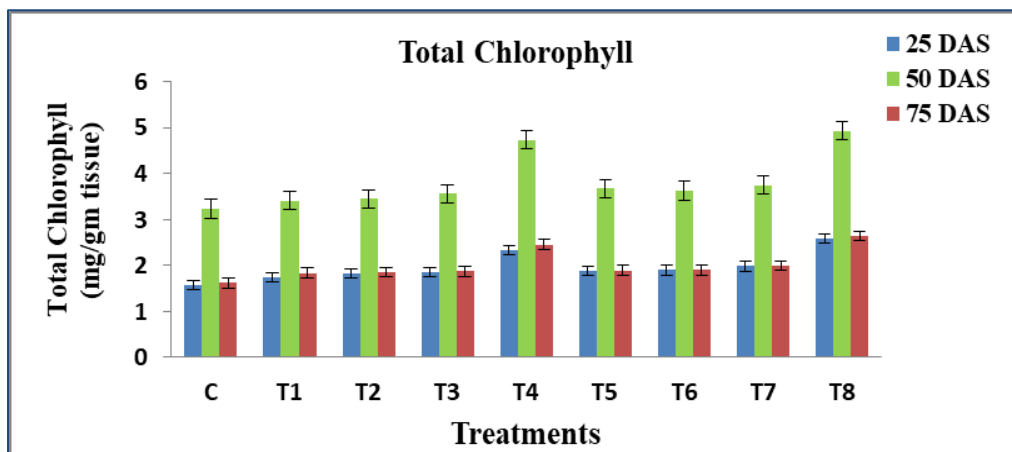
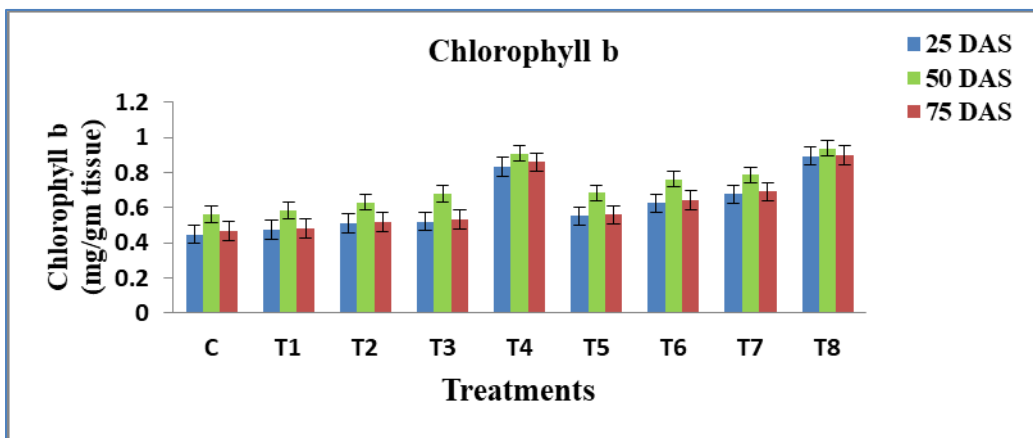
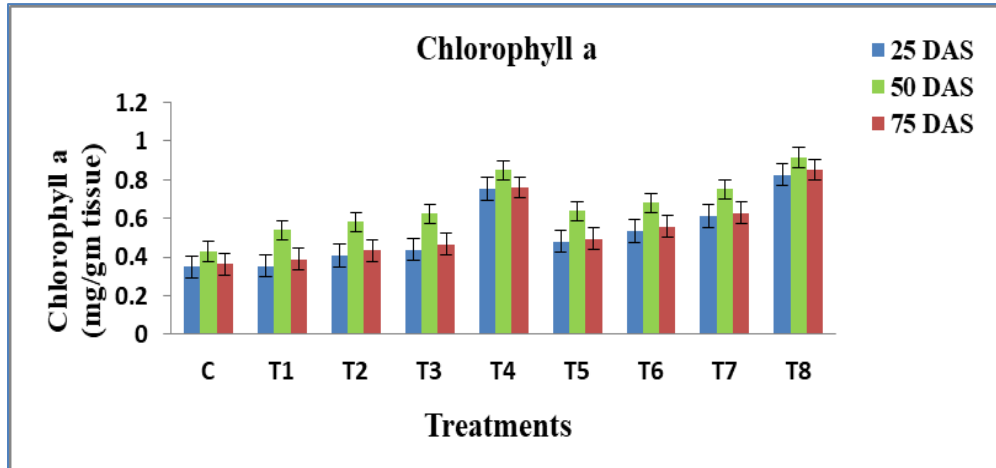


Figure - 8

Impact of Biocomposted CSW and JFPW on Chlorophyll a, b and Total Chlorophyll Content in Yardlong bean Leaves



4.4.3 (c) *Clitoria ternatea* L. (Shankhpushpi)

Chlorophyll a, chlorophyll b and total chlorophyll content of shankhpushpi leaves increased significantly up to 60 DAS and then gradually declined after that in all the treatments (from T₁ to T₈) when compared with Control (Figure- 9).

The treatment T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹, showed a remarkably significant increase in chlorophyll content from 30 to 60 DAS which was followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ which ranged from 0.328 to 0.459 mg/g tissue followed by 0.324 to 0.449 mg/g tissue (chlorophyll a), 0.654 to 0.926 mg/g tissue followed by 0.647 to 0.912 mg/g tissue (chlorophyll b), 0.982 to 1.385 mg/g tissue followed by 0.909 to 1.361 mg/g tissue (total chlorophyll) and it was decreased gradually to 0.447 followed by 0.439 mg/g tissue (chlorophyll a), 0.908 followed by 0.894 mg/g (chlorophyll b) and 1.355 followed by 1.332 mg/g tissue (total chlorophyll). The least amount of chlorophyll was recorded in Control.

4.4.3 (d) *Amaranthus tricolor* L. Var. Arun (Red amaranth)

Among the treatment T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹, registered maximum chlorophyll content from 25 to 35 DAS which ranged from 0.273 to 0.527 mg/g tissue followed by T₄ - Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ which ranged from 0.257 to 0.470 mg/g tissue (chlorophyll a), 0.639 to 0.844 mg/g tissue followed by 0.581 to 0.784 mg/g tissue (chlorophyll b), 3.578 to 4.630 mg/g tissue followed by 2.649 to 3.818 mg/g tissue (total chlorophyll) when compared to other treatments the least amount of chlorophyll was recorded in Control as shown Figure -10.

According to research by AL-Kahtani *et al.*, (2018), tomato plants planted in sandy soil supplemented with a compost mixture and 40% sheep manure (C5) had the maximum leaf chlorophyll content when compared to plants cultivated in other combinations. The current investigation was supported by Karimi *et al.*, (2015) findings that the use of organic fertilisers might boost the chlorophyll content of *Ziziphora clinopodioides* Lam.

The present study was in line with the work of Ravimycin, (2016) who recorded that the application of vermicompost increased the total chlorophyll content in *Coriandrum sativum*. Similar work was carried out by Vijayalakshmi and Gayathri, (2017) who recorded that Chlorophyll a, b and total chlorophyll content of chili plant was significantly higher in T4 treatment.

Figure -9

Impact of Biocomposted CSW and JFPW on Chlorophyll a, b, and Total Chlorophyll content in Leaves of Shankpushpi

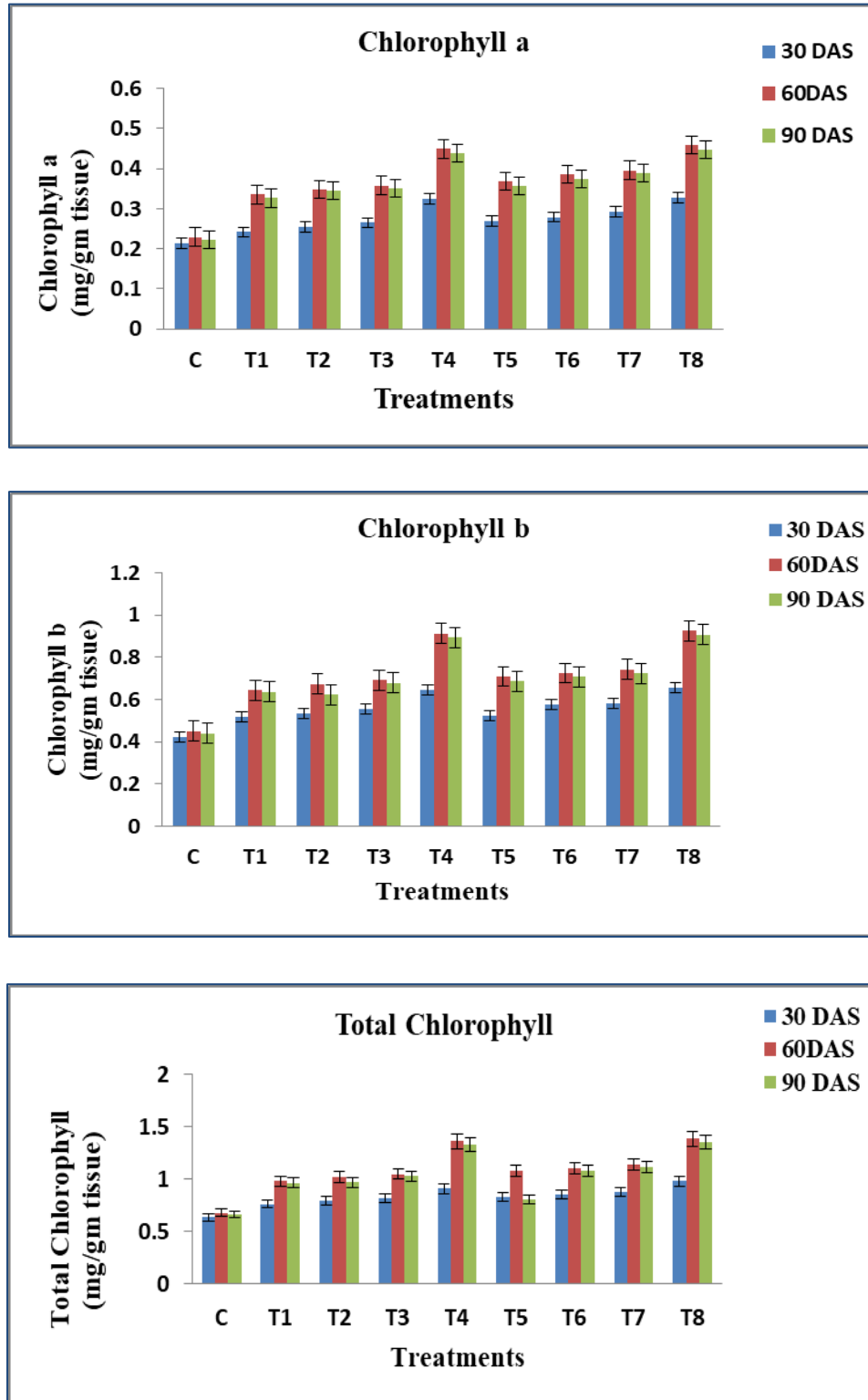
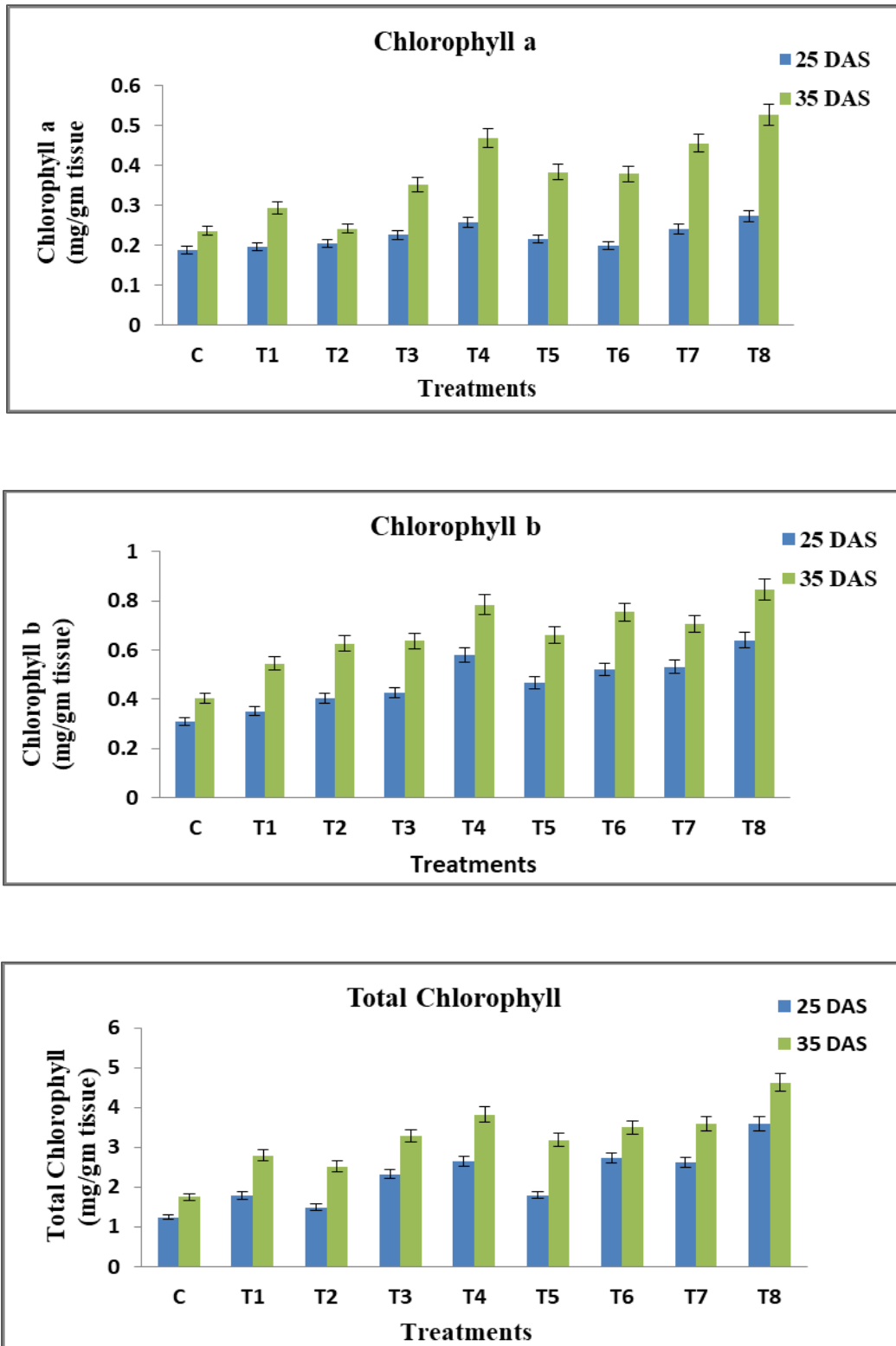


Figure - 10

Impact of Biocomposted CSW and JFPW on Chlorophyll a, b and Total Chlorophyll Content in Leaves of Red Amaranth



Similar result was obtained by Gayathri and Aiswariya, (2020) who observed an increase in chlorophyll in the plants *Arachis hypogae* L. and *Sesamum indicum* L treated with mixture of organic fertilizers. Rajashri *et al.*, (2021) revealed that treatment T₃ consisting of vermicomposted groundnut shell and vegetables waste (75g) showed significantly increased chlorophyll content in pigeon pea as compared to the control, T₁ and T₂ treatments. Similar result was supported by Badar *et al.*,(2015b); Sivakumar and Karthikeyan, (2016); Ndiso *et al.*, (2018) and Madhukar, (2022).

The current study found that the greater protein content in the test crop leaves may be related to the crop plants enhanced ability to absorb nitrogen and phosphorus from the soil as a result of biocompost treatment. The maximum carbohydrates were found in the leaves of all four plants, and this was caused by the addition of biocompost to the soil, which significantly increased the carbohydrates in all treatments. The increased concentration of chlorophyll resulted from the presence of plant growth-promoting elements produced by the biocompost from the cocoa shell and jack fruit peel waste, which may have also sped up chlorophyll synthesis.

All the biochemical parameters were maximum recorded at T₈ closely followed by T₄ due to greater availability of physico-chemical nutrients and microbial activity. At 45 DAS in cowpea, 75 DAS in yardlong bean, and 90 DAS in Shankpushpi, the protein, carbohydrate and chlorophyll content is decreased. This decline of protein, carbohydrate and chlorophyll may be ascribed to the plant's use of the nutrients for flower and pod production, protein breakdown, senescence, microbial cell lysis, decreased photosynthetic activity and the plants use of newly generated carbohydrate for biological functions.

4.5 Leghaemoglobin

4.5.1 Influence of CSW and JFPW Biocompost on leghaemoglobin content in nodules of *Vigna unguiculata* (L.) Walp. and *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc

4.5.1 (a) *Vigna unguiculata* (L.) Walp. (Cowpea)

The pot culture experiment of Cowpea indicated a significant increase in leghaemoglobin content in all the treatments (T₁ to T₈) up to 35 DAS and it decreased gradually on 45 DAS mentioned in Figure -11. The leghaemoglobin content was significantly increased in T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ from 0.066 to 0.087 mg/g followed by T₄ - Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ from 0.061 to 0.078 mg/g on 25 and 35 DAS and decreased gradually to 0.071 followed by 0.070 mg/g on 45 DAS as compared to the Control (increased from 0.024 to 0.031 mg/g up to 35 DAS and decreased to 0.027 on 45 DAS).

4.5.1 (b) *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc

The pot culture experiment of Yardlong bean revealed that there was a substantial increase in leghaemoglobin content in all the treatments up to 50 DAS after that it was decreased gradually to 75 DAS as shown in Figure - 12. The leghaemoglobin content was found to be maximum in T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ from 0.072 to 0.093 mg/g followed by T₄ - Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ from 0.070 to 0.095 mg/g on 25 and 50 DAS and decreased gradually to 0.086 followed by 0.070 mg/g on 75 DAS as compared to control (increased from 0.030 to 0.048 mg/g up to 50 DAS and decreased to 0.032 mg/g on 75 DAS).

The present finding is in accordance with the result of Das and Bandyopadhyay, (2011) who reported that the integrated application of *Rhizobium leguminosarum* and phosphate solubilizing bacteria increased the leghaemoglobin content of nodule with increase in the nodule number, fresh nodular weight and yield of fresh bean crop (*Phaseolus vulgaris* L.). Singh and Vijayalakshmi, (2013) stated that increase in leghaemoglobin content in green gram.

Figure-11

Leghaemoglobin Content in Cowpea Nodules Influenced by Biocomposted CSW and JFPW

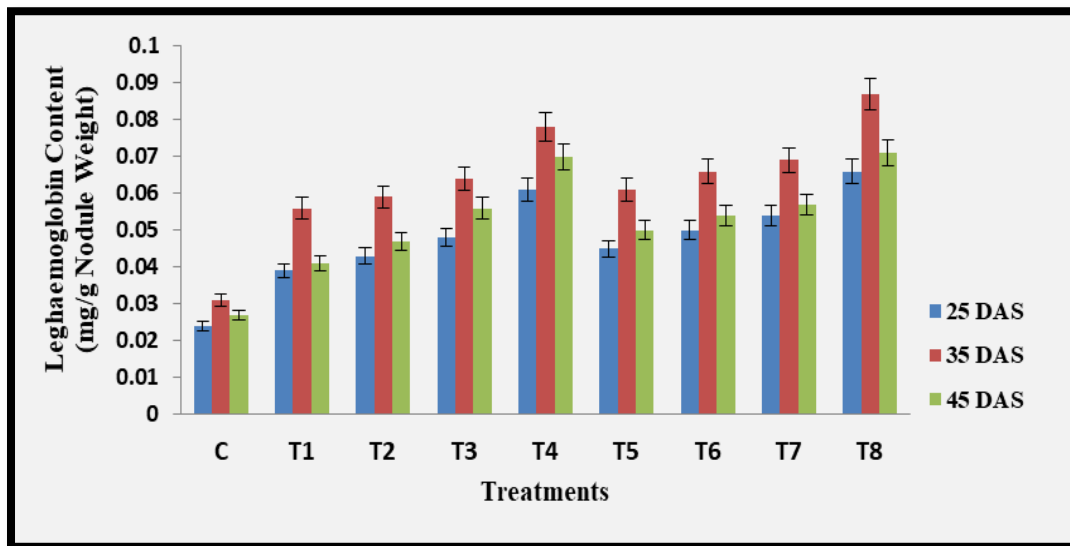
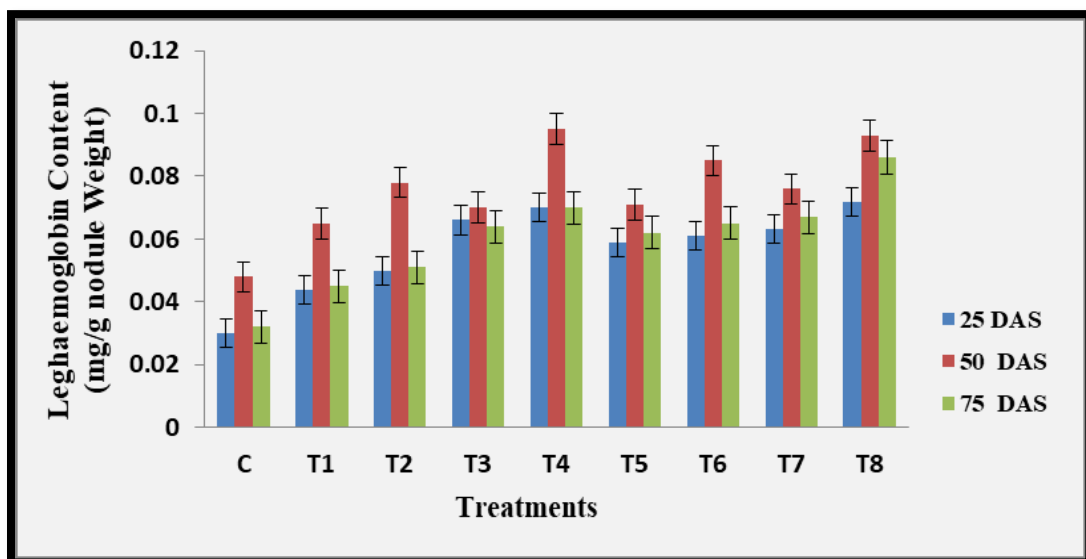


Figure-12

Leghaemoglobin Content in Nodules of Yardlong bean Influenced by Biocomposted CSW and JFPW



The result is on par with Verma *et al.*, (2014) who observed a maximum leghaemoglobin content of 2.00 mg/g with the application of vermicompost (6t ha⁻¹) in fenugreek. An increase in leghaemoglobin content might be due to the presence of nitrogen in root nodules. Similar work was done by Moinuddin *et al.*, (2014) who revealed that combined inoculation of phosphorus (60/kg) + biological phosphorus fertilizer (*Pseudomonas striata*) increased the leghaemoglobin content in chickpea nodules.

Sakthivigneswari and Vijayalakshmi, (2016b) confirmed the application of biocompost increased the leghaemoglobin content in soybean root nodules. Bharti and Kumar, (2016) revealed that 15 percent concentration of *Mycorrhiza* significantly increased the leghaemoglobin content in *Vigna mungo* root nodules.

From the current experiments, it was clear that the application of T₈ and T₄ increased the leghaemoglobin content compared to the control. Leghaemoglobin is a red pigment protein that acts as an oxygen carrier within bacteroid cells. Nodules lacking this important protein invariably lack nitrogenase activity and therefore lack nitrogen-fixing capability. Leghaemoglobin level in nodules and the amount of nitrogen fixed by the legume-rhizobium symbiosis are correlated. Nodule is an essential organ of legumes, containing microorganisms that fix nitrogen. Leghaemoglobin, have a strong affinity for oxygen; the oxygen concentration is kept in an ideal range to prevent oxygen toxicity to the nitrogenase enzyme and to support bacterial respiration.

The nitrogenase enzyme, which is present in the nodule, converts N₂ into NH₃, this nitrogen is used by the plants metabolism. Leghemoglobin content in cowpea at 45 DAS and yardlong bean at 75 DAS started to decline. During this period leghemoglobin level in nodules was reduced due to increased O₂ concentration and nitrogenase enzyme inhibition, resulting in poor N₂ fixation.

4.6. Influence of Biocomposted CSW and JFPW on Protein and Carbohydrate content in seeds and leaf of Selected Test Crops

4.6.1 (a) *Vigna unguiculata* L. Walp. (Cowpea)

The experimental study of seed protein content of cowpea was found to be maximum at T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ of 67.80 mg/g tissue followed by T₄-Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ of 65.33 as compared to control (33.48 mg/g tissue) on 65 DAS.

The carbohydrate content was found to be more in T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ of 94.59 mg/g tissue followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ of 83.63 mg/g tissue as compared to the Control (58.09 mg/g tissue) as presented in Table -31.

4.6.1 (b) *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc (Yardlong bean)

The seed protein content of Yardlong bean was found to be maximum in T₈-Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ of 130.69 mg/g tissue followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ of 127.16 mg/g tissue as compared to control (59.22 mg/g tissue) on 90 DAS as depicted in Table -32. The carbohydrate content was found to be more in T₈-Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ 99.21 mg/g tissue followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ of 96.55 mg/g tissue as compared to the control (63.47 mg/g tissue).

4.6.1 (c) *Clitoria ternatea* L. (Shankpushpi)

The protein content was found to be maximum in T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ of 85.90 mg/g tissue followed by T₄- Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ of 83.80 mg/g tissue as compared to control (51.90 mg/g tissue) on 120 DAS.

The carbohydrate content was found to be more in T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ of 82.11 mg/g tissue followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ of 76.30 mg/g tissue as compared to the control 39.52 mg/g tissue (Table-33).

4.6.1 (d) *Amaranthus tricolor* L. (Red amaranth)

The leaf protein content was found to be maximum in T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ of 89.90 mg/g tissue followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ of 85.09 mg/g tissue as compared to Control 49.54 mg/g tissue on 50 DAS.

The carbohydrate content was found to be more in T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ of 93.21 mg/g tissue followed by

T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ of 81.92 mg/g tissue as compared to the Control 57.16 mg/g tissue (Table -34).

According to Zodape *et al.*, (2010) a remarkable increase in protein and carbohydrate content was observed in green gram with the application of seaweed (*Kappaphycus alvarezii*) extract. Similar result was obtained by Baviskar *et al.*, (2012) who reported that the application of biocompost (5t/ha⁻¹) increased the protein content of cluster bean than in control. Raissi *et al.*, (2013) revealed that application of organic manure increases the carbohydrates content in *Plantago ovata*.

Hussain *et al.*, (2017) reported that vermicompost application increases the carbohydrates content in *Abelmoschus esculentus*. The present study was in agreement with the results of Ashwini *et al.*, (2018) who found that significantly higher seed protein content and protein yield (24.38 % and 480.00 kg ha⁻¹) in pigeonpea at T₆ as compared to T₈ (21.71 % and 307.62 kg ha⁻¹) and T₉ (22.19% and 278.61 kg ha⁻¹).

A similar result was observed by Vijayalakshmi and Karthiyayini, (2018) vermicompost -15gm + *Asospirillum* supplemented seedlings absorbed significantly more protein and carbohydrates whereas the chlorophyll content was recorded more in 20g of vermicompost-treated seedlings of both crop *Solanum nigrum* L. and *Trigonella foenum-graecum* L. Maximum protein and carbohydrate content in seeds of cowpea, yardlong bean and shankhpushpi was caused by the combined action of cocoa shell and jack fruit peel with *Pleurotus eous*, *Pleurotus florida* and *Eudrilus eugeniae*, which improved the availability of phosphorus, which in turn had an impact on nitrogen absorption by plants and eventually aggregated in seeds as protein and carbohydrate.

Table - 31

**Influence of Biocomposted CSW and JFPW on Protein and Carbohydrate
Content in Seeds of Cowpea**

Treatments	Cowpea seed (65 DAS)	
	Protein (mg/g tissue)	Carbohydrate (mg/g tissue)
C	33.48	58.09
T ₁	48.61	67.18
T ₂	57.97	72.19
T ₃	59.56	75.39
T ₄	65.33	83.63
T ₅	59.07	75.45
T ₆	56.86	79.36
T ₇	61.05	78.25
T ₈	67.80	94.59
SED	3.3359	1.3100
CD (0.05)	7.0085	2.7523
CD (0.01)	9.6036**	3.7714**

** Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P. eous* + 10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW + *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW + 10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

Table - 32

**Influence of Biocomposted CSW and JFPW on Protein and Carbohydrate
Content in Seeds of Yardlong bean**

Treatments	Yardlong bean seed (90 DAS)	
	Protein (mg/g tissue)	Carbohydrate (mg/g tissue)
C	59.22	63.47
T ₁	86.41	76.22
T ₂	91.74	78.35
T ₃	99.46	81.33
T ₄	127.16	96.55
T ₅	89.62	84.27
T ₆	100.05	88.52
T ₇	102.57	91.75
T ₈	130.69	99.21
SED	0.8247	0.8221
CD (0.05)	1.7326	1.7272
CD (0.01)	2.3741**	2.3667**

** Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P. eous* + 10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW + *E. eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW + 10 g *P. eous* +10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

Table - 33

**Effect of Biocomposted CSW and JFPW on Protein and Carbohydrate
Content in Seeds of Shankpushpi**

Treatments	Shankpushpi seed (120 DAS)	
	Protein (mg/g tissue)	Carbohydrate (mg/g tissue)
C	51.90	39.52
T ₁	63.53	47.62
T ₂	66.17	51.89
T ₃	72.17	56.05
T ₄	83.80	76.30
T ₅	75.35	61.52
T ₆	79.53	64.04
T ₇	81.62	69.19
T ₈	85.90	82.11
SED	0.6545	0.0082
CD (0.05)	1.3751	0.0172
CD (0.01)	1.8843**	0.0235**

** Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5 t/ha⁻¹), T₂ (Raw CSW + 20 g *P. eous* + *E. eugeniae* 5 t/ha⁻¹), T₃ (Raw CSW + 20g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P. eous* +10 g *P.florida* + *E. eugeniae* 5 t/ha⁻¹), T₅ (Raw JFPW + *E. eugeniae* 5 t/ha-1), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₈ (Raw JFPW +10 g *P. eous* + 10 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹)

Table - 34
Effect of Biocomposted CSW and JFPW on Protein and Carbohydrate Content
in leaves of Red amaranth

Treatments	Red amaranth leaves (50 DAS)	
	Protein (mg/g tissue)	Carbohydrate (mg/g tissue)
C	49.54	57.16
T ₁	57.09	62.61
T ₂	62.27	65.08
T ₃	74.63	70.24
T ₄	85.09	81.92
T ₅	82.18	74.56
T ₆	69.81	68.35
T ₇	85.72	76.85
T ₈	89.90	93.21
SED	1.8564	1.8758
CD (0.05)	3.9003	3.9411
CD (0.01)	5.3445**	5.4004**

** Significant at 1% (P<0.01), DAS – Days After Sowing

Where C-Control (without treatment), T₁ (Raw CSW + *E. eugeniae* 5t/ha⁻¹), T₂ (Raw CSW+20 g *P.eous* + *E.eugeniae* 5t/ha⁻¹), T₃ (Raw CSW + 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P.eous* +10 g *P. florida* + *E.eugeniae* 5t/ha⁻¹), T₅ (Raw JFPW + *E.eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW+20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E.eugeniae* 5t/ha⁻¹), T₈ (Raw JFPW +10 g *P.eous* + 10g *P.florida*+*E.eugeniae* 5 t/ha⁻¹)

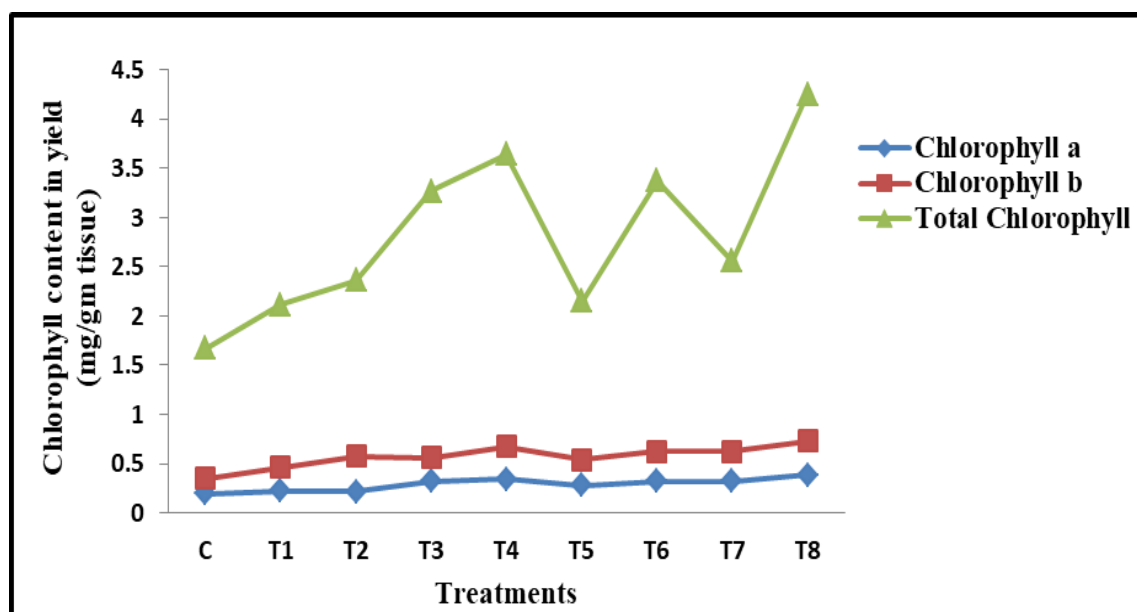
4.7 Effect of Biocomposted CSW and JFPW on Chlorophyll content in Leaf of Red Amaranth

The maximum chlorophyll content of red amaranth was observed at 50 DAS as shown Figure -13. Among the treatment T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹, registered maximum chlorophyll a (0.381 mg/g

tissue), chlorophyll b (0.729 mg/g tissue) and total chlorophyll (4.253 mg/g tissue) followed by T₄ - Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ chlorophyll a (0.342), chlorophyll b (0.674 mg/g tissue) and total chlorophyll (3.641 mg/g tissue) when compared to Control (0.194, 0.348, 1.672 mg/g tissue).

Figure -13

**Influence of Biocomposted CSW and JFPW on Chlorophyll
Content in Leaf of Red Amaranth (50 DAS)**



Similar findings were obtained by Vijayalakshmi and Karthiyayini, (2018) who found that vermicompost treatment increased the chlorophyll content of both *Solanum nigrum* L. and *Trigonella foenum-graecum* L. seedlings. The result was that seedlings treated with 15gm of vermicompost and *Asospirillum* absorbed significantly more protein and carbohydrates.

Gayathri and Malathi, (2019b) investigated that impact of several bio-fertilizers on *solanum nigrum* L. and *Amaranthus viridis* L. biochemical parameters. The tomato plant's protein level was greater in T₂ on the 30th day, T₄ on the 45th day, and T₃ on the 60th day. Meanwhile, T₂ on the 30th day, T₁ on the 45th day, and T₄ on the 60th day had larger carbohydrate contents. It was found that T₂ on day 30 and T₄ on day 45 had increased protein contents in *Amaranthus viridis* L.

The present finding is in accordance with the result of Mishra and Jain, (2013) who studied that combined application of biofertilizers (250 g) + NPK (50%) + vermicompost (5t/ha) promoted the chlorophyll (5.9 mg/g) content (7.2mg/g) in *Andrographis paniculata*.

Banerjee *et al.*, (2012) found that application of biofertilizer and cycocel significantly promoted protein content in leaves of mustard increased up to T₂ treatment (½ chemical fertilizer ½ biofertilizer and 200 ppm cycocel. The chlorophyll contents in leaves were significantly increased treatments in T₄ (3/4th biofertilizer: 1/4th chemical fertilizer) treatment. The present study coincides with the results of Kavitha *et al.*, (2013) who observed that protein and carbohydrate content of the *Amaranthus tristis* was highly enhanced by the application of *Azospirillum*, chemical fertilizer and vermicompost (T₈). Al-Sabbagh *et al.*, (2020) found that the chlorophyll content in Lettuce was statistically significant with Ecodrum compost as compared to all other treatments.

The biocomposted cocoa shells and jack fruit peels increase the activity of microorganisms, which boosts the mineral content of the soil and significantly raises its protein, carbohydrate, and chlorophyll content in yield of Red amaranth on 50 DAS. The present study showed increased protein content in red amaranths as a result of receiving more nitrogen and phosphorus from the biocompost.

The high potassium availability raised the carbohydrate content of red amaranthus leaves, which may have a positive impact on the growth and development of the plant. The T₈ & T₄ biocompost, which contain essential micronutrients that serve as the main component of antioxidant enzymes involved in protecting chloroplasts from free radicals, and the action of iron and magnesium, which are thought to be constituents of the heme group that act as precursor of chlorophyll, may have increased the amount of chlorophyll in the leaves of red amaranth at 50 DAS.

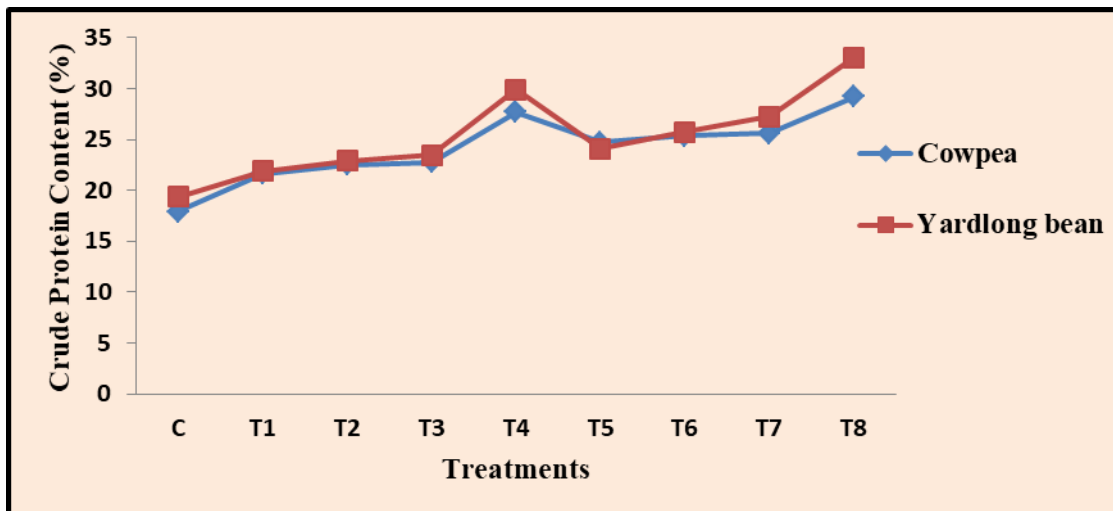
4.7 Biocomposted CSW and JFPW Effect on crude protein content in seeds of Cowpea and Yardlong Bean

A significant increase in crude protein content of cowpea seed was recorded in all the treatments on 65 DAS. Maximum crude protein was found to be registered in T₈ (29.17 %) which was followed by T₄ (27.67 %) compared to Control (17.91 %) as shown in Figure -14.

Similarly a significant increase in crude protein content of seed was recorded in all the treatments of Yardlong bean on 90 DAS. Maximum crude protein was found to be registered in T₈ (33.06 %) which was followed by T₄ (29.88 %) compared to Control (19.37 %).

Figure -14

Crude protein Content in seeds of cowpea and Yardlong bean as Influenced by Biocomposted CSW and JFPW



The use of Biocompost T₁-T₈ resulted in seeds of cowpea and yardlong bean having considerably greater crude protein content. Additionally, the availability of various nutrients in the soil and biocompost causes the crude protein content of both plants to vary among the various biocomposting units. According to the current study, T₈ and T₄ have the highest levels of crude protein due to significant nitrogen buildup.

The results in on par with Dhanraj *et al.*, (2018) who found that the seed treatment of *Bradyrhizobium japonicum*+ *Pseudomonas fluorescens* and application of full dose of RDF has recorded significantly maximum crude protein content in *Clitoria ternatea* L. Ademola and Abioye, (2017) have also reported that maximum crude protein content in *Lablab purpureus*.

A similar work was reported by Badar and Qureshi, (2014) who confirmed the application of Rice husk (5g) composted with *Trichoderma hamatum* (JUF1) improved the crude protein on 30th day and *Bradyrhizobium* sp-II (JUR2) on 60th day in *Helianthus annuus* when compared to control. Similar results were obtained by Omenna *et al.*, (2016) in cowpea.

4.8 Soil Analysis

4.8.1 Pre-harvest (Initial) Soil Analysis

The initial and experimental soil samples of all the treatments were assessed for their characteristics. The changes in soil pH, electrical conductivity (EC), available nitrogen (N), available phosphorus (P), available potassium (K) of the initial soil in different treatments and combinations are depicted in Table- 35.

The experimental study of Pre-harvest (Initial) soil analysis indicate that initial soil pH (6.83 and 6.55), EC (3.98 and 3.81 milimhos cm^{-1}), available nitrogen (208 kg/ha and 195 kg/ha), available phosphorus (21.00 kg/ha and 20.3 kg/ha) and available potassium (155 kg/ha and 147 kg/ha) were recorded more at T₈ – Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8) followed by T₄ – Raw CSW +10 g *Pleurotus eous* +10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ ha⁻¹ (biocompost 4) as compared to control (6.00, 2.18 milimhos cm^{-1} , 163 kg/ha, 19.2 kg/ha and 118 kg/ha).

Table -35

Evaluation of Pre - Harvest Soil Status of Pot Culture Experiment

Treatments	pH	EC (Millimhos Cm^{-1})	Available Nitrogen (Kg/ha)	Available Phosphorus (Kg/ha)	Available Potassium (Kg/ha)
C	6.00	2.18	163	19.2	118
T ₁	6.10	2.54	169	19.4	122
T ₂	6.15	3.20	176	19.4	123
T ₃	6.24	3.24	180	19.5	128
T ₄	6.55	3.81	195	20.3	147
T ₅	6.27	3.34	183	19.6	130
T ₆	6.35	3.41	185	19.3	134
T ₇	6.46	3.47	187	19.7	137
T ₈	6.83	3.98	208	21.00	155

Where C-Control (Without treatment), T₁ (Raw CSW+ *E. eugeniae* 5t/ha⁻¹), T₂ (Raw CSW+ 20 g *P.eous* + *E.eugeniae* 5t/ha⁻¹), T₃ (Raw CSW+ 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW+10 g *P.eous* + 10 g *P. florida*+*E.eugeniae* 5t/ha⁻¹), T₅ (Raw JFPW+ *E.eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW +20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW+ 20 g *P. florida* + *E.eugeniae* 5t/ha⁻¹), T₈ (Raw JFPW +10 g *P.eous* + 10g *P.florida* + *E.eugeniae* 5 t/ha⁻¹)

4.8.2 Post-Harvest Soil Analysis

4.8.2 (a) *Vigna unguiculata* L. Walp. Var. Co (CP) 7 (Cowpea)

Post-harvest soil status of Cowpea (Table 36) revealed that significant increase in pH (7.26 and 7.20), EC (2.57 and 2.39 milimhos cm⁻¹), available nitrogen (255 kg/ha and 233 kg/ha), available phosphorus (33.9 kg/ha and 29.6 kg/ha) and available potassium (137 kg/ha and 130 kg/ha) was noted in T₈ treatment followed by T₄ treatment as compared to the control (6.07, 1.10 milimhos cm⁻¹, 178 kg/ha, 20.5 kg/ha, 90 kg/ha).

Table - 36
Impact of Biocomposted CSW and JFPW on Post-Harvest
Soil Analysis of Cowpea

Treatments	pH	EC (Millimhos Cm ¹)	Available Nitrogen (Kg/ha)	Available Phosphorus (Kg/ha)	Available Potassium (Kg/ha)
C	6.07	1.10	178	20.5	90
T ₁	6.22	1.23	190	21.8	108
T ₂	6.26	1.50	196	22.5	113
T ₃	6.40	1.62	199	22.9	117
T ₄	7.20	2.39	233	29.6	130
T ₅	6.52	1.66	204	23.4	119
T ₆	6.53	1.70	207	23.7	124
T ₇	6.61	1.74	214	24.5	126
T ₈	7.26	2.57	255	33.9	137

Where C-Control, (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5t/ha⁻¹), T₂ (Raw CSW+ 20 g *P.eous* + *E.eugeniae* 5t/ha⁻¹), T₃ (Raw CSW + 20 g *P. florida*+ *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P.eous* +10 g *P. florida* + *E.eugeniae* 5t/ha⁻¹), T₅ (Raw JFPW + *E.eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E.eugeniae* 5t/ha⁻¹), T₈ (Raw JFPW +10 g *P.eous* + 10g *P.florida* + *E.eugeniae* 5 t/ha⁻¹)

4.8.2 (b) *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc Var.NS-621 (Yardlong bean)

Post-harvest soil status of Yardlong bean showed that highest pH (7.35 and 7.21), EC (2.68 and 2.50 milimhos cm^{-1}), available nitrogen (288 kg/ha and 276 kg/ha), available phosphorus, (34.7 kg/ha and 30.2 kg/ha) and available potassium (143 kg/ha,132 kg/ha) in T₈ treatment followed by T₄ treatment as compared to the Control (6.06, 1.12 milimhos cm^{-1} , 180 kg/ha, 20.8 kg/ha, 96 kg/ha) respectively (Table -37).

Table - 37
Influence of Biocomposted CSW and JFPW on Post-Harvest
Soil Analysis of Yardlong bean

Treatments	pH	EC (Millimhos Cm^{-1})	Available Nitrogen (Kg/ha)	Available Phosphorus (Kg/ha)	Available Potassium (Kg/ha)
C	6.06	1.12	180	20.8	96
T ₁	6.20	1.26	194	21.5	110
T ₂	6.24	1.52	197	21.7	115
T ₃	6.38	1,66	200	22.6	119
T ₄	7.21	2.50	276	30.2	132
T ₅	6.44	1.72	204	23.1	124
T ₆	6.59	1.74	210	23.4	127
T ₇	6.78	1.80	215	25.8	128
T ₈	7.35	2.68	288	34.7	143

Where C-Control (Without treatment), T₁ (Raw CSW+ *E. eugeniae* 5t/ha⁻¹), T₂ (Raw CSW+20 g *P.eous* + *E.eugeniae* 5t/ha⁻¹), T₃ (Raw CSW+ 20 g *P. florida* + *E. eugeniae* 5t/ha⁻¹), T₄ (Raw CSW+10 g *P.eous* +10 g *P. florida* +*E.eugeniae* 5t/ha⁻¹), T₅ (Raw JFPW + *E.eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW+20 g *P. eous* + *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW+20 g *P. florida*+*E.eugeniae* 5t/ha⁻¹), T₈ (Raw JFPW +10 g *P.eous*+ 10g *P.florida*+*E.eugeniae* 5 t/ha⁻¹)

4.8.2 (c) *Clitoria ternatea* L. (Shankhpushpi)

Post-harvest soil status of shankhpushpi indicates that highest pH (7.14 and 7.11), EC (1.76 and 1.68 millimhos cm^{-1}), available nitrogen (223 kg/ha and 214 kg/ha), available phosphorus (28.6 kg/ha and 25.3 kg/ha), available potassium (127 kg/ha and 122 kg/ha) in T₈ treatment followed by T₄ treatment as compared to the Control (6.02, 1.05 millimhos cm^{-1} , 156 kg/ha, 19.7 kg/ha, 80 kg/ha) as presented in table 38.

Table - 38

Effect of Biocomposted CSW and JFPW on Post-Harvest

Soil Analysis of Shankhpushpi

Treatments	pH	EC (Millimhos Cm^{-1})	Available Nitrogen (Kg/ha)	Available Phosphorus (Kg/ha)	Available Potassium (Kg/ha)
C	6.02	1.05	156	19.7	80
T ₁	6.10	1.16	168	20.4	94
T ₂	6.11	1.33	173	20.6	99
T ₃	6.32	1.38	181	21.4	105
T ₄	7.11	1.68	214	25.3	122
T ₅	6.36	1.52	186	22.1	108
T ₆	6.44	1.60	190	22.5	114
T ₇	6.49	1.67	194	23.8	117
T ₈	7.14	1.76	223	28.6	127

Where C- Control (Without treatment), T₁ (Raw CSW+ *E. eugeniae* 5t/ha⁻¹), T₂ (Raw CSW+20 g *P.eous* + *E.eugeniae* 5t/ha⁻¹), T₃ (Raw CSW+ 20 g *P. florida* + *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P.eous* +10 g *P. florida* + *E.eugeniae* 5t/ha⁻¹), T₅ (Raw JFPW + *E.eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous*+ *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida* + *E.eugeniae* 5t/ha⁻¹), T₈ (Raw JFPW + 10 g *P.eous* + 10g *P.florida* + *E.eugeniae* 5 t/ha⁻¹)

4.8.2 (d) *Amaranthus tricolor* L. Var. Arun (Red amaranth)

Post-harvest soil status of red amaranth revealed that there was an increase in pH (7.18 and 7.13), EC (1.79 and 1.75 millimhos cm^{-1}), available nitrogen (228 kg/ha and 220 kg/ha), available phosphorus (30.5 kg/ha and 27.8 kg/ha), available potassium (129 kg/ha and 125 kg/ha) was registered in T₈ treatment followed by T₄ treatment as compared to the Control (6.04, 1.07 millimhos cm^{-1} , 168 kg/ha, 19.9 kg/ha, 84 kg/ha) (Table 39).

Table -39

**Efficiency of Biocomposted CSW and JFPW on Post-Harvest
Soil Analysis of Red Amaranth**

Treatments	pH	EC (Millimhos cm^{-1})	Available Nitrogen (Kg/ha)	Available Phosphorus (Kg/ha)	Available Potassium (Kg/ha)
C	6.04	1.07	168	19.9	84
T ₁	6.15	1.18	175	20.7	97
T ₂	6.23	1.37	179	20.10	101
T ₃	6.27	1.42	185	21.3	106
T ₄	7.13	1.75	220	27.8	125
T ₅	6.33	1.58	188	22.2	109
T ₆	6.47	1.66	193	22.6	114
T ₇	6.58	1.70	197	24.4	118
T ₈	7.18	1.79	228	30.5	129

Where C-Control (Without treatment), T₁ (Raw CSW + *E. eugeniae* 5t/ha⁻¹), T₂ (Raw CSW + 20 g *P.eous*+*E.eugeniae* 5t/ha⁻¹), T₃ (Raw CSW + 20 g *P. florida*+ *E. eugeniae* 5 t/ha⁻¹), T₄ (Raw CSW + 10 g *P.eous* +10 g *P. florida* + *E.eugeniae* 5t/ha⁻¹), T₅ (Raw JFPW + *E.eugeniae* 5 t/ha⁻¹), T₆ (Raw JFPW + 20 g *P. eous*+ *E. eugeniae* 5t/ha⁻¹), T₇ (Raw JFPW + 20 g *P. florida*+*E.eugeniae* 5t/ha⁻¹), T₈ (Raw JFPW +10 g *P.eous* + 10g *P.florida* + *E.eugeniae* 5 t/ha⁻¹)

This result was supported by the work of Said *et al.*, (2010) who confirmed maximum EC content of 0.55 millimhos cm^{-1} in the treatment due to the application of pressmud (10 t/ha). The result is on par with the result of Macci *et al.*, (2012) who reported that the application of organic fertilizer increased the physico-chemical properties of almond tree plantation soil. Vijayakumari *et al.*, (2012) indicate that post harvested soil of *Glycine max* L. showed more NPK content due to the application of Panchagavya, humic acid and microherbal fertilizer treated soil.

The present study was positively correlated with the findings of Vimera *et al.*, (2012) who found pH, available nitrogen, phosphorus and potassium influenced by integrated application of NPK fertilizers, organic manures and biofertilizers in post-harvest the soil of chili plant. Similar work was carried out by Meena, (2013) who obtained highest available soil nitrogen, phosphorus and potassium with the application of vermicompost 10 t/ha in soil after the harvest of green gram. The current study was shown to be favourably connected with the findings of El-Mohamedy *et al.*, (2015) who discovered that applying biocompost boosted the nitrogen, phosphorus and potassium content in potato grown soil.

Khalil *et al.*, (2019) observed that all treatments receiving organic and inorganic fertilisers in varying ratios had a substantial impact on the chemical characteristics of maize crop post-harvest soil. Senthilvalavan and Ravichandran, (2020) confirmed the results of macro and micro nutrient contents in post-harvest soil of rice and black gram significantly influenced by INM (Integrated Nutrient Management).

PHASE IV

The above-mentioned experimental findings were determined to be statistically significant in all the biocompost T₁-T₈ as compared to the control treatment. Among the eight different combination of biocompost, treatment T₈-Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (Biocompost 8) was found to be a efficient organic manure compared to other treatments. The Phase I, Phase II and Phase III experimental results confirmed that T₈ (Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹) is the best treatment. According to these results, antibacterial activity, antioxidant activity and estimation of mineral composition were carried out in seeds of *Vigna unguiculata* L. Walp (Cowpea), *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc (Yardlong bean) and leaf extracts of *Clitoria ternatea* L. (Shankapushpi) and *Amaranthus tricolor* L. (Red amaranthus) which were grown under best treatment (T₈) and control (C).

4.9 Antibacterial Activity of Test crops against *Escherichia coli* and *Staphylococcus aureus*

In this study, evaluation of antibacterial activity of aqueous and methanol seed extracts of *Vigna unguiculata* L. Walp (cowpea), *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc (yardlong bean) and leaf extracts of *Clitoria ternatea* L. (Shankapushpi) and *Amaranthus tricolor* L. (red amaranthus) best treatment (T₈) and control (C) were tested for their antibacterial activity against *Staphylococcus aureus* (gram positive) and *Escherichia Coli* (gram negative) bacterial species and inhibition zone of Kanamycin (antibiotics) are shown in Plate 14,15 & Figure 15-18 . Both the extracts showed better antibacterial activity in all the test crop plants.

4.9 (a) *Vigna unguiculata* L. Walp.Var.Co (CP) 7 (Cowpea)

Control treatment (C)

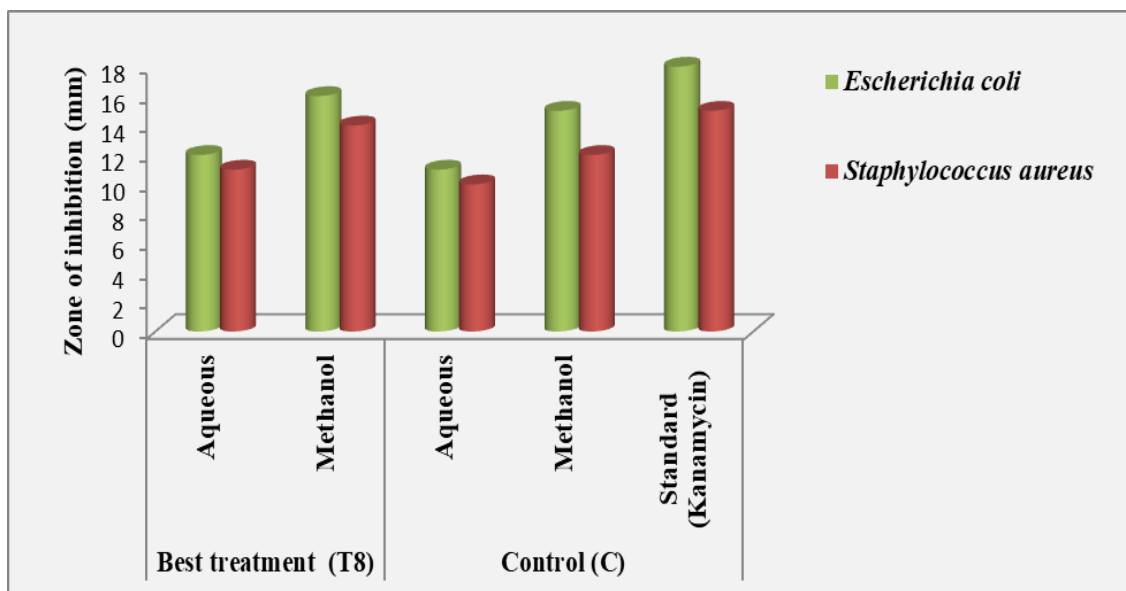
Aqueous seed extract of cowpea had a less inhibition zone of 11 mm and 10 mm was observed against *Escherichia coli* and *Staphylococcus aureus*. Methanol extract recorded highest inhibition zone 15 mm and 12 mm against *Escherichia coli* and *Staphylococcus aureus* respectively.

Best treatment (T₈)

As per the result, the aqueous seed extract of cowpea showed the minimum zone of inhibition at 12 mm and 11 mm for *Escherichia coli* and *Staphylococcus aureus*. Methanol seed extracts exhibited the maximum activity of inhibition zone of 16mm and 14mm for *Escherichia coli* and *Staphylococcus aureus* respectively. The highest zone of inhibition was recorded (16mm) against *Escherichia coli* in methanol seed extracts followed by aqueous seed extract. The results were compared with standard antibiotic Kanamycin which showed the zone of inhibition (18 mm and 15 mm) as shown in Figure -15 and Plate 14.

Figure -15

**Antibacterial Activity of Aqueous and Methanol Seed Extracts of
Cowpea (At 50 µL Concentration)**

**4.9 (b) *Vigna unguiculata* subsp. *sesquipedalis* L. Verdc Var.NS-621 (Yardlong bean)****Control treatment (C)**

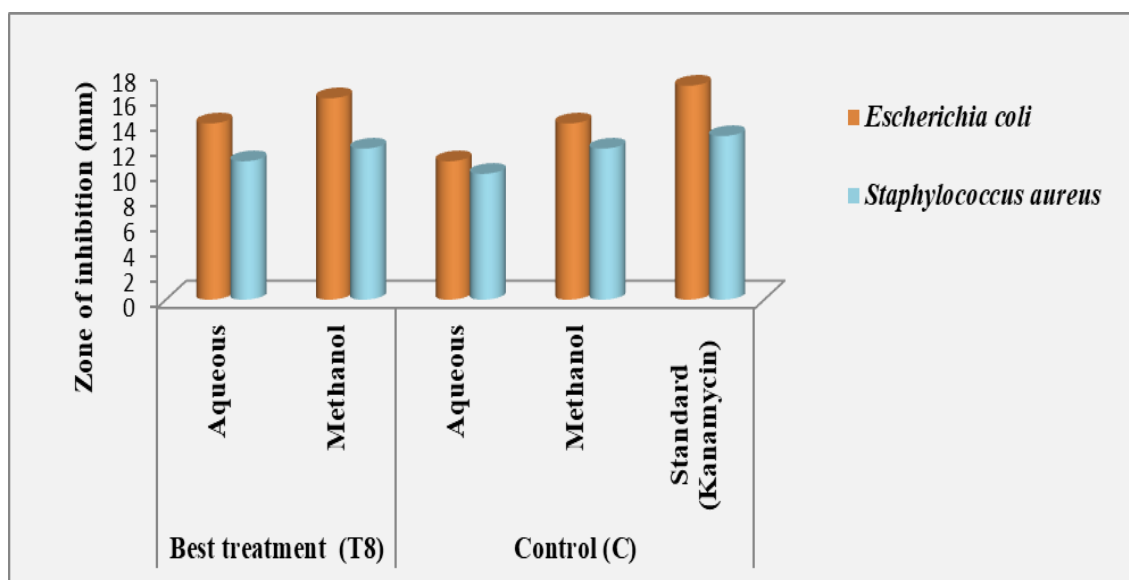
As per the result, the aqueous seed extract of Yardlong bean showed the less inhibition zone against *Escherichia coli* and *Staphylococcus aureus* (11mm and 10 mm) respectively. Methanol seed extracts recorded highest zone of inhibition zone against *Escherichia coli* and *Staphylococcus aureus* (14 mm and 12mm). The zone of inhibitions (17mm and 13 mm) was moderately differ from each other as compared to the Kanamycin (standard antibiotics).

Best treatment (T₈)

The aqueous seed extract Yardlong Bean showed the minimum activity of inhibition zone (14mm and 11mm) for *Escherichia coli* and *Staphylococcus aureus* respectively. Methanol seed extracts showed the maximum inhibition zone (16mm and 12mm) for *Escherichia coli* and *Staphylococcus aureus* respectively. The highest zone of inhibition (16mm) was found against *Escherichia coli* in methanol seed extracts followed by aqueous extract. The zone of inhibitions (17 mm and 13 mm) was moderately different from each other as compared to the standard antibiotics (Kanamycin). The results were depicted in Figure-16 and Plate-14.

Figure -16

**Antibacterial Activity of Seed Extracts of Yardlong bean
(At 50 μ L Concentration)**



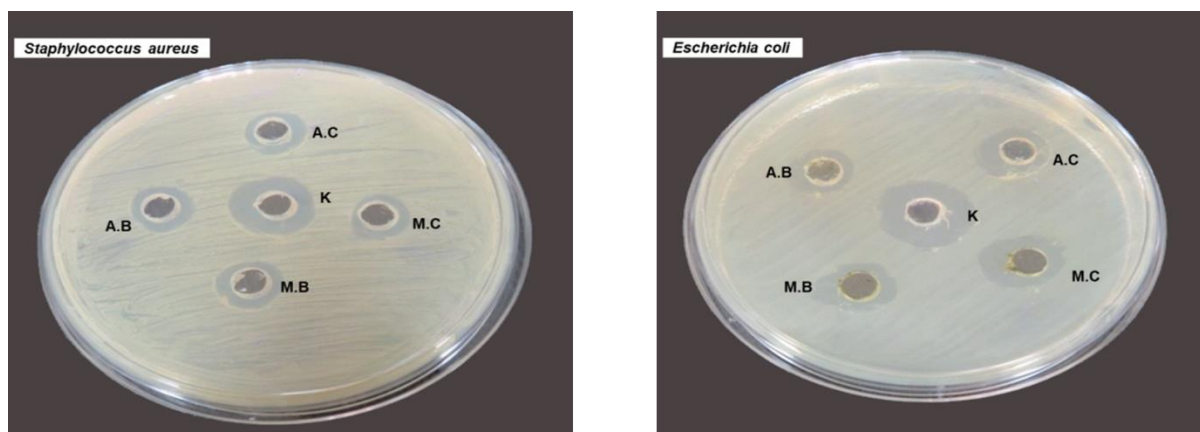
C- Control (without treatment)

Best treatment (T₈)- Raw JFPW + 10 g *P. eous* + 10 g *P. florida*+ *E. eugeniae* 5t/ha⁻¹

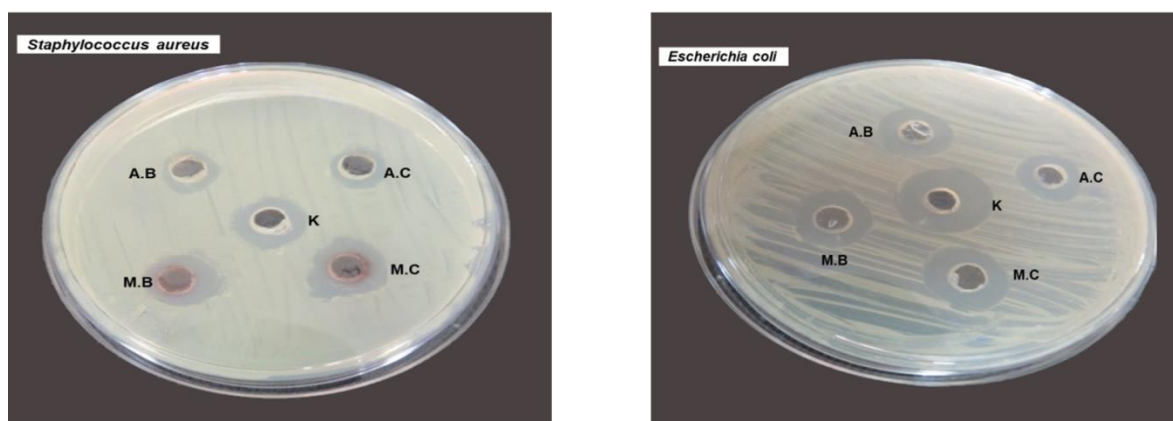
PLATE -14

ANTIBACTERIAL ACTIVITY OF SEED EXTRACTS OF TEST CROPS

Aqueous and Methanol Seed Extracts of Cowpea (*Vigna unguiculata* L. Walp. Var.Co (CP) 7) against *Staphylococcus aureus* and *Escherichia coli*



Aqueous and Methanol Seed Extracts of Yardlong bean (*Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc Var.NS-621) against *Staphylococcus aureus* and *Escherichia coli*



A.C- Aqueous seed extract of control treatment

M.C- Methanol seed extract of control treatment

A.B- Aqueous seed extract of best treatment (T_8 Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8))

M.B-Methanol seed extract of best treatment (T_8 Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8))

K- Kanamycin (Standard)

4.9 (c) *Clitoria ternatea* L. (Shankhpushpi)

Control treatment

The aqueous leaf extract of Shankhpushpi was observed minimum activity against *Escherichia coli* and *Staphylococcus aureus* (zone inhibition of 12mm and 11mm) respectively. Methanolic seed extracts showed the maximum activity against *Escherichia coli* and *Staphylococcus aureus* (inhibition zone of 13mm and 12mm) at 50µl concentration respectively. The highest zone of inhibition (13 mm) was found against *Escherichia coli* in methanol leaf extracts followed by aqueous extract.

Best treatment (T₈)

The aqueous leaf extract of Shankhpushpi showed the minimum activity against zone inhibition of 13mm and 12mm for *Escherichia coli* and *Staphylococcus aureus* respectively. Methanol leaf extracts showed the inhibition zone 15mm and 14 mm for *Escherichia coli* and *Staphylococcus aureus* at 50µl concentration respectively. The highest zone of inhibition (15 mm) was found against *Escherichia coli* in methanol leaf extracts followed by aqueous extract. The Kanamycin (standard antibiotic) was found the zone of inhibition of 16mm and 15mm for *Escherichia coli* and *Staphylococcus aureus* respectively as presented in Figure-17 and Plate -15.

4.8 (d) *Amaranthus tricolor* L. Var. Arun (Red amaranth)

Control treatment (C)

According to the results, the aqueous leaf extract of red amaranth exhibited the zone of inhibition 11 mm and 12mm against *Escherichia coli* and *Staphylococcus aureus* respectively. Methanol leaf extracts showed the maximum activity inhibition zone of 12 mm and 13 mm against *Escherichia coli* and *Staphylococcus aureus* at 50µl concentration respectively. The highest zone of inhibition (13mm) was found against *Staphylococcus aureus* in methanol leaf extracts followed by aqueous extract.

Best treatment (T₈)

The aqueous leaf extract of red amaranth showed the inhibition zone of 12mm and 13mm for *Escherichia coli* and *Staphylococcus aureus* respectively. Methanol leaf extracts recorded the inhibition zone 14mm and 15mm for *Escherichia coli* and *Staphylococcus aureus* at 50µl concentration respectively. The maximum zone of inhibition (15mm) was found against *Staphylococcus aureus* in methanol leaf extracts followed by aqueous extract.

When compared to the standard antibiotics, varied just slightly from one another. The standard antibiotic Kanamycin indicates the zone of inhibition against (16mm and 17 mm) *Escherichia coli* and *Staphylococcus aureus* respectively.

Figure -17

**Antibacterial Activity of Leaf Extracts of Shankpushpi
(AT 50 μ L Concentration)**

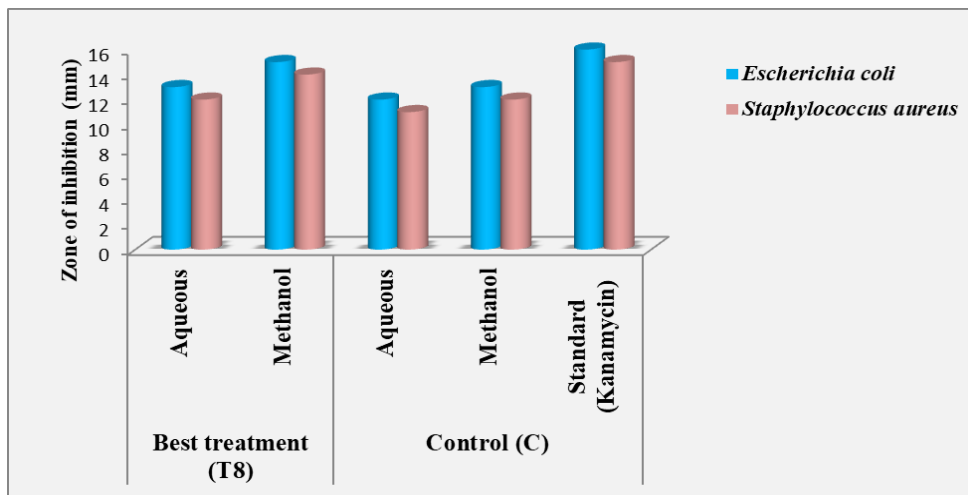
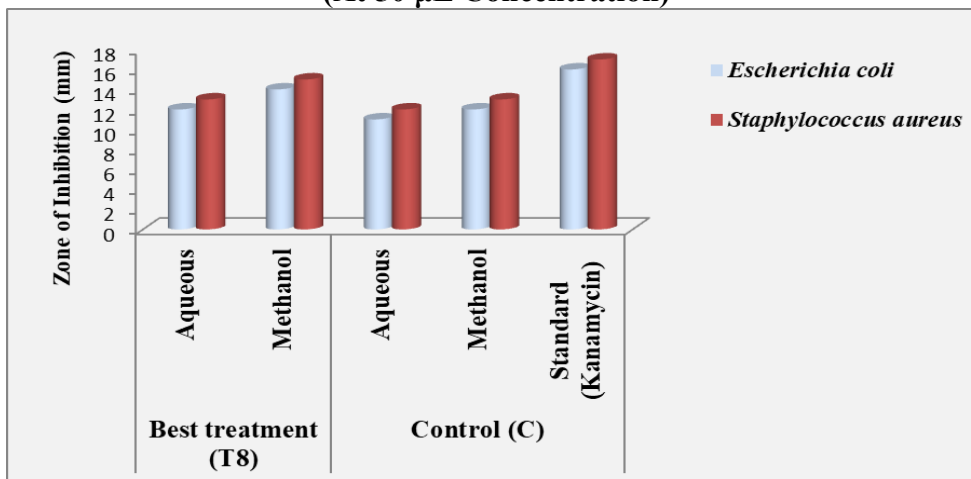


Figure -18

**Antibacterial Activity of Leaf Extracts of Red Amaranth
(At 50 μ L Concentration)**

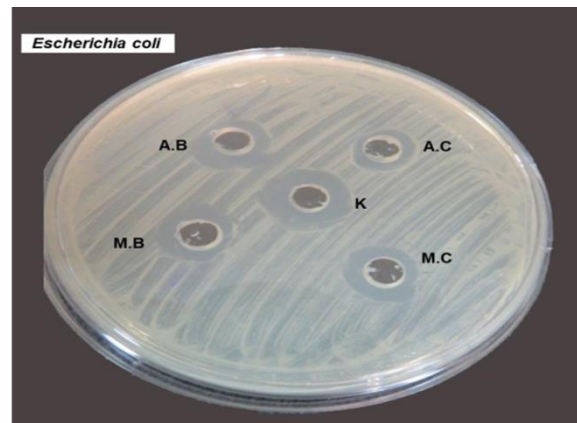
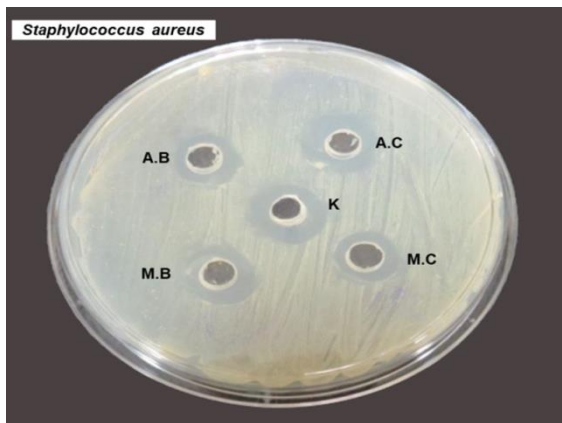


C- Control (Without treatment),
Best treatment (T₈) - Raw JFPW + 10 g *P. eous* + 10 g *P. florida* +
E. eugeniae 5t/ha⁻¹

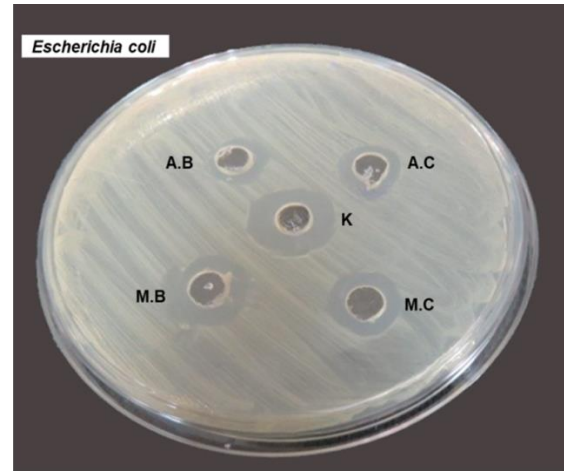
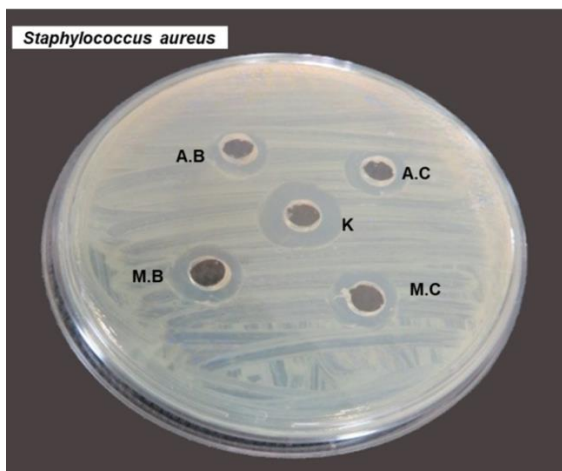
PLATE - 15

ANTIBACTERIAL ACTIVITY OF LEAF EXTRACTS OF TEST CROPS

Aqueous and Methanol Leaf Extracts of Shankpushpi (*Clitoria ternatea* L.) against *Staphylococcus aureus* and *Escherichia coli*



Aqueous and Methanol Leaf Extracts of Red amaranth (*Amaranthus tricolor* L. Var. Arun) against *Staphylococcus aureus* and *Escherichia coli*



A.C - Aqueous leaf extract of Control treatment

M.C - Methanol leaf extract of Control treatment

A.B - Aqueous leaf extract of Best treatment (T_8 . Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹(biocompost 8))

M.B -Methanol leaf extract of Best treatment (T_8 .Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹(biocompost 8))

K - Kanamycin (Standard)

Osuagwu and Edeoga, (2010) who reported that antibacterial activity of the leaves of *Ocimum gratissimum* (L) and *Gongronema latifolium* (Benth) will be increased by applying NPK fertilizer in the proper amounts, which will boost the value and effectiveness of these plants as medicines. The results of the current study were positively correlated with those of Shahat *et al.*, (2011), who established that an organically grown fennel cultivar has the highest zone of inhibition against both gram negative (*Escherichia coli*, *Pseudomonas aeruginosa*) and gram positive (*Staphylococcus aureus*, *Bacillus subtilis*) bacteria.

Majumdar and Parihar, (2012), reported methanol and aqueous extracts of *Costus pictus* leaf, root, stem and flowers showed antibacterial activity against *Shigella sp*, *Klebsiella sp*, *Bacillus subtilis* and *Escherichia coli*. Similar work was performed by Thirumurugan *et al.*, (2010) and Alagesaboopathi, (2011).

The current finding was associated with Barari *et al.*, (2015) who observed the antibacterial activity towards *Staphylococcus aureus* (Gram-positive strains) were more active than *Escherichia coli* (Gram-negative strains). Similar type of work was done by Das *et al.*, (2017) found that significant impact on the antibacterial activity of *Cajanus cajan* leaves due to the Vermicompost and farmyard manure application in the soil.

The findings of the current study are comparable to Lenny and Rizky, (2020) who found that a methanolic extract of *Vigna unguiculata* (L.) Walp leaves had a modest antibacterial effect against the gram-positive bacterium *Staphylococcus aureus*, with an inhibition zone width of 15.5 cm. However, gram negative received a poor result (*Escherichia coli*).

Alfarrayeh, *et al.*, (2022) who confirmed that the results of the antibacterial properties exhibited that were more active against Gram-positive (*Staphylococcus aureus*, *Bacillus subtilis*, and *Micrococcus luteus*) than Gram-negative (*E. coli* and *K. pneumoniae*) bacteria. The highest values of inhibition were seen in the *Inula viscosa*, against *S. aureus* (25 mm) and *B. subtilis* (22 mm), as well as for the extract *Achillea fragrantissima* against *S. aureus* (24 mm). *Inula viscosa*, and *Sarcopoterium spinosum* have been proven to have good antibacterial activity.

The results of the current investigation, showed that best treatment (T₈) of test crops exhibited considerable antibacterial activity in methanol extracts, followed by aqueous

extracts. Instead of using chemical fertilizers, biocomposting applications are more sustainable for agriculture and produce more nutrient-dense food.

4.10 ANTIOXIDANT ACTIVITY OF TEST CROPS

The antioxidant assay was carried out in aqueous and methanol seed extracts of the cowpea, yardlong bean and leaf extracts of Shankhpushpi and Red amaranth in all test crops grown under treatment T₈ (best treatment) and Control (C). The selected test crops observed significant antioxidant activity in methanol extracts followed by aqueous extracts.

4.10.1 DPPH radical scavenging activity

DPPH test is thought to be the most appropriate and accurate approach for assessing the capacity of antioxidants to scavenge free radicals, hence it is used to assess the antioxidant activity of various plants and plant products.

The free radical scavenging capacity of aqueous and methanolic seed and leaf extracts of test crop were investigate by its ability to bleach the stable DPPH radical. The DPPH scavenging activity of the aqueous and methanol extracts of four test crops at varying concentrations from 30, 50, 150, 250 & 350 $\mu\text{g/mL}$ was determined with ascorbic acid as standard. DPPH antioxidant activity at 350 $\mu\text{g/mL}$, recorded the highest values in methanol followed by the aqueous extracts (best treatment and control).

Cowpea

Control: As per the result, aqueous seed extract of cowpea was observed significant DPPH scavenging activity of 77.23% and methanol extract of 82.26% at 350 $\mu\text{g/mL}$.

Best treatment (T₈): The aqueous seed extract of cowpea was determined appreciable DPPH scavenging activity of 84.37% and methanol extract 90.22% at 350 $\mu\text{g/mL}$. The maximum radical scavenging activity was recorded at methanol seed extracts followed by aqueous extract as compared to control treatment extracts. DPPH radical scavenging activity of cowpea seeds were determined and are presented in Figure -19.

Yardlong bean

Control: DPPH radical scavenging activity of aqueous seed extract of Yardlong bean was observed significant scavenging ability of 84.61 % at 350 $\mu\text{g/mL}$. Methanol seed extract showed a scavenging ability of 89.33 % at 350 $\mu\text{g/mL}$ respectively.

Best treatment (T₈): The aqueous seed extract of Yardlong Bean indicate that 86.52% and methanol extract 94.26% of DPPH scavenging activity were recorded at 350 µg/ml. The maximum radical scavenging activity was recorded at methanol seed extracts followed by aqueous extract as compared to control treatment extracts. DPPH radical scavenging activity of Yardlong bean seeds were determined and are presented in Figure - 20.

Figure -19

DPPH radical scavenging activity of Cowpea seed extracts

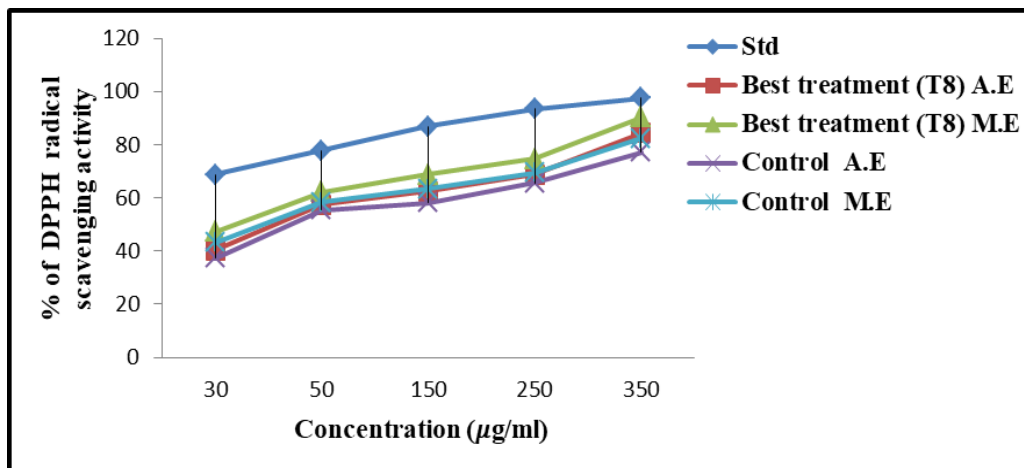
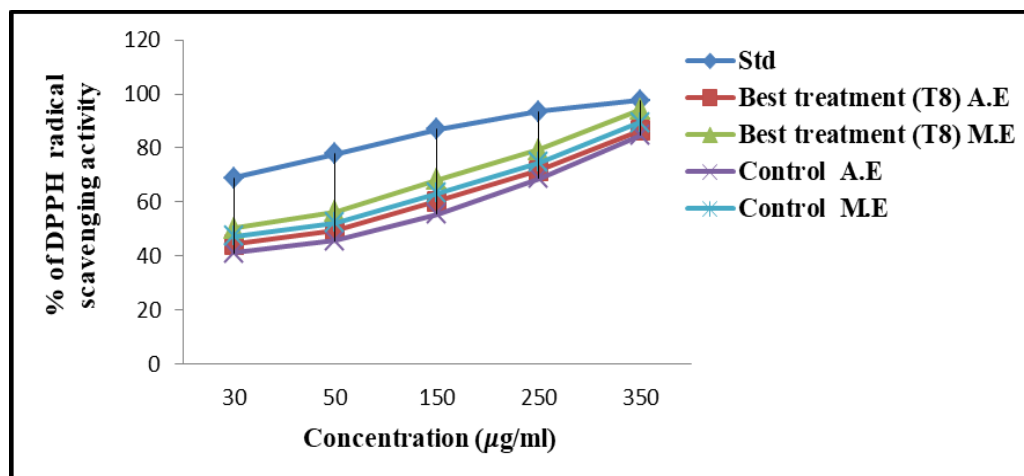


Figure -20

DPPH radical scavenging activity of Yardlong bean seed extracts



Standard – Ascorbic acid

C- Control (Without treatment)

A.E- Aqueous extract, M.E- Methanol extract

Best treatment (T₈) - Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹

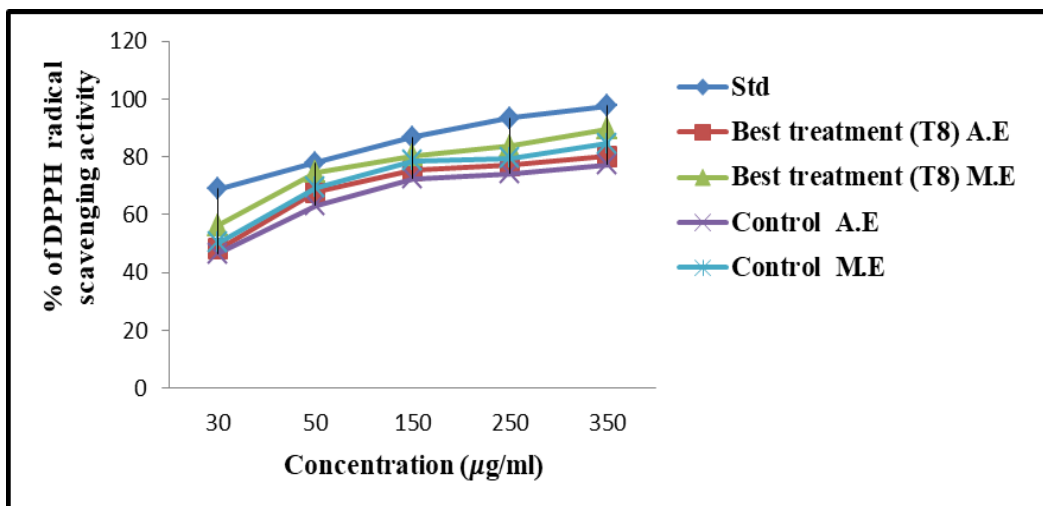
Shankpushpi

Control: DPPH radical scavenging activity of aqueous leaf extract of Shankpushpi was observed significant scavenging ability of 77.35% at 350 $\mu\text{g/mL}$. the methanol seed extract showed a scavenging ability of 84.61 % at 350 $\mu\text{g/mL}$ respectively.

Best treatment (T₈): The aqueous leaf extract of Shankpushpi indicate that 80.26% and methanol extract 89.57% of DPPH scavenging activity were recorded at 350 $\mu\text{g/mL}$ respectively. The maximum radical scavenging activity was recorded at methanol seed extracts followed by aqueous extract as compared to control treatment extracts. DPPH radical scavenging activity of leaf extracts of shankpushpi illustrated in Figure -21.

Figure -21

DPPH radical Scavenging Activity of Shankpushpi Leaves Extracts



Standard – Ascorbic acid

C- Control (Without treatment)

A.E- Aqueous extract

M.E- Methanol extract

Best treatment (T₈) - Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹

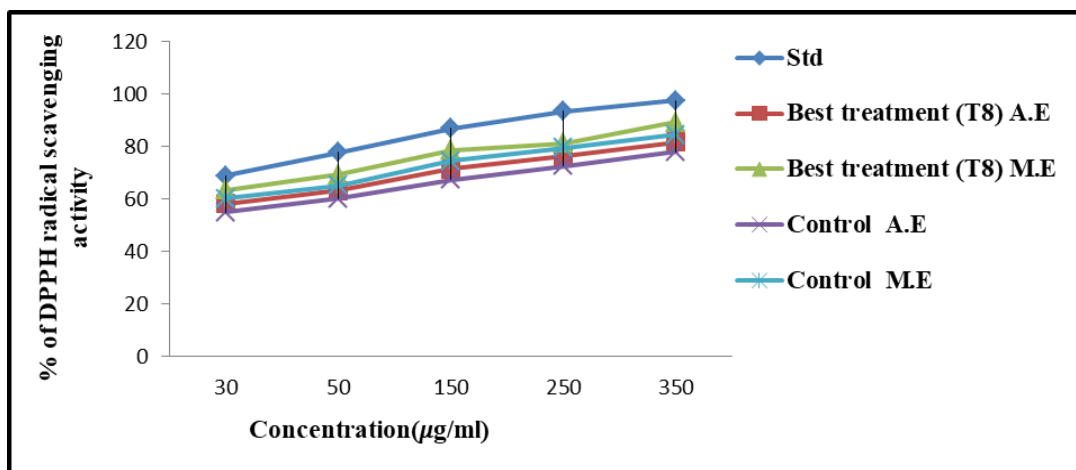
Red Amaranthus

Control: DPPH radical scavenging activity of aqueous leaf extract of red amaranthus had appreciable scavenging ability of 77.92 % at 350 $\mu\text{g/mL}$. The methanol seed extract showed an better scavenging ability of 84.61 % at 350 $\mu\text{g/mL}$ respectively.

Best treatment (T₈): The aqueous leaf extract of red amaranthus found that 81.59% and methanol extract 89.34 % of DPPH scavenging activity were recorded at 350 $\mu\text{g/mL}$. The maximum radical scavenging activity was recorded at methanol leaf extracts followed by aqueous extract as compared to control treatment extracts. DPPH assay of leaf extract red amaranthus indicated in figure-22.

Figure -22

DPPH radical Scavenging Activity of Red Amaranth Leaves Extracts



Standard – Ascorbic acid

C - Control (without treatment)

A.E - Aqueous extract

M.E - Methanol extract

Best treatment (T₈) - Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹

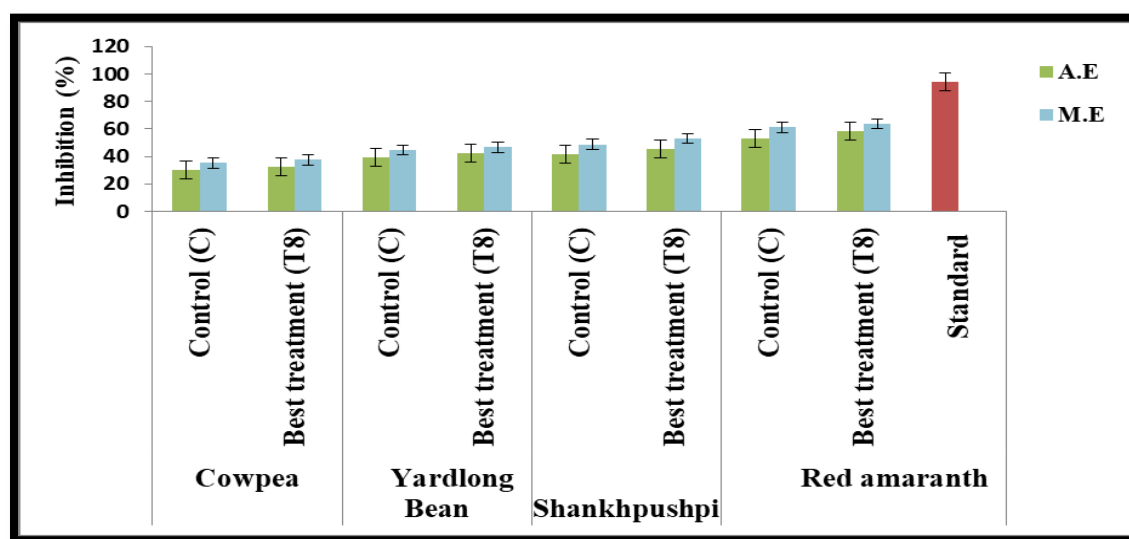
4.10.2 Hydrogen Peroxide Scavenging Activity

Hydrogen peroxide (H_2O_2) is one of the free radicals which is injurious for the cells in higher concentrations and these free radicals can be scavenged by antioxidants.

The present work evaluated the efficiency of aqueous and methanol seed and leaf extracts to scavenge the non-radical oxidant hydrogen peroxide in vitro. The H_2O_2 scavenging activity was tested using aqueous and methanol extracts from the seeds of cowpea, yardlong bean, leaf of shankpushpi, and red amaranth. Among the selected four test crops, Red amaranth's methanol (63.70%) and aqueous (58.36%) leaf extracts had the highest levels of hydrogen peroxide scavenging, followed by the Control treatments (61.18% and 53.24%) respectively. It was also observed that all the extracts are likely to have hydrogen peroxide scavenging activity in the order red amaranth > shankpushpi > yardlong Bean > cowpea. The results were depicted in the Figure-23.

Figure -23

Hydrogen Peroxide Scavenging Activity of Selected Test Crops



Std - Standard – Ascorbic acid

A.E - Aqueous extract

M.E - Methanol extract

C- Control (Without treatment)

Best treatment (T_8) - Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹

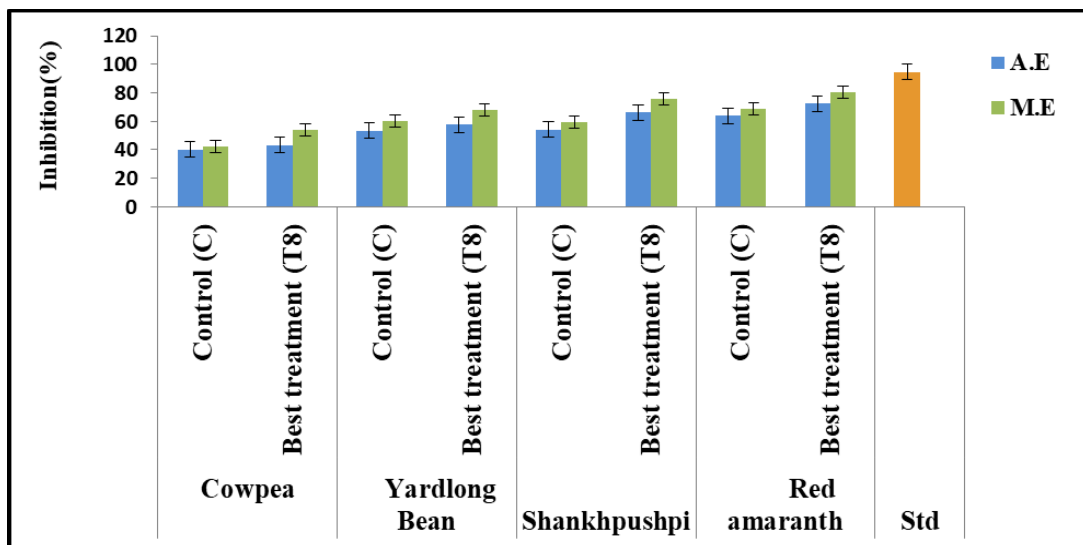
4.10.3 Nitric Oxide Radical Scavenging Activity

The Nitric oxide scavenging method involves the decrease of NO release from Sodium nitroprusside due to competition between NO and scavengers for oxygen.

The nitric oxide radical scavenging activity was found in all the selected plants, which grown under the best treatment (T₈) and minimum activity was observed in Control. Among the four plants, significant nitric oxide radical scavenging activity was observed in methanol leaf extracts of Red amaranth (80.51%) followed by aqueous leaf extracts (72.31%). Among the four test crops the Nitric Oxide Radical Scavenging activity was in the order Red amaranth > Shankpushpi > Yardlong Bean > Cowpea. It was concluded that all the plant extracts have nitric oxide scavenging activity which is shown in Figure-24.

Figure -24

Nitric Oxide Scavenging Activity of Selected Test Crops



Std- Standard – Ascorbic acid

A.E- Aqueous extract

M.E- Methanol extract

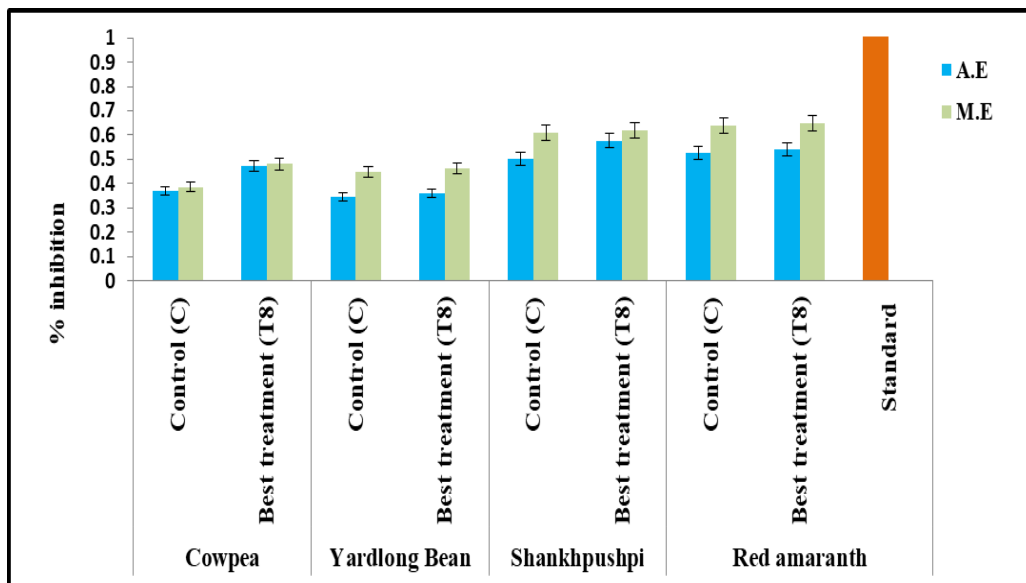
C- Control (Without treatment)

Best treatment (T₈)- Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹ (biocompost 8)

4.10.4 Reducing Power Assay

The best treatment T₈ (Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹) and control grown test crops was evaluated for the ability of reducing power Assay. Among the four selected crops, reducing power was maximum in Red amaranth in methanol leaf extract (0.647) as compared to aqueous extract (0.542). The reducing power assay was moderate in Control treatment in the methanol leaf extract (0.639) followed by aqueous leaf extract (0.528) and the values were comparable to that of ascorbic acid standard. It could also be observed that all the extracts are likely to have reducing power assay in the order Red amaranth > Shankpushpi > Cowpea > Yardlong bean (Figure-25). Reducing power assay can identify the potential antioxidant activity of a substance.

Figure -25
Reducing Power Assay of Selected Test Crops
(Absorbance at 700nm)



Std - Standard – Ascorbic acid

A.E - Aqueous extract

M.E - Methanol extract

C- Control (Without treatment)

Best treatment (T₈) - Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹

Multiple modes of action are used by antioxidant chemicals to interact with various radicals or oxidants. Appropriate antioxidant activities show that antioxidants are scavenging free radicals and preventing lipid peroxidation (Marathe *et al.*, 2011). Therefore, more than one test is required to increase the accuracy in measuring the antioxidant. Olarewaju *et al.*, (2018) have indicate that the combined application of organic manure with urea fertilizer enhanced the 2,2,-diphenyl-1picrylhydrazyl radical scavenging.

Sombie *et al.*, (2019) have found that high significant ability of DPPH free radical scavenging potential in cowpea leaves due to application of NPK+Jatropha treatment (T3). This study are also in accordance with the results of Salama *et al.*,(2015) have reported that methanol extracts of both sweet fennel cultivars (Dolce and Zefa fino) were able to scavenge DPPH radical due to the application of organic and bio-organic fertilizers. These results revealed that organic fertilizer application increased the antioxidant activity compared to control (100% NPK). Similar observation was reported by Silva *et al.*, (2018) and Dushing and Surve, (2019).

Similar antioxidant radical scavenging activity results were evaluated by Farooq *et al.*, (2019) who found that aqueous and hydro-alcoholic extract of *Ficus carica* showed DPPH (56.53 and 54.15%), hydrogen peroxide radical scavenging activity (77.569 and 79.69%),reducing power assay (222.44 and 315.25 µg/ml) and nitric oxide radical scavenging activity (56.94 and 65.198%) respectively.

Shinde Madhumati and Khade, (2020) indicated an that improved and stronger antioxidant scavenging potential of Maize due to the application of Azotobacter and PSB biofertilizers. Ramaiya *et al.*, (2021) who found that the stronger antioxidant activity was observed in leaves of organic cultivation (2.31 mg mL⁻¹) compared to conventional practice (4.69 mg mL⁻¹). Similarly, the organic mesocarp and pulp possessed stronger DPPH values with 4.88 mg mL⁻¹ and 13.61 mg mL⁻¹, respectively. The higher level of DPPH indicated that cultivation practices influenced the antioxidant bioactive compounds in *Passiflora quadrangularis* L. Machado *et al.*, (2020) observed that antioxidant activity (DPPH and FRAP) was higher in spinach plants grown with ammonium nitrate than those grown with ammonium sulfate. Serri *et al.*, (2021) verified that the antioxidant capacity of coriander leaf was significantly higher in vermicompost, glycine and NPK treatments compared to control plants.

The findings suggest that T₈ (Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹) treatment significantly improved the test crops' antioxidant capability when compared to the control. Test crop seeds and leaves had a greater antioxidant capacity, which was mostly attributed to an increase in antioxidant components rather than antioxidant enzymes and phytochemicals as well.

4.11 PHYTOCHEMICAL SCREENING

The preliminary phytochemical screening study was carried out in aqueous, methanol, and ethyl acetate leaf extract of *Clitoria ternatea* L. (Shankhpushpi) and *Amaranthus tricolor* L. (Red amaranth) grown under best treatment (T₈- Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹). The results are given in Table 40.

4.11 (a) Phytochemical assessment of *Clitoria ternatea* L. (Shankhpushpi)

Shankhpushpi leaves indicated the presence of alkaloids, phenols, tannins and terpenoids in aqueous, methanol, and ethyl acetate extracts. Glycosides were identified in the ethyl acetate extract, while saponins and flavonoids were also detected in the aqueous leaves extract. Methanol leaves extract of Shankhpushpi showed the presence anthroquinones, flavonoids, glycosides and steroids. whereas saponins and aminoacids absent in all three extracts.

4.11 (b) Phytochemical assessment of *Amaranthus tricolor* L. (Red amaranth)

Red amaranth leaves determined presence of alkaloids and phenols in all three extracts. Anthroquinones, amino acids, flavonoids, glycosides, steroids, and tannins were all present in the methanol leaves extract of red amaranth, whereas Saponins were not present in any of the three extracts. The present study confirms the presence anthroquinones, flavonoids, glycosides and tannins in ethyl acetate extract.

Phytochemicals are naturally occurring biologically chemical substances that are present in plants. Plants are known to be protected from a variety of diseases by phytochemicals, which act as a defence mechanism. Recent studies have shown that these phytochemicals can really shield people from a wide range of ailments.

Babu *et al.*, (2016) obtained *Rosa bourboniana* flowers from the vermicompost-adjusted plot (T1) had a greater amount of phytochemical elements, confirming the favourable impact of vermicompost in changing the phytochemical content of plants in comparison to that of chemical fertiliser. The flowers from the chemical fertiliser adjusted

plot (T2) have lower levels of phytochemicals and slightly greater levels than the control plot (T3). Aneja *et al.*, (2011) found that phytochemical screening of *Amaranthus tricolor* Linn showed the presence of alkaloids, flavonoids, glycosides, tannins, proteins and amino acids.

Table - 40

Phytochemical screening of *Clitoria ternatea* L. and *Amaranthus tricolor* L. leaves

Sl. No	Phytoconstituents	Best Treatment (T ₈)					
		<i>Clitoria ternatea</i> L.			<i>Amaranthus tricolor</i> L.		
		Aqueous Extract	Ethyl acetate Extract	Methanol Extract	Aqueous Extract	Ethyl Acetate Extract	Methanol Extract
1	Alkaloids	+	+	+	+	+	+
2	Anthraquinone	-	-	+	-	+	+
3	Amino acids	-	-	-	-	-	+
4	Flavonoids	+	-	+	-	+	+
5	Glycosides		+	+	-	+	+
6	Phenols	+	+	+	+	+	+
7	Steroids	-	-	+	-	-	+
8	Saponins	+	-	-	-	-	-
9	Tannins	+	+	+	-	+	+
10	Terpenoids	+	+	+	-	+	-

Tiwari *et al.*, (2018) reported the presence of alkaloids, flavonoids and coumarins in *Achyranthes aspera* leaf. Kannika, *et al.*, (2019) found that phytochemical analysis of *Euphorbia hirta* grown in soil amended with Poultry farm solid waste showed an increase in flavonoids, saponin and tannin over that of plants grown in control.

The present study was positively correlated with the findings of Kousalya and Doss, (2020), who revealed presence of alkaloids, flavonoids, saponins, carbohydrates, proteins, amino acids, phenols, glycosides, tannins, sterols and terpenes content in leaves of *Artabotrys hexapetalus* under different extracts. Similar results were obtained by Priya and Sharma, (2021) who observed the phytochemical analysis of the root, flower and leaf of *Hibiscus rosa-sinensis*. The results revealed that in methanolic and aqueous extracts the presence of alkaloids, carbohydrates, flavonoids, reducing sugars, polyphenols, cardiac glycosides, phlobatannins, terpenoids, saponins and tannins.

Pandian and Ilango, (2022) studied the preliminary phytochemical screening of the leaf of *Huberantha senjiana*. Chloroform, ethyl acetate, n-hexane, isopropyl alcohol and methanol extracts showed the presence of alkaloids, flavonoids, proteins and carbohydrates, etc. These results were in agreement with those obtained by Yadav and Saravanan, (2019) in *Curcuma caesia*, Syed *et al.*, (2020) in *Tridax procumbent* and Abbasi and Najam-Us-Saqib, (2021) in *Bauhinia variegata*.

4.11 MINERAL COMPOSTION OF TEST CROPS

4.11.1 Influence of CSW and JFPW biocompost on Mineral Composition of Test Crops

The mineral composition study was conducted in leaves of *Vigna unguiculata* L. Walp. Var. Co (CP) 7 (Cowpea), *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc Var.NS-621 (Yardlong Bean), *Clitoria ternatea* L. (shankhpushi) and *Amaranthus tricolor* L. Var. Arun (Red amaranth). Best treatment (T₈-Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹) and control treatment grown test crops were only used for this analysis as depicted in Table – 41.

Mineral concentrations of cowpea observed was significant sodium (2.50%), Phosphorus (0.49), Potassium (9.07), Calcium (2.10%), Iron (4.56%), Magnesium (1.94%) and Zinc (3.80%) content in best treatment (T₈) respectively. The less nutrient concentration was found in control.

Yardlong Bean was recorded appreciable amount of sodium (2.18%), Phosphorus (5.10), Potassium (8.67), Calcium (2.24%), Iron (3.55%), Magnesium (2.51%) and Zinc (2.83%) content in Best treatment (T₈) as compared to the control.

Similarly shankhpushi showed highest sodium (0.30%), phosphorus (0.76), potassium (1.58), calcium (0.81%), iron (5.39%), magnesium (0.56%) and zinc (4.27%) content in best treatment (t₈) as compared to leaves of control treatment.

Red amaranth had maximum sodium (2.65%), phosphorus (56.22), potassium (2.10), calcium (32.06%), iron (8.55 %), magnesium (49.18 %) and Zinc (2.35%) content in best Treatment (T₈) respectively. Control was found to have minimum mineral composition. The results concluded that best treatment grown test crops had maximum nutrient content in leaves as compared to control treatment. Mineral concentrations in the leaves of test crops are presented in Table - 41.

Table - 41

Influence of Best Treatments on Mineral Composition of Test Crops Leaves

Mineral composition	<i>Vigna unguiculata</i> (L.) Walp.		<i>Vigna unguiculata</i> subsp. <i>sesquipedalis</i> (L.) Verdc		<i>Clitoria ternatea</i> L.		<i>Amaranthus tricolor</i> L.	
	Control (C)	Best Treatment (T ₈)	Control (C)	Best Treatment (T ₈)	Control (C)	Best Treatment (T ₈)	Control (C)	Best Treatment (T ₈)
Sodium (Na) %	1.47	2.50	1.64	2.18	0.16	0.30	1.90	2.65
Phosphorus (P)%	0.35	0.49	3.86	5.10	0.55	0.76	50.12	56.22
Potassium (K)	8.03	9.07	7.23	8.67	1.23	1.58	1.87	2.10
Calcium (Ca)	1.80	2.10	1.55	2.24	0.68	0.81	24.11	32.06
Iron (Fe)	3.90	4.56	2.82	3.55	4.77	5.39	7.86	8.55
Magnesium (Mg)	1.58	1.94	1.79	2.51	0.39	0.56	40.22	49.18
Zinc (Zn)	2.83	3.80	0.87	1.10	3.14	4.27	1.79	2.35

Thus the different nutrient composition of the leaves of four test crops can be expressed as highest to lowest.

- Sodium (Na) - Red amaranth > Cowpea > Yardlong bean > Shankpushpi
 Phosphorus (P) - Red amaranth > Yardlong bean > Shankpushpi > Cowpea
 Potassium (K) - Cowpea > Yardlong bean > Red amaranth > Shankpushpi
 Calcium (Ca) - Red amaranth > Yardlong bean > Cowpea > Shankpushpi
 Iron (Fe) - Red amaranth > Shankpushpi > Cowpea > Yardlong bean
 Magnesium (Mg) - Red amaranth > Yardlong bean > Cowpea > Shankpushpi
 Zinc (Zn) - Shankpushpi > Cowpea > Red amaranth > Yardlong bean

Deshmukh and Jadhav, (2014) evaluated the presence of various mineral contents from *Clitoria ternatea* Linn. leaves. The experimental results of Mofunanya *et al.*, (2015) have shown that organic fertilizer undergrown *Amaranthus spinosus* L recorded significantly higher Zn, Cu, Mg, K, Fe, Ca, Na and P content when compared with inorganic fertilizer.

Omidi *et al.*, (2017) reported that application of 25% peanut shells compost had the maximum amount of nitrogen, iron and potassium in violet plant. However greatest effect on amount of zinc (50% peanut shells compost) and calcium (75% peanut shells compost) also obtained. Ayito *et al.*, (2018) found that application of 30 NPK + 90 Neem (kg N/ha) were significantly enhanced the various nutrient concentration of Okra.

Similar study was done by Ashwini *et al.*, (2018) observed significantly higher nitrogen, phosphorus and potassium uptake in pigeonpea due to the activity of T₆ (FYM at 6 t/ha + RDF + biofertilizers). Mahmud *et al.*, (2018) observed vermicomposted soil had significantly increased micro and macronutrients in leaf of pineapple plants.

Mohamed *et al.*, (2019) have also reported that effect of compost application enhancing NPK and Ca, Mg, Na, Fe, Mn, Zn, and Cu content in wheat grains as compared with chemical fertilization. Similar study was done by Biama *et al.*, (2020) in cowpea and Sharma and Chadak, (2022) in Okra.

Plants need minerals as important nutrients in order to carry out life-supporting activities. These minerals are acquired by plants from the soil. The present study indicates remarkable physicochemical characteristics of T₈ (Raw JFPW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹(biocompost 8)) (treatment-supplemented soil result in a rise in the mineral composition of test crop leaves. Therefore, food with a proper mineral composition becomes crucial for the human diet.

The overall results of phase IV showed that adding vermicomposted jack fruit peel waste (T₈) to the soil had a beneficial impact on the antibacterial, antioxidant, phytochemical, and mineral composition (micro and macro nutrients) of respective test crops.