

RESULTS AND DISCUSSION

The present chapter explains the results and discussion pertaining to microbial population during biocomposting, physico chemical parameters, FT-IR, Field Emission Scanning Electron Microscope (FESEM) morphological characterization of raw and biocomposted agro industrial paddy and coffee husk wastes and its impact on the selected test plants i.e., Moth bean (*Vigna aconitifolia* (Jacq.) Marechal) Var. RMO- 40, Black gram (*Vigna mungo* (L.) Hepper) Var. CO - 6, Fenugreek (*Trigonella foenum-graecum* L.) Var. Lam Selection -1 and Kalmegh (*Andrographis paniculata* (Burm.f.) Nees) Var. CIM-Megha. Their vegetative growth, biochemical analysis, yield parameters, leghaemoglobin content in nodules, phytochemical analysis of medicinal plants, antioxidant activity, antibacterial activity of the best treatment and analysis of pre and post harvest soil were discussed in this chapter under different headings in four phases.

PHASE -I

COMPOSTING

4.1 Microbial population

4.1.1 Microbial Population during 20, 40, 60 and 80 Days of Biocomposting

Microbial population was analyzed from the six different agro industrial paddy and coffee husk bicomposts. The following biocomposted treatments were used for microbial population analysis.

Compost 1 - Raw paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha), Compost 2 - Raw paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha), Compost 3 - Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha), Compost 4 - Raw coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha), Compost 5 - Raw coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha), Compost 6 - Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha).

The results obtained on the total microbial population (bacteria, fungi and actinomycetes) of the agroindustrial paddy and coffee husks biocompost to assess the quality of biocomposts on 20, 40, 60 and 80 days of microbial variations in each biocomposting unit are exhibited in Figures 1, 2 & 3.

4.1.1.1 Population of Bacteria

The changes in the bacterial population were recorded on 20, 40, 60 and 80 days as it is shown in Figure 1. During mesophilic phase of biocomposting, bacterial count was increased on 20th day in C₆ (1.35×10^6 CFU/ml) and C₃ (1.22×10^6 CFU/ml) followed by C₅ (0.97×10^6 CFU/ml) when compared to control (0.59×10^6 CFU/ml). On 60th day remarkable bacterial growth was noted in C₆ (2.81×10^6 CFU/ml) and C₃ (2.74×10^6 CFU/ml), followed by C₅ (1.85×10^6 CFU/ml) over control (0.99×10^6 CFU/ml) in thermophilic phase. On 80th day the bacterial population appeared to decline slightly during the maturation period. The maximum growth of bacterial population was observed in C₆ (1.87×10^6 CFU/ml), C₃ (1.72×10^6 CFU/ml) when compared to control (0.77×10^6 CFU/ml) respectively.

4.1.1.2 Population of Fungi

The total fungal count was significantly increased in C₆ (0.77×10^4 CFU/ml) followed by C₃ (0.71×10^4 CFU/ml) when compared to the Control (0.12×10^4 CFU/ml) on 20th day. During thermophilic phase a remarkable increase was noted in C₆ (1.75×10^4 CFU/ml), C₃ (1.7×10^4 CFU/ml) over the Control (0.32×10^4 CFU/ml) on 60th day. As the decomposition progress population increased along with the days, favorable number of fungal population was found in all the biocomposts but during maturation phase (80th day) slight decline was noted in C₆ (1.22×10^4 CFU/ml), C₃ (1.01×10^4 CFU/ml) and C₅ (0.77×10^4 CFU/ml) over the Control (0.29×10^4 CFU/ml) as shown in Figure -2.

4.1.1.3 Population of Actinomycetes

On 20th day, actinomycetes population obtained highest in C₆ (0.35×10^5 CFU/ml) followed by C₃ (0.31×10^5 CFU/ml) when compared to Control (0.04×10^5 CFU/ml). During thermophilic phase, maximum actinomycetes population were recorded on 60th day in C₆ (0.87×10^5 CFU/ml), C₃ (0.83×10^5 CFU/ml) over the Control (0.2×10^5 CFU/ml). All the compost treatments showed decline in the population of actinomycetes in C₆ of 0.47×10^5 CFU/ml, C₃ of 0.42×10^5 CFU/ml followed by C₅ 0.39×10^5 CFU/ml over the Control (0.06×10^5 CFU/ml) on 80th day of the maturation phase.

Figure - 1

Impact of Biocomposting on Bacterial Population

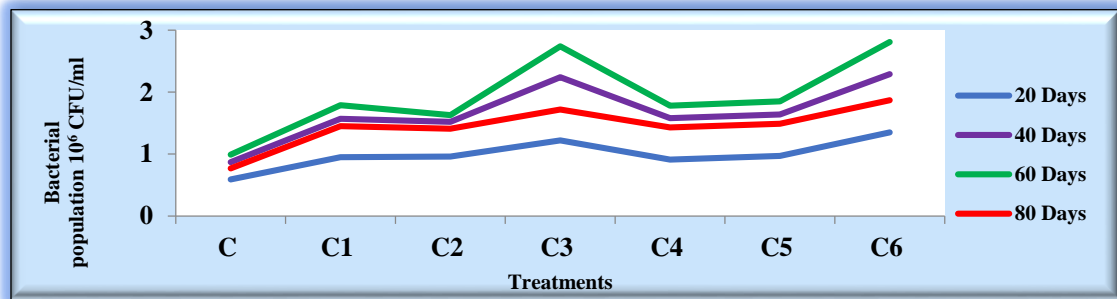


Figure - 2

Impact of Biocomposting on Fungal Population

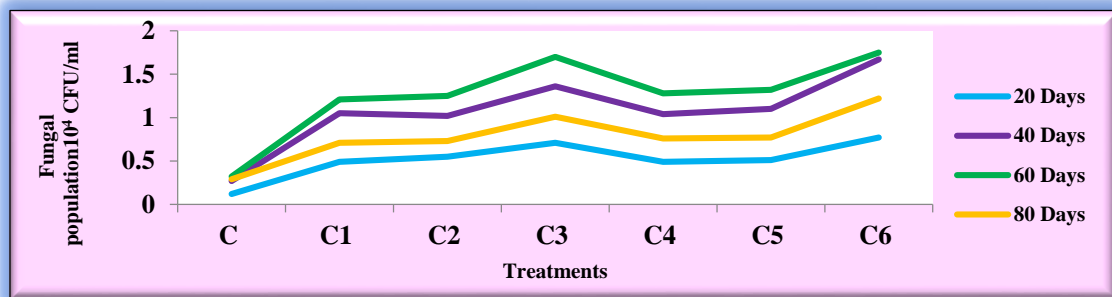
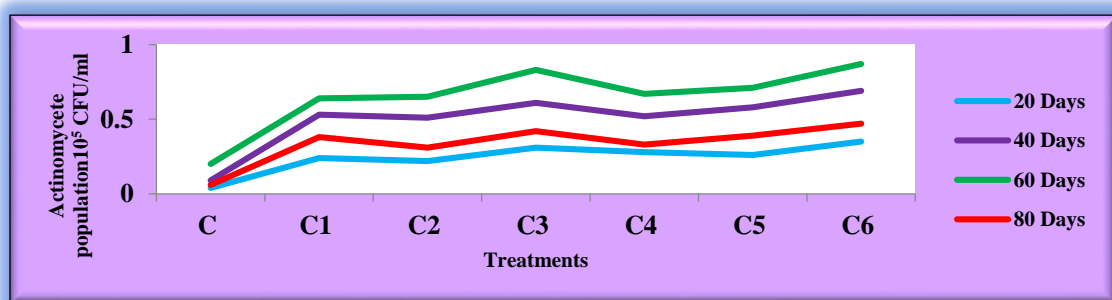


Figure - 3

Impact of Biocomposting on Actinomycetes Population



C - Control

C₁ - Raw Paddy husk +20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

C₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

C₃ - Raw Paddy husk + 6.5 g *Pleurotus eous*+ 6.5 g *Pleurotus florida* +7g *Trichoderma asperelloides*+*Eisenia fetida* (5t/ha)

C₄ - Raw Coffee husk +20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

C₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

C₆ - Raw Coffee husk + 6.5 g *Pleurotus eous*+ 6.5 g *Pleurotus florida* +7g *Trichoderma asperelloides*+*Eisenia fetida* (5t/ha)

The above results were in correlation with that of the work of Lee *et al.*, (2004) who found 30–500 times higher fungal populations and 50-400 times higher bacteria population in food waste compost treatments. Gopal *et al.*, (2009) observed that populations of heterotrophic bacteria (19×10^6 CFU g⁻¹), fungi (12×10^4 CFU g⁻¹), actinomycetes (5×10^4 CFU g⁻¹) and spore forming bacteria (35×10^4 CFU g⁻¹) was increased in cow manure substrate with gut contents of *Eudrillus* sp.

Similar results were observed by Sen and Chandra, (2009) during composting (without earthworms), on 20th day, bacterial population increased from 3.19×10^5 to 3.24×10^5 CFU 10⁻⁵ on 60th day while vermicompost showed the increase of bacterial population on 20th day (3.21×10^5) to (3.12×10^5) on 60th day. Similar results were reported by Veeresh *et al.*, (2010) who observed higher population of bacteria ($930.33 \text{ CFU} \times 10^6 \text{ g}^{-1}$), Fungi ($252.00 \text{ CFU} \times 10^4 \text{ g}^{-1}$) and actinomycetes ($212.00 \text{ CFU} \times 10^6 \text{ g}^{-5}$) in jeevamrutha treatments.

The present findings are in agreement with that of Wei *et al.*, (2012) who observed bacteria and fungi at the dominant phases of composting with higher proportion between them in degrading the cellulose, lignin and hemicelluloses of the plant biomass composting of yellow poplar (*Liriodendron tulipifera*), wood-chips and mown lawn grass clippings (85:15 in dry-weight). Similar to our results Srirajyam and Manivannan (2015) also observed higher microbial population (bacteria, fungi and actinomycetes) in vermicompost with the combination of cow dung + press mud + coffee husk (1:1:1 ratio) + *Perionxy ceylanensis* at the initial substrate stage ($3.54 \text{ CFU} \times 10^6 \text{ g}^{-1}$). The results are in conformity with that of Manu *et al.*, (2017) who noted substantial variation in microbial populations with higher bacterial counts than fungi during the composting process of mixed waste (food waste + garden waste 1:2 ratio) in modified drums while white rot fungi were present in control drum.

Similar results were reported by Jarboui *et al.*, (2021) who observed higher mesophilic bacteria (3.2 and $7.2 \text{ CFU} \times 10^8$), yeasts (0.28 & $2 \text{ CFU} \times 10^5$) and molds (1.3 & $1 \text{ CFU} \times 10^5$) in food waste compost and fermented extract. The present results are in agreement with that of Silpa *et al.*, (2021) who reported that the combined application of microorganism treated biocomposting units C8 (Raw jackfruit peel + 10 g *Pleurotus eous* +

10 g *Pleurotus florida* + *Eudrilus eugeniae*) & C4 (Raw cocoa shell + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae*) are microbiologically more active than other composting units. The results are similar to those of Shi *et al.*, (2021) who observed an increase of *Acidobacteria*, *Chloroflexi*, *Actinobacteria*, *Firmicutes*, *Proteo bacteria* and *Bacteroidetes* during thermophilic stage of corn stalk composting and later decreased with the increase of composting time.

The present results are in agreement with Dash *et al.*, (2022) who observed highest bacterial population ($6.2 \text{ CFU} \times 10^{-3}$ and $6.0 \text{ CFU} \times 10^{-4}$ dilutions) and fungal population ($5.4 \text{ CFU} \times 10^{-2}$ and $5.2 \text{ CFU} \times 10^{-4}$ dilutions) in elephant dung with rice straw degradation. Similar to our results Zhou *et al.*, (2023a) also observed the bacteria phylum *Firmicute* decreased from 85.1% to 40.3% while *Actinobacteria* increased from 14.4% to 36.7%, and main fungal class *Eurotiomycetes* decreased from 60.9% to 19.6% while *Sordariomycetes* increased from 16.9% to 69.7% during the composting of *Cinnamomum camphora* leaf. Similarly, Zhou *et al.*, (2023b) also observed significant increase of *Proteobacteria* and *Sordariomycetes* during the initial composting of Aromatic Plant Biomasses (APBs) *Cinnamomum camphora* and *Stropharia rugosoannulata* cultivation materials.

Populations of bacteria, fungi and actinomycetes were increased from the initial level to maturity of biocompost that is from 20th day to 60th day and also it was noted a gradual decrease in the growth of microorganisms on 80th day. This indicated that the enhancement of the biocompost and the role of microorganisms have enriched the macro and micronutrients. Using consortium of microorganisms in the composting process has improved the growth of population. Temperature also acted as the primary factor which influenced the microbial activity and the changes in the biocomposting material by three temperature phases (mesophilic, thermophilic and maturation phase) during which variations in the microbial activity was recorded along with the fluctuations of the temperature.

Maximum activity of enzymes was observed on 60th day. Specific enzymes depend on the specific functional groups of microbial communities. These microorganisms increase at certain points during organic matter decomposition and they are influenced by the

substrate concentration which enriches the growth of the microorganisms during decomposition process.

The significant increase of bacteria, fungi and actinomycetes from 20 days to 60 days and decline from 60 to 80 days could be due to the high nutrient concentration in the initial substrate material and vermicompost. Optimal moisture, large surface area of the vermin casts also used for better multiplication and activity of microbes in the degradation process of the wastes. Hence, the enhancement of microbial population of bacteria, fungi and actinomycetes might be due to the contribution of earthworm gut microbe's activity which boosted the mineralization of paddy and coffee husks vermicompost.

4.1.2 Physico - chemical and morphological analysis of the raw and vermicomposted paddy and coffee husk

Degradation of agro industrial wastes could be done only through composting process. In this sub headings, it is explained about the essential evaluation of compost maturity through FESEM, FT-IR and important physico chemical parameters like pH, EC, lignin, cellulose, total N, total P, total K, Ca, Mg and C:N ratio.

4.1.2.1 Morphological study of the vermicompost by Field Emission Scanning Electron Microscope (FESEM)

FESEM analysis was used to compare and visualize the morphological characterization of the surface level substrates in raw (paddy and coffee husk) and 6 biocomposting units.

The paddy and coffee husks were generated and processed into vermicompost. In general, the temperature and pressure present inside the pile, presence of lignin and cellulose materials inhibit the activity of microorganisms, but the decomposition process undergoes rigorously with microbial activity along with physical changes of the substances. Hence, paddy and coffee husk materials present in the organic fraction are decomposed into powdered humic like substances. The FESEM examination shows the surface morphology and physical changes occurring in raw (paddy and coffee husk) as a thick matrix of cellulose, lignin, pectin and starch. FESEM micrographs of different composts (C₁ to C₆) showed porous, spherical, filamentous formations with microbial degradation as seen in Figure-4.

Essential information has revealed from the micrographs obtained from FESEM analysis on surface morphology of vermicompost and raw samples of paddy and coffee husk. Earthworms (*Eisenia fetida*) made the feed mixtures into fine particles, further action by microbes and enzymes in the earthworm gut degrade the substrates. It was observed that small cavities, lignin, cellulose fibrous structure were observed on the surface of the raw samples of paddy and coffee husks as shown in images (Figure - 4).

FESEM, the powerful magnification technique at 10 μ m resolution with focused beams of electrons showed the comparison between the surface information of all the vermicompost samples (C₁, C₂, C₃, C₄, C₅ & C₆) and raw samples in which surface area of vermicompost was higher than that of the raw samples. Within the vermicompost samples, the highest proportion of the surface changes were recorded with higher fragmentation, pores and ingestion of the substrate organic matter by the earthworms and enzymatic action of the microorganisms in compost 6 (C₆ - Raw coffee husk + 6.5 g *Pleurotus eous*+ 6.5 g *Pleurotus florida* +7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) followed by compost 3 (C₃ - Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha).

It was observed that the particle size of the vermicompost was smaller than the raw samples. The morphological modification of vermicompost showed that protein, lignin and cellulose matrix was completely digested by the earthworms, enzymes and microbes. Numerous surface irregularities of vermicompost confirmed the complete maturity in Compost - 6 and Compost - 3 followed by Compost - 1, Compost - 2, Compost - 4 and Compost - 5. In general, microorganisms prefer a permeable, ruptured surface for better and faster action. The ultimate maturity of compost shows heterogeneous surfaces with various modifications such as crystal like particles and it is due to the changes made by the microbial breakdown of paddy and coffee husk. The biocomposting units (C₃ and C₆) applied with microbial consortium (6.5 g *Pleurotus eous*+ 6.5 g *Pleurotus florida* +7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) showed significant and better biodegradation of paddy and coffee husk.

The present results coincide with the results of Baharuddin *et al.*, (2009) who observed the surface structure of untreated shredded empty fruit bunch (EFB) SEM

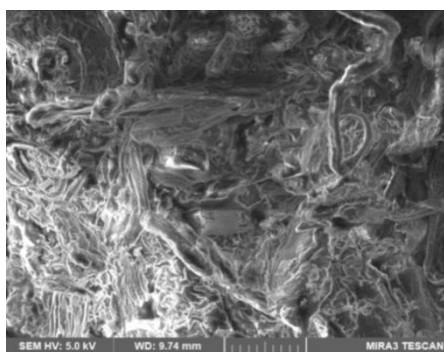
images with firm threads of lignin with smooth surface while the treated EFB with many pores, disrupted lignin. Similar results were observed by Baharuddin *et al.*, (2011) who studied electron micrograph of pressed shredded Empty Fruit Bunch (EFB) where it showed removal of some silica bodies at the surface level and plant cells were undamaged. Similar results were in par with Senthil Kumar *et al.*, (2014) who studied the surface morphology of flower waste vermicompost inoculated with biofertilizers, SEM analysis showed the changes in E2 (Vermicompost + *Azospirillum*) with more fragments and pores than the control. The fragmented nature of the palm oil mill byproduct vermicompost revealed that the substrates were ingested and fragmented by the earthworms and lead to a large surface area of vermicompost in SEM images (Lim and Wu, 2016).

Similar results were reported by Bhat *et al.*, (2017) who described that the surface morphology of vermicompost can be obtained from special transformation of the substrate feed mixtures by earthworms, function of microbes and enzymes in the gut regions of earthworms clearly. Similar to our work Thiyageshwari *et al.*, (2018) also observed that SEM images of rice husk epidermis with loose, rugged and lumpy composition due to the decomposition process of *Aspergillus* species on cellulose, hemicellulose, lignin and pectin. As reported previously by Saha *et al.*, (2019) who identified from the SEM microgram the morphology of lemongrass distillation waste biochar changed dramatically with the presence of porous network interconnected macro and micro pores, when compared to the raw compacted lemon grass.

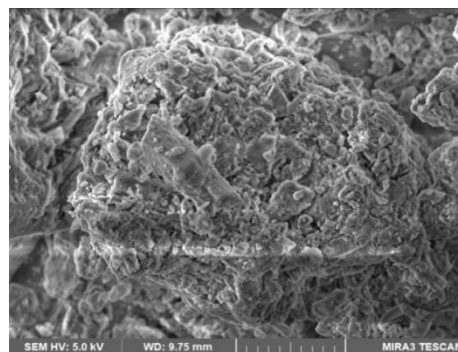
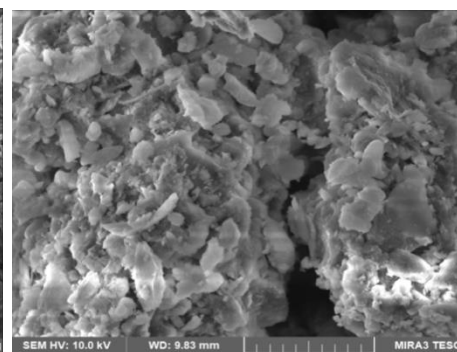
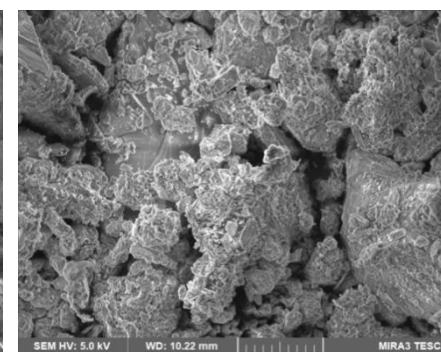
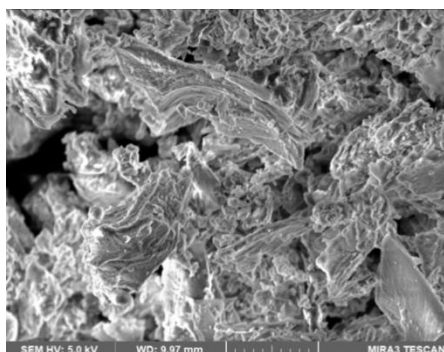
The results were in consistence with Srivastava *et al.*, (2020) who observed initial municipal solid waste mixture with compacted flock structure whereas the vermicompost with porous, fragmented granular structure in SEM image due to the ingestion of earthworm (*Eisenia fetida*), the activity of various enzymes and enteric microbial activities which are present in the gut region of the earthworms. The results are in par with Orta-Guzmán *et al.*, (2021) where the SEM images of Sugar Cane Bagasse (SCB) noted typical fingerprint of cellulose, hemicellulose and lignin compounds which are reduced after the composting. The results coincide with the findings of Quadar *et al.*, (2022) who observed the coconut husk vermicompost samples with higher disintegration, fragmentation and degradation of lignocelluloses, lignin content than of the initial samples through SEM.

Figure - 4

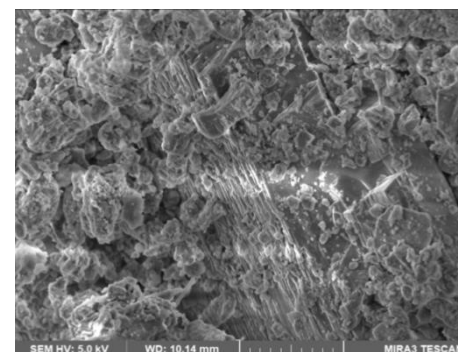
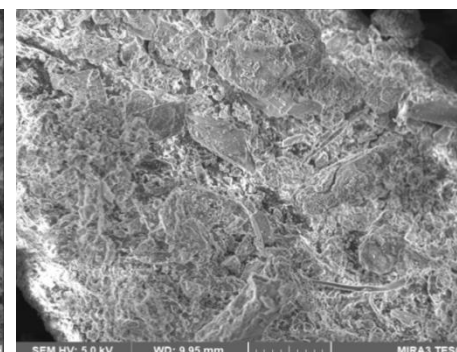
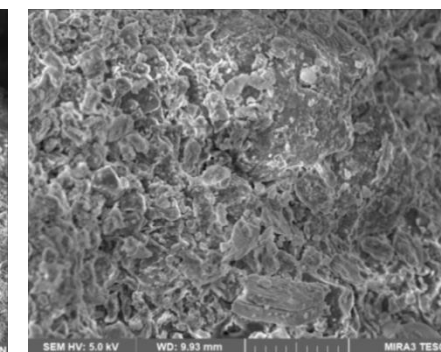
Field Emission Scanning Electron Microscope (FESEM) Images of raw and composted paddy and coffee husk



FESEM image of Paddy husk (Raw sample - 1)

FESEM image of C₁FESEM image of C₂FESEM image of C₃

FESEM image of Coffee husk (Raw sample - 2)

FESEM image of C₄FESEM image of C₅FESEM image of C₆

Sample 1- Raw Paddy husk

C₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

C₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

C₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Sample -2 Raw Coffee husks (silver skin)

C₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

C₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

C₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Similarly Sharma *et al.*, (2023) also observed that the combinations of cattle dung, *Tectona grandis* leaf litter compost increased surface roughness and irregularity in the final compost which demonstrated that the composting process produced high - quality fertilizer with high porosity and readily available nutrients. While the initial compost samples displayed variability and sparse material distribution per unit area with no compaction.

4.1.2.2 Fourier Transform Infrared (FTIR) Spectroscopy analysis of Paddy and Coffee Husk before and after biodegradation under composting conditions

Identification of active functional groups, chemical structure of the organic material degradation and stabilization process of raw paddy and coffee husks as well as all the composts were analyzed with FTIR spectroscopy. The results exhibited the presence of alcohol, nitrocompounds, halo compounds, aromatic compounds, esters and carboxylic acids. The absorption bands in FT-IR spectra is presented in Tables - 2 to 9 and Figures - 5 & 6.

The spectra with peak values, absorption bands and functional groups of raw and composted paddy and coffee husk showed various strong as well as medium stretches of bands.

Table - 2

Absorption bands in FT-IR Spectra of raw Paddy husk

Absorption cm^{-1}	Functional Group	Compound class
3819.06	O-H stretch	Alcohol
3402.43	O-H stretch	Alcohol
1496.76	N-O stretch	Nitro compound
1041.56	S-O stretch	Sulfoxide
771.53	C-H bending	1,2,3 Tri substituted
686.66	C-Br stretch	Halo compound
648.08	C-Br stretch	Halo compound
617.22	C-Br stretch	Halo compound
601.79	C-I stretch	Halo compound
540.07	C-I stretch	Halo compound

The main absorbance of broad band around 3819.06 to 3402.43 cm^{-1} (OH band, OH⁻ groups), a peak at 1496.78 cm^{-1} strong appearance denoted the N-O stretch with

Nitro compounds. A strong peak was also found at 1041.56 cm^{-1} denoted the S-O stretch with sulfoxide compounds. 771.53 cm^{-1} denoted strong appearance of C-H bending 1, 2, 3 Trisubstituted compounds, between 686.66 to 617.22 cm^{-1} strong C-Br stretch was denoted with halo compounds, and between 601.79 to 540.07 cm^{-1} strong appearance of C-I stretch was denoted with halo compounds. The functional groups of spectral peaks are listed in Table-2 and Figure-5.

Table - 3

Absorption bands in FT-IR Spectra of Raw Coffee husk

Absorption cm^{-1}	Functional Group	Compound class
3417	O-H	Alcohol
3379	O-H stretching	alcohol
1636	C=C bending	Alkene
1249.87	C-N bending	Amine
1041	C-O bending	Primary alcohol
1033.85	CO-O-CO bending	anhydride
802	C-C bending	Alkene
686.66 & 679	C-Br stretch	Halocompound
655 & 617.22	C-Br stretch	Halocompound
563	C-Br stretch	Halocompound
540	C-I stretch	Halocompound

Raw coffee husk showed the main absorbance of broad band around 3417 to 3379 cm^{-1} (OH band, OH^- groups), a peak at 1636 cm^{-1} medium appearance denoted the C=C bending with alkene compounds. A strong peak was also found at 1041 cm^{-1} denoted the C-O stretch with primary alcohol compounds. 802 cm^{-1} denoted medium appearance of C-C bending alkene compounds, between 679 to 563 cm^{-1} strong C-Br and C-I stretch was denoted with halo compounds. The presence of functional groups spectral peaks are listed in Table-3 and Figure-6.

Biocompost 1 (C₁): C₁ represents broad band at 3873.06 , 3826.77 and 3711.04 cm^{-1} is due to three O-H bending which are caused by the presence of alcohol. The peak at

3016.67 cm^{-1} is due to the stretching vibration of C-H found in Alkane, C=O bending at 1789.94 cm^{-1} was attributed to Acid halide. Nitro compound, Sulfoxide at 1512.19, 1026.13 cm^{-1} respectively. C-H bending at 918.12 and 779.24 cm^{-1} was denoted with 1, 2, 4 Trisubstituted compounds. C-Br stretching at 686.66, 648.08 & 617.22 cm^{-1} and C-I stretch at 563.21 cm^{-1} were denoted with Halo compounds (Table - 4 & Figure-5).

Table-4

Absorption bands in FT-IR Spectra of Biocompost 1

Absorption cm^{-1}	Functional Group	Compound class
3873.06, 3826.77, 3711.04	O-H	Alcohol
3016.67	C-H stretching	Alkane
1789.94	C=O bending	Acid halide
1512.19	N-O bending	Nitrocompound
1026.13	S=O bending	Sulfoxide
918.12, 779.24	C-H bending	1,2,4 Trisubstituted
686.66, 648.08, 617.22	C-Br stretch	Halocompounds
563.21	C-I stretch	Halocompound

Biocompost 2 (C₂): FTIR spectrum of C₂ biocompost peak at 3865.35, 3826.77 & 3711.04 cm^{-1} were ascribed to the O-H stretching of alcohol. The peaks at 3016.67 & 2840.86 cm^{-1} are due to the vibration of the C-H stretching of alkane. The presence of aromatic compound was confirmed by the peak at 2306.86 cm^{-1} with C-H bending. The peak at 1789.94 cm^{-1} are due to the presence of C=O bending of acid halide and the peak at 1689.64 cm^{-1} confirmed the presence of primary amides with C=N stretching. The presence of nitro compounds in N-O stretching was denoted at 1519.91 cm^{-1} . Carboxylic acid and anhydride were attributed at 1396.46 cm^{-1} and 1041.56 cm^{-1} with O-H and CO-O-CO stretching respectively. The peak at 779.24 cm^{-1} denoted with the group alkene (C=C bending), halo compounds were denoted at the peaks 686.66, 648.08, 617.22, 532.35 & 518.64 cm^{-1} , (C-Br bending) at 563.21 & 540.07 cm^{-1} (C-I bending) (Table - 5 & Figure - 5).

Biocompost 3 (C₃): FT-IR spectrum of biocompost 3 showed a strong peak at 3826.77, 3711.04, and 3464.15 cm^{-1} (O-H bending) which indicated the alcohol. C-H stretching was denoted to alkane at 2978.09 and 2706.81 cm^{-1} . Acid halide (C=O stretching) was found at

1789.44 cm^{-1} , nitro compounds at 1519.91 cm^{-1} , carboxylic acid at 1398.46 cm^{-1} with N-O and O-H stretching. The presence of alkene and anhydride with the bending of C=C, CO-O-CO at 779.24, 1033.85 cm^{-1} . Halo compounds were indicated at 686.66, 648.08 & 617.22 cm^{-1} (C-Br stretching) and 563.21 & 540.07 cm^{-1} (C-I stretching) (Table - 6 & Figure - 5).

Table-5

Absorption bands in FT- IR Spectra of Biocompost 2

Absorption cm^{-1}	Functional Group	Compound class
3865.35, 3826.77 & 3711.04	O-H bending	Alcohol
3016.67 & 2840.86	C-H stretching	Alkane
1789.94	C=O bending	Acid halide
1689.64	C=N bending	Primary amides
1519.91	N-O bending	Nitro compounds
1396.46	O-H bending	Carboxylic acid
1041.56	CO-O-CO bending	Anhydride
779.24	C=C bending	Alkene
686.66, 648.08, 617.22, 532.35 & 518.64	C-Br bending	halocompound
563.21 & 540.07	C-I bending	halocompound

Biocompost 4 (C₄): FTIR spectrum of C₄ denoted with O-H bending at 3826.77 & 3711.04 cm^{-1} indicates the presence of alcohol. The band at 1056.99 cm^{-1} was due to S=O bending representing the presence of sulfoxide. C-H bending at 941.26 cm^{-1} indicate the presence of aromatic compound and C=C bending at 817.82 & 686.66 assigned to alkenes. The peaks at 648.08, 617.22, 578.64 cm^{-1} & 547.78 cm^{-1} (C-Br bending) and 509.21 cm^{-1} (C-I bending) indicating the presence of halo compounds respectively (Table - 7, Figure - 6).

Biocompost 5 (C₅): Biocompost 5 represents strong band at 3811.34 cm^{-1} and 2306.86 cm^{-1} was due to O-H stretching vibrations which are caused by the presence of alcohol. The peak at 1519.91 cm^{-1} is due to the bending of N-O which indicates nitro compounds. C-N stretching at 1288.45 cm^{-1} obtained aromatic amine and C=C stretching was attributed to alkene at 686.66 while the presence of halo compounds were due to the stretching of C-Br at 648.08, 617.22 & 578.64 cm^{-1} and C-I stretching at 509.21 cm^{-1} (Table - 8 & Figure - 6).

Biocompost 6 (C₆): The FTIR spectrum of C₆ showed a broad band at 3417.86 cm⁻¹ due to O-H stretching vibration which is represented by the presence of alcohol. Alkane peaks were represented at 2977.21 cm⁻¹ & 2851.23 cm⁻¹ due to the vibration stretching of C-H bending. Alkene was identified at 995.27 & 941.26 cm⁻¹ with C-C bending. The C-Br stretching at 655.80, 609.51 cm⁻¹ and C-I bending at 563.21, 540.07 cm⁻¹ & 509.21 cm⁻¹ observed halo compounds (Table - 9 & Figure - 6).

Table-6**Absorption bands in FT-IR Spectra of Biocompost 3**

Absorption cm ⁻¹	Functional Group	Compound class
3826.77, 3711.04, 3464.15	O-H bending	Alcohol
2978.09 & 2706.81	C-H stretching	Alkane
1789.44	C=O bending	Acid halide
1519.91	N-O bending	Nitro compounds
1398.46	O-H bending	Carboxylic acid
1033.85	CO-O-CO bending	Anhydride
779.24	C=C bending	Alkene
686.66, 648.08 & 617.22	C-Br bending	Halo compound
563.21 & 540.07	C-I bending	Halo compound

Table - 7**Absorption bands in FT-IR Spectra of Biocompost 4**

Absorption cm ⁻¹	Functional Group	Compound class
3826.77,3711.04	O-H bending	Alcohol
1056.99	S=O bending	Sulfoxide
941.26	C-H bending	Aromatic compound
817.82	C=C bending	Alkene
686.66	C=C bending	Alkene
648.08, 617.22, 578.64 & 547.78	C-Br bending	Halo compounds
509.21	C-I bending	Halo compounds

Table - 8

Absorption bands in FT- IR Spectra of Biocompost 5

Absorption cm^{-1}	Functional Group	Compound class
3811.34 & 2306.86	O-H bending	Alcohol
1519.91	N-O bending	Nitro compound
1288.45	C-N bending	Aromatic Amine
686.66	C=C bending	Alkene
648.08, 617.22 & 578.64	C-Br bending	Halo compounds
509.21	C-I bending	Halo compounds

Table - 9

Absorption bands in FT- IR Spectra of Biocompost 6

Absorption cm^{-1}	Functional Group	Compound class
3417.86	O-H bending	Alcohol
2977.21 & 2851.23	C-H bending	Alkane
995.27 & 941.26	C-C bending	Alkene
655.80, 609.51	C-Br bending	Halo compounds
563.21, 540.07 & 509.21	C-I bending	Halo compounds

These results were in par with that of Baharuddin *et al.*, (2011) who noted the changes in the shredded and pressed - shredded empty fruit bunch with strong bands at the region of 900 -1740 and 2800 to 3400 cm^{-1} . Lim and Wu, (2016) reported that the palm oil mill byproduct vermicompost noted decomposition of carbohydrates, reduction in band height of FT-IR spectra at 3100 - 3600 cm^{-1} region. Similar result was reported by Bhat *et al.*, (2017) who found through FT-IR spectroscopy technique, the reduction in polypeptides, polysaccharides, aliphatic, aromatic, carboxylic, phenolic groups and lignin during vermicomposting process.

The results were in consistence with Khatua *et al.*, (2018) who observed a prominent FT-IR peaks between 3600 and 3100 cm^{-1} that revealed the reduction of polypeptides, poly saccharides and aromatic compounds at the final stage of decomposition process during vermicomposting of banana waste. Similarly Fersi *et al.*, (2019) noted decrease of aliphatic groups, increasing of OH groups and modifications of complex

chemical structures of lignin, cellulose and hemicelluloses of olive mill waste water sludge and coffee grounds compost during FTIR analysis.

Similar to our work Ganguly and Chakraborty, (2019) observed in FTIR spectroscopy that the degradation of primary and secondary paper mill sludge vermicompost with an intense wide bands in between 3200 -3500 cm^{-1} which indicates an –OH stretching of acids, phenols and alcohols functional groups. The results are in par with that of the findings of Saha *et al.*, (2019) who identified the functional groups variability with a broad band at 3500 and 4000 cm^{-1} indicating the presence of aliphatic hydrocarbons and carbonyl groups from the FTIR spectra of lemongrass distillation waste biochar when compared it to the raw compacted lemon grass indicated by highly cross linked network of carboxylic acids.

Similar result was noted by Srivastava *et al.*, (2020) who observed the lessening in peaks at 3387.8 cm^{-1} reflecting decomposition of phenols, carbohydrates due to reduction in OH and CH_2 functional groups in municipal solid waste vermicompost indicating the stability and maturity of the vermicompost. The results were in consistence with Orta-Guzmán *et al.*, (2021) who observed in FTIR spectra analysis of sugarcane agro industrial waste with wide band centered at $\sim 3620 \text{ cm}^{-1}$ corresponding to O-H stretching and at 2917 cm^{-1} appeared with C-H stretching vibration, the signal at ~ 2330 with alkyne groups, which contain the lignin.

The findings corroborate with Quadar *et al.*, (2022) who observed degradation of cellulose, lignin and hemicelluloses at 1612 cm^{-1} of coconut husk and in vermicompost nitrogen rich compost at 1381 cm^{-1} which demonstrated excellent maturity. Similarly Sharma *et al.*, (2023) have observed that combinations of cattle dung and *Tectona grandis* leaf litter compost increased nitrogen-containing compounds and decreased aliphatic, aromatic compounds. The most frequent peaks, between 3500 and 3000 cm^{-1} , were often induced by alcohol or carboxylic acid groups as well as N–H bond stretching. The present findings are in par with that of Pottipati *et al.*, (2023) who studied FTIR spectroscopy and indicated the degradation of vegetable waste vermicompost which displayed an intense wide band in between 3590 and 3650 cm^{-1} that attributed to monomeric alcohols and phenols.

Figure - 5

Absorption bands in FT-IR spectra of raw Paddy husk and Composts 1, 2 and 3

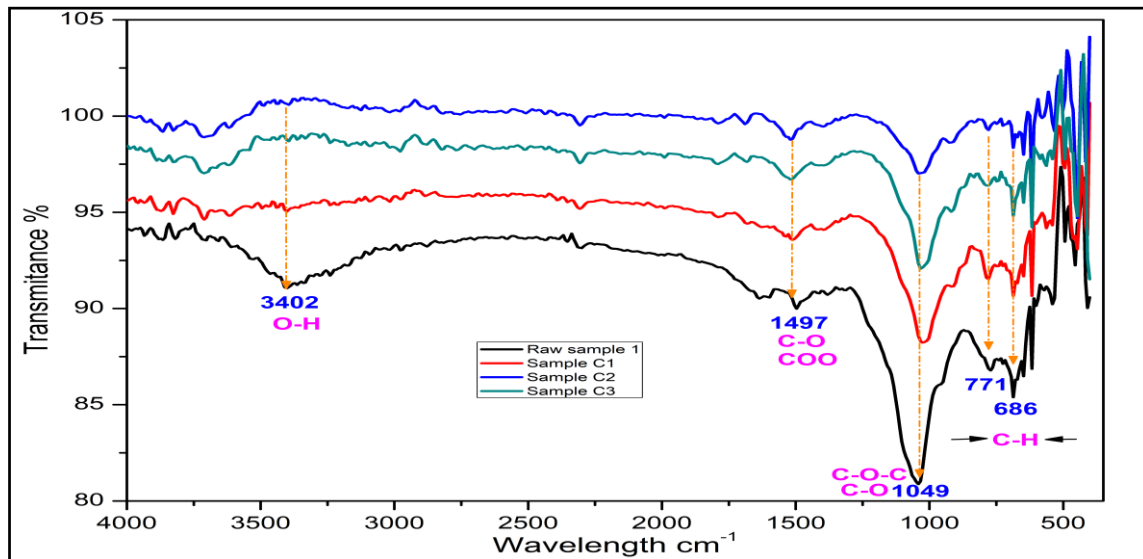
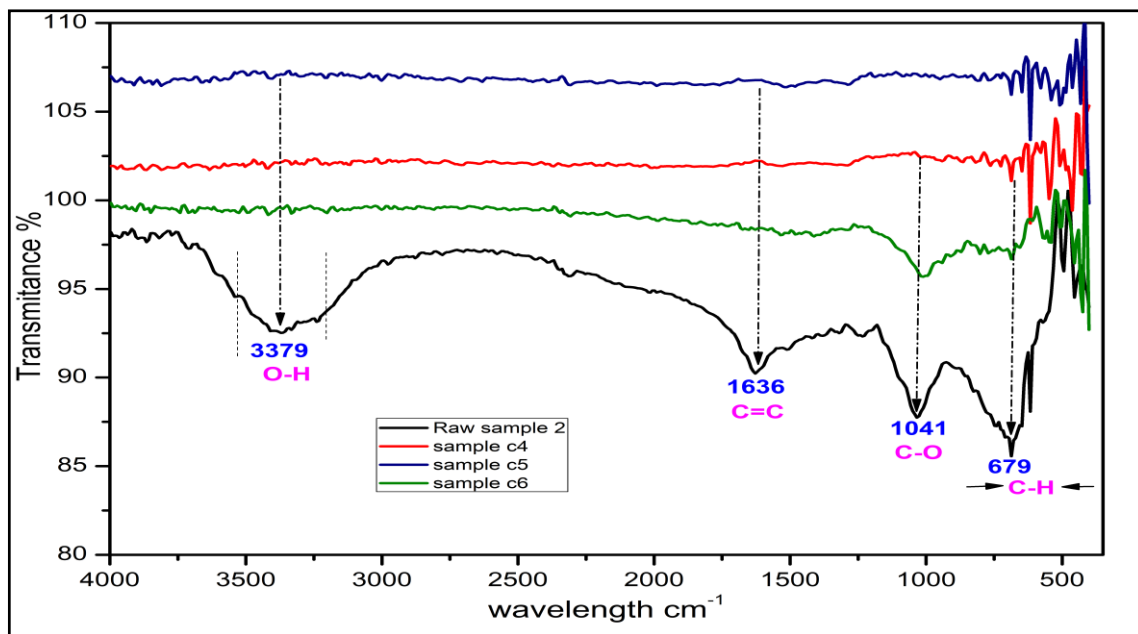


Figure - 6

Absorption bands in FT-IR spectra of raw Coffee husk and Composts 4, 5 and 6



- C₁ - Raw Paddy husk +20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)
 C₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)
 C₃ - Raw Paddy husk + 6.5 g *Pleurotus eous* + 6.5 g *Pleurotus florida* +7g *Trichoderma asperelloides*+*Eisenia fetida* (5t/ha)
 C₄ - Raw Coffee husk +20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)
 C₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)
 C₆ - Raw Coffee husk + 6.5 g *Pleurotus eous* + 6.5 g *Pleurotus florida* +7g *Trichoderma asperelloides*+*Eisenia fetida* (5t/ha)

The results obtained from the study describe the presence of functional groups and declining of respected bands due to degradation of lignin and cellulose molecules. The study revealed that C₆ and C₃ showed significant differences as compared to C₁, C₂, C₄ & C₅ bands. FTIR analysis of raw paddy and coffee husk revealed some common absorption bands and corresponding functional groups like alcohol, alkene, alkane and halo compounds in all the composts. But there were some functional groups like nitro compounds, sulfoxide, aromatic amine, carboxylic acid and anhydride varied from each other. Various organic compounds were present in all the spectra and very few differences were observed in C₃ (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) and C₆ (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha).

These reductions could be due to the decomposition process and decreasing intensity of the long chained polysaccharides by the earthworms, they slowly transform them into other oxygenated compounds such as carboxylic and ester compounds during the vermicomposting process. The raw husks observed contains cellulose and lignin while vermicomposting by consortium of microorganisms resulted in a nitrogen rich compost and degradation of lignin content, showed stabilization, degradation of final product by the earthworms (*Eisenia fetida*) revealed that the compost is matured and less phytotoxic.

4.1.2.3 Physico - Chemical composition of the raw and biocomposted Paddy and Coffee husk

Lignin and Cellulose content

Lignin is an organic polymer and plays vital role in water transport, mechanical support and resistance to various stresses. Cellulose is the most abundant organic polymer on earth. Both of them are major constituents of the cell wall structures.

Through the technique of vermicomposting, transformation has occurred in the organic waste to usable agricultural amendments. The present investigation revealed that lignin and cellulose contents of raw paddy and coffee husk were 18.20%, 32.80% and 9.60%, 42.50%, it was reduced to 4.10%, 9.00% in C₆ and C₃ of 5.60%, 9.01% as shown in Table-10. Significant decrease was found in compost 6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha).

Table - 10

Physico - Chemical composition of raw samples and composted Paddy and Coffee husk

Physico - Chemical Changes	Raw material		Treatments					
	Raw Paddy Husk	Raw Coffee Husk	C1	C2	C3	C4	C5	C6
Lignin (%)	18.20	9.60	5.80	6.60	5.60	4.80	5.30	4.10
Cellulose (%)	32.80	42.50	9.80	9.32	9.01	12.00	13.00	9.00
pH	6.3	5.7	6.6	6.5	7	6.4	6.8	7.3
EC (dS/m⁻¹)	3.18	2.59	1.77	1.51	1.06	1.43	1.22	1.01
Organic carbon (%)	35.95	44.61	29.3	29.09	28.20	32.01	29.11	28.01
Total N (%)	0.51	0.99	1.09	1.24	2.01	1.35	1.43	2.10
Total P (%)	0.26	0.27	0.35	0.46	0.56	0.46	0.48	0.59
Total K (%)	0.59	2.46	1.28	2.4	2.83	1.33	2.21	2.88
Ca (%)	0.30	0.39	0.54	0.59	0.71	0.65	0.51	0.79
Mg (%)	0.31	0.29	1.60	1.20	2.30	1.50	1.80	2.90
C/N Ratio	70.4:1	45.6:1	26.8:1	23.45:1	14.02:1	23.71:1	20.35:1	13.33:1

C₁ - Raw Paddy husk +20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

C₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

C₃ - Raw Paddy husk + 6.5 g *Pleurotus eous*+ 6.5 g *Pleurotus florida* +7g *Trichoderma asperelloides*+*Eisenia fetida* (5t/ha)

C₄ - Raw Coffee husk +20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

C₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

C₆ - Raw Coffee husk + 6.5 g *Pleurotus eous*+ 6.5 g *Pleurotus florida* +7g *Trichoderma asperelloides*+*Eisenia fetida* (5t/ha)

The results were in consistence with Sen and Chandra, (2007) who found decrease in lignin (26.4%), cellulose (33.8%) and hemicelluloses (8.6%) contents of sugar industry wastes vermicompost at the ratio of 7:1:1:1 with pressmud, trash, bagasse and cowdung mixture. Similar to our results Aira *et al.*, (2006) recorded that earthworms *Eisenia fetida* along with pig slurry, microbial rich substrate has increased the rate of decomposition of cellulose content (0.43 to 0.26%) during vermicomposting process.

The result is in agreement with the findings of Wei *et al.*, (2012) who observed an increasing activity of the enzymes cellulase in later stages (24 weeks of plant biomass compost), hemicellulase mainly a-arabinosidase and b-galactosidase (3 weeks plant biomass compost) due to the local microbial populations adjusting the production of harvested enzymes in response to the accessibility and digestibility of chemically different substances of lignin, cellulose and hemicelluloses.

The results were in par with that of Sarika *et al.*, (2014) who noted degradation of cellulose (55.07 % to 14.79 %) and lignin (39.72 to 28.33 %) due to the activity of mesophilic bacteria, actinomycetes, fungi and protozoa during rotary drum composting of water hyacinth which help in the biodegradation of raw materials and breakdown into easily degradable components sugars and amino acids. The present results are consistent with that of Viji and Neelanarayanan, (2015) who observed significant decrease in cellulose (36.83 to 8.66), hemicelluloses (23.83 to 2.16) lignin (15 to 0.93) in Paddy straw + *Rhizopus oryzae* + *Aspergillus oryzae* + *Aspergillus fumigatus* composting.

The results are in conformity with that of Manu *et al.*, (2017) who observed substantial reduction in lignin (9.86 to 2.11 kg), cellulose (9.22 to 1.45 kg) and hemicelluloses (11.09 to 1.94 kg) during the composting process of mixed waste (food waste + garden waste 1: 2 ratio) in modified drums when compared to the control drum. Similarly Fersi *et al.*, (2019) observed in heap - 3 (H3) a faster degradation of lignin, better decomposition of cellulose (25.28%) during green wastes co-composting with olive mill waste water sludge and coffee grounds when compared to other heaps.

Similar study was reported by Sidelko *et al.*, (2020) who observed the significant decrease in lignin, cellulose and hemicelluloses by 7.11%, 51.02%, 79.76% during the composting with periodical windrows process of sewage sludge, predigested barley straw

and wood chips due to the high temperatures in decomposition of complex hydrocarbon structures. The results were in consistence with Shi *et al.*, (2021) who observed degradation of lignin, cellulose and hemicelluloses in the early stages at high temperatures during corn stalk composting due to the activity of thermophilic bacteria.

Similar to our results Dash *et al.*, (2022) also observed initial cellulose, hemicellulose and lignin content of the rice straw 39.4, 20.4 and 9.3% and reduced significantly to 18.4, 17.8 and 7.2% after inoculated with microbe consortia to the rice straw. The present results are in par with the findings of Saranraj *et al.*, (2022) who observed reduction in lignin (5.40 to 0.96%), cellulose (29.64 to 8.18 %) and hemicelluloses (20.18 to 6.74%) of the market waste composting from initial level to matured state.

Similar to our results Zhou *et al.*, (2023a) reported decreasing trend in lignin (46.2 to 30.7 g kg⁻¹), cellulose (258 to 115 g kg⁻¹) and hemicelluloses (222 to 22.8 g kg⁻¹) during the composting of *Cinnamomum camphora* leaf industrial aromatic plant residues (IAPRs). Similar result was obtained by Zhou *et al.*, (2023b) who observed significant decrease of cellulose, hemicelluloses and lignin during composting of aromatic plant biomasses (APBs), *Cinnamomum camphora* and *Stropharia rugosoannulata*.

Sharp declining of lignin and cellulose content of the wastes were due to the presence of cellulase enzymes released by the microbes present in the compost as well as the gut micro flora of the earthworms. The microorganisms contain enzymes that help in transformation of cellulose to useful reducing sugars. Hence, the decomposition process could be easier and the vermicompost can be used as an excellent source for sustainable crop production as a nutrient rich vermicompost.

pH

Compost maturity is generally analyzed with pH value index. The pH value of raw paddy husk was 6.3 and raw coffee husk of 5.7, as the degradation progress, pH value considered to be changed. The pH value in the compost is an excellent indicator to identify the maturity of compost and tend to reach the neutral pH values. Maximum maturity of compost was recognized in compost - 6 with pH value of 7.3 followed by compost -3 (7).

The results were in consistence with Sen and Chandra, (2009) who reported the changes in pH value from 7.23 to 7.42 of sugar industry waste vermicompost during 60th day. The present results are on par with Baharuddin *et al.*, (2009) who observed that when composting of oil palm empty fruit bunch, pH value increased from 7.8 to 8.0 and later decreased to 7.8 at the final compost. Similarly increase value in pH of paddy and coffee husk waste biocompost was due to the participation of microbial enzymes and the activity of earthworms.

Similar findings are corroborated by Dzung *et al.*, (2013) who observed an increase in pH from raw coffee husk (5.74) to composted coffee husk (7.50). Similar results were observed by Varghese and Prabha, (2014) who noted an increase in pH value from 5.6 to 6.9 during biodegradation process of jackfruit waste into liquid biofertilizer vermish. The present results are in conformity with that of Manu *et al.*, (2017) who observed pH of the mixed waste (food waste + garden waste 1:2 ratio) in modified drum 3 increased from 4.0 to 6.3 due to the degradation of acids and alcoholic compounds along with organic content and production of humic substances during composting process.

Similar observations were made by Khatua *et al.*, (2018) in banana stem waste using *Eisenia fetida* showed the pH value lower than initial level (8.3) in BS1CD1 (1part banana stem waste: 1 part cow dung) of 7.5 and the decrease in pH could be due to the production of CO₂, ammonia, NO₃⁻ and organic acids through microbial decomposition of raw waste during vermicomposting process. The result is in par with Patil *et al.*, (2018) who observed that the pH (6.63 and 6.56) was recorded maximum at 180 days of incubation of coir waste and cow dung. The shift in pH value could be due to effect of the microorganisms along with earthworm *Eudrilus euginae* and *Eisenia fetida* species during the process of vermicomposting. The results werein consistence with Thiyageshwari *et al.*, (2018) who observed that composting of RRH with 2% lignocellulolytic fungus (Raw Rice Husk + *Aspergillus* sp.) increased the pH from initial level to maturation of the compost (7.1 to 7.8) due to the release of ammonia in proteolytic process.

The results are in agreement with that of Ganguly and Chakraborty, (2019) who found a significant change in pH from 6.39 to 8.23 of paper mill primary sludge vermicompost due to the breakdown of fatty acids, precipitation of mineral salts and

complexed humic acids. Srivastava *et al.*, (2020) observed a decrease in the pH of the substrate 7.25 in final vermicomposting as compared to initial substrate of municipal solid waste (8.35). Similar observations were made by Hassan and El-Azeim, (2020) who observed higher pH value (7.9) in plant residue compost compared to the control (7.7).

Similar to our results Kumngen *et al.*, (2023) also observed pH value (5.11 to 6.66) increase in final stage of food waste composting. The present results are similar to that of Pottipati *et al.*, (2023) who assessed the maturity of vegetable waste vermicompost and found a sharp change in initial pH of 5.6 to 8 during vermicomposting. The results were in consistence with Mazumder *et al.*, (2023) who assessed the multimetal contaminant in agricultural soil amended with organic wastes vegetable waste rotary drum compost (VWC), water hyacinth compost (WHC) and *Hydrilla verticillata* Compost (HVC) and found significant change in pH from initial (6.0, 7.8 and 5.23) stage of composting to final phase (6.96, 6.1 and 7.40).

The earthworms are very sensitive to the pH of the substrates. The increase of pH value is due to the earthworm's activity in breaking down the substrates, thus it enhances the available nutrients in the vermicompost. Biological decomposition of organic waste depends on the action of microbes as a reason for the change in pH during composting.

Electrical conductivity

The EC value of raw paddy husk was recorded 3.18 dSm^{-1} and coffee husk recorded 2.59 dSm^{-1} (Table -10) as the composting process was reaching the maturity, the compost 3 EC value decrease from 3.18 to 1.06 dSm^{-1} and compost 6 noted decreasing of EC value from 2.59 to 1.01 dSm^{-1} . EC values were considered to evaluate the amount of nutrients present in the compost and salinity of the organic compounds of the compost.

The present result is similar to the findings of Wang *et al.*, (2017) who observed higher EC values in vermicompost obtained by earthworms *Eisenia fetida* in semi decomposed cow manure ($2,190.00 \text{ dSm}^{-1}$) than the chicken manure ($17,850.00 \text{ dSm}^{-1}$). The present results are in conformity with that of Manu *et al.*, (2017) who observed an increase EC in mixed waste (food waste + garden waste 1:2 ratio) in modified drum 3 due to the decomposition of a fraction of organic matter into mineral salts and ammonium ions during composting process.

The results were similar to that of Patil *et al.*, (2018) who found gradual increase of EC from 0.81 dSm⁻¹ to 1.49 dSm⁻¹ in coir waste composting materials during 30 days to 180 days. Thiyareshwari *et al.*, (2018) recorded slight change in EC (0.25 to 0.27 dSm⁻¹) during composting of raw rice husk with 2% lignocellulolytic fungus (Raw Rice Husk + *Aspergillus* sp.).

The results of declining trend was shown by Ganguly and Chakraborty, (2019) who found the EC values of primary sludge (PS 2.95 to 1.75mS cm⁻¹) and secondary sludge (SS 2.65 to 1.45mS cm⁻¹) of paper mill waste vermicompost. However, Srivastava *et al.*, (2020) observed increase EC from 1.27 to 2.79 mS cm⁻¹ in initial solid municipal waste substrate and final vermicompost. Similar observations were made by Hassan and El-Azeim, (2020) who observed higher EC value (2.20 dSm⁻¹) in plant residue compost compared to the control (1.35 dSm⁻¹). The present results are similar to that of Jarboui *et al.*, (2021) who confirmed the maturity of the food waste compost and fermented extract with high EC (3.24 & 3.12 dSm⁻¹) values.

Similar to our results Libutti *et al.*, (2023) observed difference in EC value of vermicompost (265.0 dSm⁻¹), wood chip biochar (52.0 dSm⁻¹) and vine pruning biochar (249.0 dSm⁻¹). The present findings are on par with that of Kumngen *et al.*, (2023) who observed a change in EC values (4.31 to 3.42 dSm⁻¹) of food waste compost. The present results are similar to that of Mazumder *et al.*, (2023) who assessed the multimetal contaminant in agricultural soil amended with organic wastes (vegetable waste rotary drum compost (VWC), water hyacinth compost (WHC) and *Hydrilla verticillata* compost (HVC) and found significant decrease EC values from initial stage (40.8, 8.4 and 1.88 dSm⁻¹) of composting to final phase (2.03, 4.7 and 1.80 dSm⁻¹).

The decrease in EC was due to the degradation of organic substrate and elevated levels of soluble mineral salts in available forms during the process of vermicomposting. In the thermophilic stage of the composting process, a large amount of organic matter is degraded and nutrients are consumed as the result of high microbial activity. The later stages of composting process lower the temperatures, reduce the microbial activity and induce the accumulation of nutrients in soluble phase, thus EC decreases in the vermicompost.

Organic carbon and C: N ratio

In the present investigation, it is evident that the initial organic carbon content of raw paddy and coffee husk wastes recorded 35.95% and 44.61% which is given in (Table – 10). Use of *Pleurotus eous*, *Pleurotus florida*, *Trichoderma asperelloides* and *Eisenia fetida* decreased the organic carbon in all the composts as compared to control. Maximum decreasing trend of biodegradation in the vermicomposts was observed in compost 6 (28.01%) as compared to all the other compost treatments and raw samples.

The C: N ratio was considered as an important indicator of compost maturity. This parameter was considered to determine the maturity of compost and to define the compost quality. The results as depicted in table - 6 showed significant reduction of C: N ratio by the compost 6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida*(5t/ha) followed by compost 3. The C: N ratio was decreased from raw coffee husk (45.6:1) to compost 6 (13.33:1) followed by raw paddy husk (70.4:1) to compost 3(14.02:1).

This findings are in par with that of Abou El-Magd *et al.*, (2006) who identified the higher C:N ratio of cattle manure (9.67) when compared to poultry manure (7.4). Similar results were reported by Rao, (2007) who noted increase in organic carbon of urban solid waste compost ranging from 20.15% to 24.0% in aerobic method and 21.5 % to 23.25% in anaerobic method in comparison with the control (33.50%). The present results coincide with the results of Baharuddin *et al.*, (2009) who observed an initial C/N ratio of 44.5 % which decreased to 12.8% during composting of oil palm empty fruit bunch. Similar result was observed by Sen and Chandra, (2009) who recorded decrease C/N ratio from 22 to 11 % and total organic carbon from 38 to 32 % during vermicomposting of sugar industry wastes. The results were in par with Singh *et al.*, (2010) who recorded a significant reduction of organic carbon from 19.06 % (pure residue) to 15.17% of peppermint plant extract biocompost.

Similar findings are in conformity with Dzung *et al.*, (2013) who observed a decrease C:N ratio in the composted coffee husk (13.6) when compared to the raw coffee husk (40.02). Similar to these results, a narrowing of organic carbon (50.8 to 28.2%) and C/N ratio (40.02 to 13.6%) was observed by Sekhar *et al.*, (2014) in coffee husk composting.

Similarly Viji and Neelananarayanan, (2015) also observed a significant decrease in total organic carbon (42.53 to 16.07) and C: N ratio (85:1 to 10:1) in paddy straw + *Rhizopus oryzae* + *Aspergillus oryzae* + *Aspergillus fumigatus* compost as compared to raw paddy straw. The present results are in agreement with that of Manu *et al.*, (2017) who reported decrease in C/N ratio below 20 in the mixed waste (food waste + garden waste 1:2 ratio) in modified drum 3 due to the decomposition of a fraction of organic matter into mineral salts and ammonium ions during composting process.

Relatively, decrease of total organic carbon (493g Kg⁻¹ to 332g Kg⁻¹) and C/N ratio (80.03% to 9.07%) was found in the work of Khatua *et al.*, (2018) in banana stem waste vermicompost (BS2CD1). Similar results were observed by Srivastava *et al.*, (2020) who found significant decrease in TOC by 21.70% and C/N ratio (62.53% to 21.6%) in final municipal solid waste vermicompost due to organic matter degradation, mineralization, respiration and assimilation of carbon by the microbes and earthworm activity have led to the decrease in total organic carbon.

Similar observations were made by Hassan and El-Azeim, (2020) who observed a higher C: N ratio (26.50) in plant residue compost compared to the control (24.31). Similarly Jarboui *et al.*, (2021) also observed improvement in TOC (25.60%) and C/N ratio (11.13) in food waste compost. Similar to our results Dash *et al.*, (2022) also observed reduction in C:N ratio of rice straw composting from initial level ranging (60.0 to 67.3%) to 28th day of composting (24.8 to 27.7%) in all the treatments.

Similar findings are confirmed by Kumngen *et al.*, (2023) who noted reduction of C/N ratio (26:1 to 15:1) in food waste compost which shows the maturity of compost. The present results are similar to that of Mazumder *et al.*, (2023) who assessed the multimetal contaminant in agricultural soil amended with organic wastes (vegetable waste rotary drum compost (VWC), water hyacinth compost (WHC) and *Hydrilla verticillata* compost (HVC) and found significant decrease in total carbon from initial (32.50, 39.6 and 49.84 %) stage of composting to final phase (14.44, 40.1 and 22.24%).

Reduction in Organic carbon of the composted paddy and coffee husk might be due to fragmenting action of the micro flora and earthworms that modify the substrate condition, promote the microbial respiration and oxidation of organic matter. Due to the

loss of carbon mainly in the form of CO₂ the carbon content decreased. Thus the improvement of nitrogen and decrease in carbon content lower the C:N ratio. Reduction in the OC content of the vermicompost indicates the mineralization of organic materials present in the paddy and coffee husk as well as proved the effectiveness of the added fungal inoculums and its supplementation in degradation of paddy and coffee husk.

Total Nitrogen, Phosphorus and Potassium

Data presented in table - 10 revealed the total nitrogen content in the end product of all the biocompost was higher than raw samples (0.51, 0.99 %). The maximum increase (0.99 to 2.10 %) was noted in the biocompost (C₆) produced by raw coffee husk pre decomposed by consortium of *Pleurotus eous*, *Pleurotus florida*, *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) followed by the other treatments and raw wastes.

The total phosphorus content showed an increasing trend in paddy and coffee husk waste during biodegradation. Highest content (0.59 & 0.56 %) was observed in compost 6 and 3 as compared to raw paddy (0.26 %) and coffee husk (0.27 %) samples.

It is evident from Table - 10 that the initial total potassium content showed an increasing trend in biodegradation of all the composts with significant increase in total potassium content of 2.83 % & 2.88% during decomposition of paddy and coffee husk in C₃ and C₆ against raw samples (0.59 & 2.46%).

These findings confirm the previous observation made by Abou El-Magd *et al.*, (2006) who identified the difference in poultry (2.64, 1.80 & 2.37%) and cattle manure (1.22, 0.30 & 2.90%) NPK values. The present results are in accordance with Singh *et al.*, (2010) who observed a drastic increase in N (2.9, 2.5 & 2.0%), P (0.35, 0.20 & 0.16%) and K (2.95, 2.52 & 2.18%) in 1:3,1:1 and 3:1 treatment ratio of *Mentha piperita* residue biocompost than that of the initial value (1.1,0.10 and 1.08%).

Similar findings are corroborated by Dzung *et al.*, (2013) who observed an increase in N P K (1.27, 0.06 & 2.46%) of raw coffee husk to composted coffee husk (2.07, 0.55 & 2.87%). Similar increase in N (1.27 to 2.07%), P (0.06 to 0.55%) and K (2.46 to 2.87%) was found in the work of Sekhar *et al.*, (2014) during 3 months of composting of coffee husk. Similarly Viji and Neelananarayanan, (2015) also observed a

significant increase in total nitrogen (0.5 to 1.55%), total phosphorus (0.02 to 1.48%) and total potassium (0.76 to 1.57%) of paddy straw + *Rhizopus oryzae* + *Aspergillus oryzae* + *Aspergillus fumigatus* composting as compared to raw paddy straw.

The results were in par with Guo *et al.*, (2015) who observed that N, P, K in before compost (1.87, 0.240 & 0.523%) decrease after the vermicomposting (1.63, 0.248 & 0.503%) with the amendments of maize, cattle manure and *Eisenia fetida*. Similar to present results Thiyageshwari *et al.*, (2018) observed increase in nitrogen content from 0.34% to 1.10%, P of 0.29 to 0.96% and K of 0.44% to 1.24% in rice husk vermicompost amended with *Aspergillus* sp. from day 15 to 90 days of decomposition. Khatua *et al.*, (2018) recorded increase of total nitrogen, phosphorus and potassium (38.87, 5.49 and 16.34 g kg⁻¹) on 60th day of banana stem waste vermicompost using *Eisenia fetida* when compared to control (1.81, 0.68 & 5.62 g kg⁻¹).

Similar results were obtained by Quadar *et al.*, (2022) who observed increase in nitrogen content from initial level (42.97%) to final level (92.74%) in coconut husk vermicompost. The present results are similar to that of Mazumder *et al.*, (2023) who assessed the multimetal contaminant in agricultural soil amended with organic wastes vegetable waste Rotary Drum Compost (VWC), Water Hyacinth Compost (WHC) and *Hydrilla verticillata* compost (HVC) and found increase of N P K from initial stage of composting to final phase.

The increase in Nitrogen, Phosphorus and Potassium content during vermicomposting are due to the composted paddy and coffee husk which constitutes important macro as well as micro nutrients and earthworms used in the process that have greater impact on the nitrogen transformation in manure by enhancing the mineralization. Increase in phosphorus is due to the direct action of worm gut enzymes and indirect stimulation of microorganisms. During biocomposting process soil aggregation is increased and release organic acids which in turn improves the mineral availability.

Calcium and Magnesium

Table - 10 depicted that when comparing to Calcium and Magnesium content of raw paddy husk (0.30 & 0.31%) and coffee husk (0.39 & 0.29%), composted paddy and coffee

husk showed maximum content in C1 to C6 treatments. Appreciable increase in Calcium and Magnesium was recorded at C₆ (0.79 % & 2.73 %) followed by C₃ (0.71 & 2.30%).

The increase in the calcium and magnesium content might be due to the mineralization of the organic matter present in paddy and coffee husks by the inoculating the specific decomposing microorganisms which secrete various degrading enzymes. When organic waste passes through the digestion track of the earthworm, it transforms the organic matter gets enriched by nutrition.

The results were on par with Cifuentes *et al.*, (2013) who reported an increase in total calcium (0.20 to 29%) and magnesium content from 0.08% to 38% during composting trials in which bagasse was substituted with sugarcane waste in the mixture with pressmud over 140 days. Similar findings are corroborated by Dzung *et al.*, (2013) who observed an increase in Ca and Mg of the composted coffee husk (0.77 & 1.01%) as compared to raw coffee husk (0.37 & 0.42%).

The present findings are supported by the findings of Sekhar *et al.*, (2014) who observed increase in calcium (0.37 to 0.77 %) and magnesium (0.42 to 1.01%) content of coffee husk compost. The present result is similar to the findings of Wang *et al.*, (2017) who observed total Ca & Mg values higher in vermicompost obtained from earthworms *Eisenia fetida* in semi decomposed cow manure (25.10 & 2.92 g/kg) than the chicken manure (7.22 & 2.03 g/kg).

Similar results were observed by Khatua *et al.*, (2018) who recorded an increase in Ca from 0.35 to 2.53 % and Mg from 0.09 to 2.18% in banana stem composting. The results coincide with Mahmud *et al.*, (2020) who observed an increase of calcium (0.85 to 1.39 %) and magnesium (0.18 to 0.58%) of vermicompost when compared to no fertilizer (control).

The present results are similar to that of Mazumder *et al.*, (2023) who assessed the multimetal contaminant in agricultural soil amended with organic wastes (vegetable waste rotary drum compost (VWC), water hyacinth compost (WHC) and *Hydrilla verticillata* compost (HVC) showed significant increase in Ca (6.13, 2.12, 10.02 %) and Mg (7.35, 6.01, 6.45%) from initial stage of composting to final phase (8.1, 5.34, 7.23%) and (7.79, 5.32, 6.28%).

Consortium of *Pleurotus eous*, *Pleurotus florida*, *Trichoderma asperelloides* mixed with coffee husk and paddy husk could be utilized as vermicompost employing earthworm species *Eisenia fetida*. Microbial population, enrichment of N, P & K contents as well as decrease in the total organic carbon, C/N ratio, degradation of cellulose, lignin depicted the maturity and stability of the final product. The application of biocompost has lead to an increase in soil pH, a reduction in EC and an increase in N, P& K levels due to the release of alkaline substances, improvement in soil structure and stimulation of microbial activity.

The FT-IR spectroscopic studies supported the stability and maturity of the end product reflected by the reduction in readily degradable polysaccharides, aliphatic compounds and increase in aromatic functional groups. FESEM images revealed the larger surface areas and much flakier structure of final vermicompost due to the activity of earthworms and microorganisms used in the biocomposting process.

PHASE -II

4.2 Cultivation of the plants (Pot culture experiments)

Pot culture experiment was carried out with moth bean (*Vigna aconitifolia* (Jacq.) Marechal) Var. RMO - 40, black gram (*Vigna mungo* (L.) Hepper) Var. CO- 6, fenugreek (*Trigonella foenum-graecum* L.) Var.Lam Selection - 1. Kalmegh (*Andrographis paniculata* (Burm.f.) Nees) Var. CIM - Megha as the test crops to study the efficiency of paddy and coffee husk vermicompost with six different types of biocompost treatments. They were named as T₁ - Raw paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha), T₂ - Raw paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha), T₃ - Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha), T₄ - Raw coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha), T₅ - Raw coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha), T₆ - Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha). The impact of biocompost on test plants were compared against the control (without manures).

A number of biometric observations, biochemical analysis, yield parameters, leghaemoglobin content, antioxidants activity, antibacterial zone of inhibition and phytochemical analysis of the test plants were recorded at different stages during the growth of moth bean (*Vigna aconitifolia* (Jacq.) Marechal) Var. RMO - 40, black gram (*Vigna mungo* (L.) Hepper) Var. CO - 6, fenugreek (*Trigonella foenum-graecum* L.) Var. Lam Selection – 1, Kalmegh (*Andrographis paniculata* (Burm.f.) Nees) Var. CIM - Megha as influenced by different treatments at different time intervals of 20, 40, 60 and 90 DAS (moth bean, black gram, fenugreek), 30, 60, 90 and 120 DAS (Kalmegh) were statistically scrutinized and the results were presented in this Phase - II.

4.2.1 BIOMETRIC CHARACTERS

4.2.1.1 Effect of paddy and coffee husk biocompost on the vegetative characters of selected test plants

4.2.1.1.1 Root length

Moth Bean (*Vigna aconitifolia* (Jacq.) Marechal) Var. RMO- 40

Gradual increase was recorded in root length from 20 to 60 DAS in all the treatments (T1 to T6) as presented in Table - 11 and Plate - 9. A significant increase in root length was noted in all the treatments when compared to the control among all the treatments maximum increase in root length was recorded in T6 (8.5 cm), T3 (7.1cm) on 20 DAS, T6 (12.9 cm), T3 (12.2 cm) on 40 DAS and T6 (16.1 cm), T3 (15.8 cm) on 60 DAS when compared to control (3.9, 9.7 and 12.4 cm).

Black gram (*Vigna mungo* (L.) Hepper) Var. CO - 6

The root length was significantly increased in T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) followed by T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) and T5 (Raw coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha) on 20 DAS (7.9, 6.1, 5.2 cm), 40 DAS (12.2, 11.3, 9.9 cm) and 60 DAS (16.5, 15.6, 13.9 cm) as compared to the control (3.1, 7.3, 11.6 cm) shown in Table – 12 & Plate -10.

Fenugreek (*Trigonella foenum-graecum* L.) Var. Lam Selection - 1

The treatments T6 – (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha), T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) showed an increase in root length on 20 DAS (5.1, 4.7 cm), 40 DAS (11.1 cm, 10.0 cm) and 60 DAS (14.9 cm, 14.0 cm). Lowest root length was obtained in Control (2.9 cm, 8.1 cm, 11.5 cm) as compared to the other treatments as shown in Table -13 & Plate – 11.

Kalmegh (*Andrographis paniculata* (Burm.f.) Nees) Var. CIM- Megha

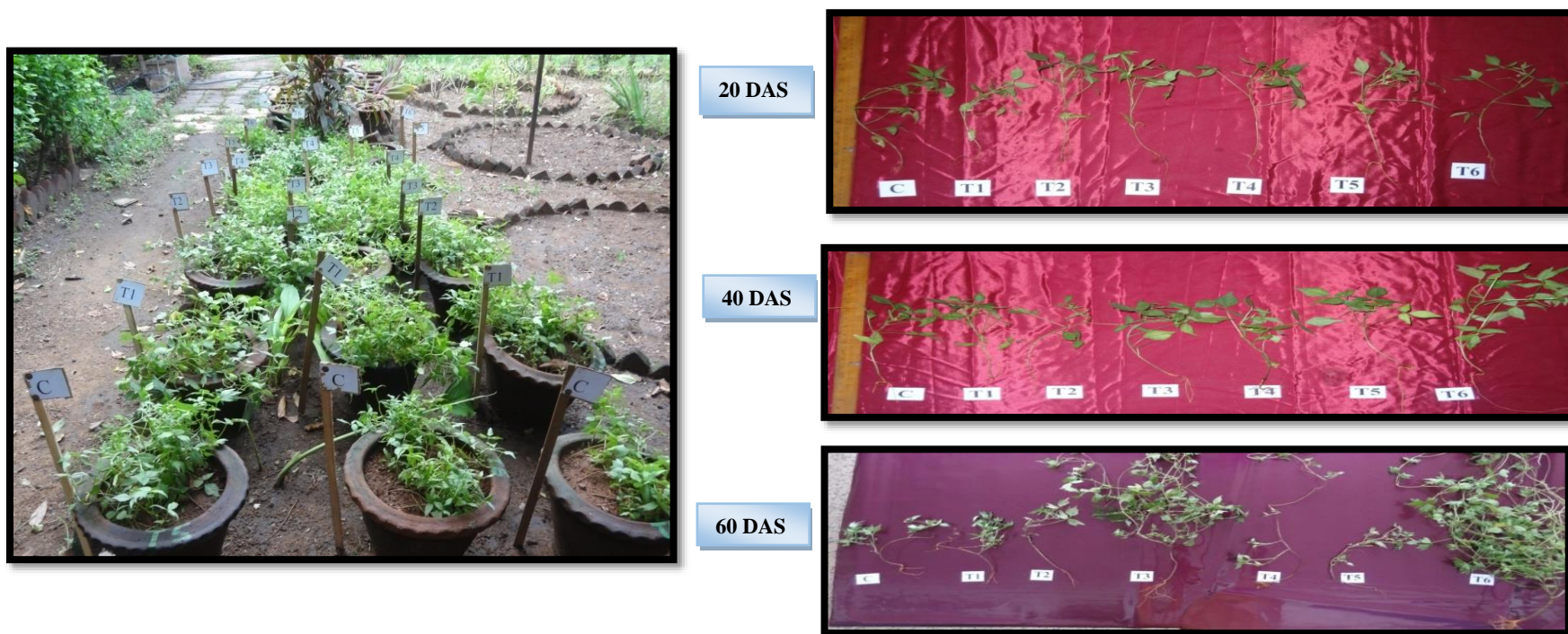
There was an increase in root length from 30 to 90 DAS in all the treatments (from T1 to T6) as shown in Table - 14 and Plate - 12. The treatment T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha), T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) showed significant increase in root length on 30 DAS (7.2, 7.0 cm), 60 DAS (9.3, 8.9 cm) and 90 DAS (13.9, 13.7 cm) with lowest root length observed in Control (3.8, 6.0 and 11.0 cm).

The results are in agreement with that of Ashwini and Sridhar, (2006) who revealed that the application of farm yard manure and areca compost increased the root length (15.1cm) in finger millet over areca compost alone (13.5 cm). The present findings are in conformity with that of Gobi and Gunasekaran, (2012) who found a significant increase in root length (5.36 cm) in black gram over the control (3.2 cm) after the application of vermicompost (pressmud, saw dust and *Lampito mauritii*). Similar result was observed by Prakash and Hemalatha, (2013) who reported that application of plant growth promoting *Rhizobacteria*, press mud vermicompost with *Eisenia fetida* increased the root length of 24.9 cm as compared to the control (22 cm) on 90th day in black gram.

The results are in par with Varghese and Prabha, (2014) who revealed that the application of jackfruit waste (*Artocarpus heterophyllus*) + cow dung in 3:1 ratio and *Eudrilus eugeniae* vermiwash increased the root length (9 cm) over control (3 cm) in *Capsicum frutescens*. The present findings are in conformity with the results of Kannahi and Ramya, (2015) who reported that the application of biofertilizer (*Azospirillum*) on the seedling of *Lycopersicum esculentum* enhanced the root length (10.11 cm) over the control (4.05 cm).

Plate - 9

Influence of paddy and coffee husk as organic manure on the vegetative parameters of moth bean
(*Vigna aconitifolia* (Jacq.) Marechal) Var. RMO - 40. (20 - 60 DAS)



C- Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Table - 11

**Influence of paddy and coffee husk as organic manure on the vegetative parameters of moth bean
(*Vigna aconitifolia* (Jacq.) Marechal) Var.RMO - 40**

Treatments	Root Length (cm)			Shoot Length (cm)			Number of Leaves			Number of Nodules		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
C	3.9	9.7	12.4	9.2	19.5	27.2	7.00	11.00	21.00	5.00	10.00	3.00
T1	5.5	10.5	13.2	13.1	22.1	33.4	8.00	13.00	26.00	7.00	13.00	5.00
T2	5.8	11.3	14.1	11.9	24.4	32.9	8.14	12.00	24.00	8.00	14.00	6.00
T3	7.1	12.2	15.8	14.9	29.2	41.0	9.00	16.00	45.00	10.00	19.00	8.00
T4	4.7	11.4	14.6	14.3	20.9	34.1	7.11	13.00	25.00	8.00	15.00	5.00
T5	6.2	11.9	15.0	13.7	23.9	40.2	8.40	14.00	27.00	9.00	16.00	7.00
T6	8.5	12.9	16.1	15.2	30.3	43.2	11.00	18.00	49.00	12.00	20.00	9.00
SEd	0.343			0.395			0.400			0.441		
CD (p<0.05)	0.693			0.798			0.808			0.891		
CD (p<0.01)	0.927**			1.067**			1.080**			1.192**		

** Significant at 1% (p<0.01) DAS- Days After Sowing)

C- Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Plate - 10

Influence of paddy and coffee husk as organic manure on the vegetative parameters of black gram
(*Vigna mungo* (L.) Hepper Var. CO - 6. (20 - 60 DAS))



20 DAS



40 DAS



60 DAS



C- Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Table - 12
Influence of paddy and coffee husk as organic manure on the vegetative parameters of black gram
(*Vigna mungo* (L.) Hepper) Var. CO – 6

Treatments	Root Length (cm)			Shoot Length (cm)			Number of Leaves			Number of Nodules		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
C	3.1	7.3	11.6	8.2	18.6	24.9	10.00	20.00	29.00	4.00	11.00	9.00
T1	4.7	9.7	13.3	10.5	19.7	25.2	12.00	23.00	30.00	6.00	19.00	12.00
T2	4.2	9.5	13.4	10.2	20.8	26.9	11.00	24.00	32.00	7.00	17.00	11.00
T3	6.1	11.3	15.6	11.1	25.2	29.1	17.00	32.00	39.00	9.00	25.00	15.00
T4	4.3	8.6	12.7	9.9	19.1	27.5	13.00	22.00	30.00	5.00	18.00	10.00
T5	5.2	9.9	13.9	10.9	21.1	27.8	14.00	25.00	33.00	8.00	20.00	13.00
T6	7.9	12.2	16.5	11.8	25.8	30.7	19.00	37.00	41.00	10.00	30.00	17.00
SEd	0.018			0.178			0.441			0.208		
CD (p<0.05)	0.037			0.361			0.891			0.421		
CD (p<0.01)	0.050**			0.483**			1.193**			0.563**		

** Significant at 1% (p<0.01) DAS- Days After Sowing)

C- Control

T1 - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T2 - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T3 - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T4 - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T5 - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Plate - 11

Influence of paddy and coffee husk as organic manure on the vegetative parameters of fenugreek
 (*Trigonella foenum-graecum* L.)Var. Lam Selection - 1. (20 - 60 DAS)



C- Control

T1 - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T2 - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T3 - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T4 - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T5 - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Table - 13
Influence of paddy and coffee husk as organic manure on the vegetative parameters of fenugreek
(*Trigonella foenum-graecum* L.) Var. Lam Selection - 1.

Treatments	Root Length (cm)			Shoot Length (cm)			Number of Leaves			Number of Nodules		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
C	2.9	8.1	11.5	5.4	7.8	16.0	7.00	15.00	22.00	6.00	11.00	7.00
T1	3.4	9.1	12.1	8.5	10.7	17.8	11.00	17.00	26.00	7.00	13.00	8.00
T2	3.2	8.6	12.9	6.3	11.8	18.3	10.00	18.00	29.00	8.00	15.00	10.00
T3	4.7	10.0	14.0	10.0	15.8	23.0	13.00	21.00	32.00	12.00	19.00	13.00
T4	3.6	8.7	12.3	6.5	10.6	19.9	11.00	19.00	28.00	9.00	16.00	11.00
T5	3.7	9.4	13.1	8.9	12.2	20.0	12.00	20.00	30.00	10.00	18.00	12.00
T6	5.1	11.1	14.9	10.5	17.4	25.0	15.00	23.00	35.00	14.00	29.00	16.00
SEd	0.186			0.164			0.018			0.186		
CD (p<0.05)	0.377			0.332			0.037			0.377		
CD (p<0.01)	0.505**			0.444**			0.049**			0.505**		

** Significant at 1% (p<0.01) DAS- Days After Sowing)

C- Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Plate - 12

Influence of paddy and coffee husk as organic manure on the vegetative parameters of kalmegh
(*Andrographis paniculata* (Burm.f.) Nees) Var. CIM - Megha (30, 60 & 90 DAS)



C- Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Table - 14
Influence of paddy and coffee husk as organic manure on the vegetative parameters of kalmegh
(*Andrographis paniculata* (Burm.f.) Nees) Var. CIM - Megha

Treatments	Root Length (cm)			Shoot Length (cm)			Number of Leaves		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
C	3.8	6.0	11.0	5.4	10.6	17.0	10.00	20.00	35.00
T1	4.2	7.2	12.0	8.1	12.1	20.2	12.00	23.00	42.00
T2	4.7	7.5	12.3	7.3	11.8	19.4	11.00	27.00	44.00
T3	7.0	8.9	13.7	9.9	15.3	25.9	14.00	35.00	87.00
T4	4.1	7.6	12.2	7.9	13.2	21.0	12.00	29.00	42.00
T5	5.1	7.9	12.5	8.3	13.6	23.1	13.00	30.00	51.00
T6	7.2	9.3	13.9	10.2	16.9	27.0	17.00	41.00	90.00
SEd	0.180			0.192			0.185		
CD (p<0.05)	0.364			0.389`			0.374		
CD (p<0.01)	0.488**			0.520**			0.501**		

** Significant at 1% (p<0.01) DAS- Days After Sowing)

C- Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

The results are in agreement with Ramya *et al.*, (2015) that the application of seaweed liquid (1.5%) extract of *Stoechospermum marginatum* to brinjal plant enhanced the root length (15.25 cm) over the control (12.25 cm).

Similar results were obtained by Beykkhormizi *et al.*, (2016) who noted that the application of vermicompost (75%) under saline (40 mmol l⁻¹ NaCl) conditions showed higher root length (60100 mm) in *Phaseolus vulgaris*. Similar to our results Sivasankari, (2016) recorded highest root length (25.7 cm) of *Vigna unguiculata* (L.) in the treatment 3 (sand+ red soil 1:1+ 50% vermicompost + 50% NPK).

Baliah and Muthulakshmi, (2017) has reported that application of vermicompost + *Pseudomonas fluorescens* has increased the root length (25.00 cm) over control (12.00 cm) in *Abelmoschus esculentus*. Similar results were observed by Ali and Kashem, (2018) that application of T3 - 392-330-150-133-8-5 kg ha⁻¹ of urea – TSP - MoP Gypsum - Zinc sulphate - Solubor boron (BFRG-2012) + vermicompost (5 t ha⁻¹) significantly increased the root length (25.75 cm) as compared to the vermicompost alone (17.33 cm) in cabbage.

The results were in consistence with Mazumder *et al.*, (2023) who assessed the growth of *Solanum lycopersicum* plant on multimetal contaminant agricultural soil amended with 35% of organic wastes (vegetable waste rotary drum compost (VWC), water hyacinth compost (WHC) and *Hydrilla verticillata* compost (HVC) with significant increase in root length in VWC (28.25 cm) and the lowest root length was observed in WHC and HVC (8.50 and 8.55cm). The present findings are in conformity with the results of Kumngen *et al.*, (2023) who recorded highest root length (21.83 ± 0.83 cm) in lettuce (*Lactuca sativa* Var. Crispa L.) on treatment 10% BA compost (food waste compost supplied by BIOAXEL Co., Ltd) + 90% soil.

Similarly present results are in agreement with that of Rahman *et al.*, (2024) who reported an increase in root length (56.00 cm) and root diameter (5.67 cm) in tomato plants with the application of compost (consistintg of saw dust, kitchen garbage, rice straw and cow dung in equal proportions) supplemented with 300 g of wheat grain colonized *Trichoderma*.

4.2.1.1.2 Shoot length

Moth Bean (*Vigna aconitifolia* (Jacq.) Marechal) Var. RMO - 40

The shoot length of the plant significantly increased as the plant grow among all the treatments, T6 (Raw coffee husk +6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha), T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) noted highest shoot length on 20 DAS (15.2 and 14.9 cm), on 40 DAS (30.3, 29.2 cm) and on 60 DAS (43.2, 41.0 cm). Lowest shoot lengths were observed in control (9.2, 19.5 and 27.2 cm) on 20, 40 and 60 days after sowing (Table - 11).

Black gram (*Vigna mungo* (L.) Hepper) Var. CO- 6

A significant increase in shoot length was recorded from 20 to 60 DAS in all the treatments when compared to control (Table - 12). Among all the treatments, a significant increase in shoot length of 11.8 cm was registered in T6, 11.1 cm in T3 on 20 DAS, 25.8 cm in T6, 25.2 cm in T3 on 40 DAS, 30.7 cm in T6, 29.1 cm in T3 on 60 DAS when compared to the control (8.2, 18.6 and 24.9 cm).

Fenugreek (*Trigonella foenum-graecum* L.) Var. Lam Selection - 1

An increase in shoot length was observed from 20 to 60 DAS in all the treatments when compared to control as shown in Table- 13. Among the treatments, a significant increase in shoot length of 10.5 cm was noted in T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha), 10.0 cm in T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) and 8.9 cm in T5 (Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha) on 20 DAS, 17.4 cm in T6, 15.8 cm in T3 and 12.2 cm in T5 on 40 DAS, 25.0 cm in T6, 23.0 cm in T3 and 20.0 cm in T5 on 60 DAS with lowest shoot length was observed in control treatment (5.4, 7.8 and 16.0 cm) on 20, 40 and 60 Days after sowing respectively.

Kalmegh (*Andrographis paniculata* (Burm.f.) Nees) Var. CIM-Megha

Significant shoot length was noted in T6 (10.2, 16.9 and 27.0 cm), T3 (9.9, 15.3 and 25.9 cm) followed by T5 (8.3, 13.6 and 23.1 cm) on 30, 60 and 90 DAS when compared to Control (5.4, 10.6 and 17.0 cm) as shown in Table-14.

The results are in consonance with those reported by Zaman *et al.*, (2015) who observed highest plant height of 105 cm in stevia when applied with vermicompost @ 7.5t ha⁻¹ in acid soil. Similar to our results Sivasankari, (2016) recorded significant shoot length (47.2 cm) of *Vigna unguiculata* (L.) in the treatment 3 (sand + red soil 1:1 + 50% vermicompost + 50% NPK).

The present results coincide with Canatoy, (2018) who observed that the application of full RRIF (recommended rate of inorganic fertilizer) + 1 ton vermicompost ha⁻¹ influenced the plant height of sweet corn at 20 DAS (44.58 cm) over control (37.48 cm). The results were positively correlated with the findings of Gul *et al.*, (2019) who revealed that combined application of urea 95 g + *Rhizobium japonicum* 2.5g enhanced the maximum plant height (87.6 cm) in cluster bean. Similarly Kiran, (2019) observed that the application of 5% vermicompost increased shoot length of lettuce (*Lactuca sativa* var. *crispa*) than the control under drought stress conditions. Similar results were observed by Singh *et al.*, (2019) the application of municipal solid waste vermicompost (75% VC + 25% sodic soil) improved the plant height (37.44 cm) when compared to other treatments in mango ginger (*Curcuma amada* Roxb.).

Similar to these results Yassen *et al.*, (2020) observed that foliar application of vermicompost at 4 ton fed⁻¹ + Vermiwash 150ml/ L (15%) foliar application showed significant plant height (38.11cm) in lettuce. The results were positively correlated with the findings of Jarboui *et al.*, (2021) who reported that the application of food waste compost and fermented extract with 100% soil when irrigated significantly increased the plant stem height of *Pisum sativum* (16.55 cm), *Cicer arietinum* (12.75 cm) and *Vicia faba* (18.22 cm).

The results are in agreement with the results of Palia *et al.*, (2021) who recorded maximum plant height (61.21 cm) was noted with the application of 20 tonnes of farm yard manure + 5 tonnes of poultry manure on brinjal (*Solanum melongena* L.). Similar results were observed by Orta-Guzmán *et al.*, (2021) who recorded that sugarcane bagase (SCB) substrate influenced the growth of the plant (29.17 cm) on 20 days after transplantation in the cultivation of tomato (*Solanum lycopersicum*).

The results are in agreement with that of Voko *et al.*, (2022) who recorded that increase in shoot length (33 cm) with the application of seaweed extract Kelpak ® (KEL 0.6%) in cowpea plant. The results coincide with that of Libutti *et al.*, (2023) who observed that application of vermicompost to the soil both alone and in a mixture with biochar from vine prunings interestingly increased the plant height (13.6, 13.2 & 14.4 cm) & leaf area (5.2, 3.8 & 4.5 m² m⁻²) of leafy vegetable (*Beta vulgaris* L.).

Similar to our results Arrijani and Setyawati, (2023) also observed that the addition of cocopeat (50%) concentration in the growing media on papaya seeds have increased the plant height (29.5 cm) at the age of 2 months after planting. The results are on par with Aydi *et al.*, (2023) who noted that melon plants when cultivated on date palm trunk compost as organic substrate showed significant shoot length (368.6 cm) on 5 months old.

The results were in consistence with Mazumder *et al.*, (2023) who assessed the growth of *Solanum lycopersicum* plant on multi metal contaminant agricultural soil amended with 35% of organic wastes (vegetable waste rotary drum compost (VWC), water hyacinth compost (WH C) and *Hydrilla verticillata* compost (HVC) highest shoot length was observed in VWC (62.77) whereas WHC and HVC showed 57.97 and 17.37cm. When 10% (food waste) BA compost + 90% soil was applied on the growth of lettuce (*Lactuca sativa* Var Crispa L.), enhanced the plant length (30.00 ± 1.00 cm) as reported by Kumngen *et al.*, (2023).

The results are in agreement with that of Chau and Dien, (2024) who recorded an increase in plant height (25.0 cm) with the application of spent coffee waste, cow manure, alone mushroom residue and rice husk as amendment for spinach.

Similar to our results Al - Tawarah *et al.*, (2024) also observed that the inclusion of 100% vermicompost (VC 100%) has increased the plant height (85.33 cm) in common beans. Resembling results were noted by Hanyabui *et al.*, (2024) that the application of pineapple waste biochar at a rate of 10 t ha⁻¹ along with compost at the same rate has increased the plant height (102.75 cm) in pineapple plants.

4.2.1.1.3 Number of Leaves

Moth Bean (*Vigna aconitifolia* (Jacq.) Marechal) Var. RMO - 40

An appreciable increase in the number of leaves/plant was recorded in all the treatments (T1 to T6) from 20 to 60 DAS as shown in Table - 11. A substantial increase in the number of leaves/plant were recorded in T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha), T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) and T5 (Raw coffee husk +20g *Pleurotus florida* + *Eisenia fetida* (5t/ha) on 20 DAS (11.00, 9.00, 8.40), on 40 DAS (18.00, 16.00, 14.00). On 60 DAS, maximum number of leaves were observed in T6 (49.00), T3 (45.00) followed by T5 (27.00) respectively. Lowest number of leaves were noted in control on 20 (7.00), 40 (11.00) and 60 (21.00) DAS.

Black gram (*Vigna mungo* (L.) Hepper) Var. CO - 6

Maximum number of leaves were recorded in T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha), T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) followed by T5 (Raw coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha) on 20 DAS (19.00, 17.00, 14.00), 40 DAS (37.00, 32.00, 25.00) and 60 DAS (41.00, 39.00, 33.00). Minimum number of leaves were noted in Control on 20 (10.00), 40 (20.00) and 60 (29.00) DAS as shown in Table-12.

Fenugreek (*Trigonella foenum-graecum* L.) Var. Lam Selection - 1

Significant effect of the compost was seen in all the treatments (T1 to T6) from 20 to 60 DAS as recorded in Table - 13. Significant increase in number of leaves were recorded by T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha), T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) on 20 DAS (15.00, 13.00) on 40 DAS (23.00, 21.00) respectively on 60 DAS (35.00, 32.00) when compared to control (7.00, 15.00, 22.00) in above sampling days.

Kalmegh (*Andrographis paniculata* (Burm.f.) Nees) Var. CIM - Megha

There was significant increase in number of leaves/plant in all the treatments and on 30 DAS, maximum number of leaves were reported in treatment T6 (17.00), T3 (14.00) followed by T5 (13.00), 60 DAS (41.00, 35.00, 30.00) and on 90 DAS (90.00, 87.00, 51.00) when compared to control (10, 20, 35) respectively (Table-14).

The results agree with those of Sanjutha *et al.*, (2008) who discovered that applying farmyard manure @15 t/ha = NPK @75:75:50Kg ha + panchgavya @ 3 % foliar spray, enhanced the number of leaves (105.67) in *Andrographis paniculata*. The results are similar to that of Manivannan *et al.*, (2009) who observed that treatment with 50% vermicompost and 50% NPK on clay loam soil showed the maximum number of leaves (208) in beans. Huerta *et al.*, (2010) similarly recognized that the application of 50% *Panicum sp* grass + 50% cocoa husks vermicompost (V) enhanced number of leaves (20.6) in amashito pepper (*Capsicum annum var. glabriusculum*).

Joshi and Vig, (2010) revealed that treatment VC 45 (45% vermicompost + soil) significantly increased the number of leaves (120) in *Lycopersicum esculentum*. Similar result was supported by Kasthuri *et al.*, (2011) who observed an increase in number of leaves (27) with mixture of municipal solid waste compost (MSWC) amendments, 250g + garden soil 5kg in the plant fenugreek.

The findings are in conformity with that of Jayanthi *et al.*, (2014) who observed that vermicompost @ 7.5t ha⁻¹ application enhanced the number of leaves (181) on 60 days after planting in stevia plant. Similar findings have been supported by Varghese and Prabha, (2014) who reported that application of jackfruit waste (*Artocarpus heterophyllus*) + cow dung in 3:1 ratio and *Eudrilus eugeniae* vermiwash increased the leaves (20) in *Capsicum frutescens*. Our results were similar with that of Kannahi and Ramya, (2015) who showed a substantial increase in number of leaves (20.3) of *Lycopersicum esculentum* with the application of Biofertilizer (*Azospirillum*).

Similar findings were corroborated by Olle, (2016) who observed an increase in the number of leaves (54.3) of tomato plant with the application of 25% vermicompost, peat, gravel and concrete block. The results are in agreement with a previous work of Mahmud *et al.*, (2020) who reported that the application of vermicompost (10 t/ha)

increased the number of leaves (44) of ex vitro MD2 pineapple plants than other treatments. Yassen *et al.*, (2020) also recorded that the foliar application of vermiwash (4 ton fed⁻¹ + Vermiwash 150 ml/ L foliar application) enhanced the number of leaves (44.67), leaf area (290 mm²) and fresh matter of leaves (425.58 g /plant) in lettuce plant.

Similar to our results Jarboui *et al.*, (2021) observed that application of food waste compost and fermented extract with 100% soil when irrigated significantly increased the number of leaves of *Pisum sativum* (12/plant), *Cicer arietinum* (63/plant) and *Vicia faba* (32/plant). Similar results were observed by Arrijani and Setyawati, (2023) that in addition of cocopeat (50%) to the growing media of papaya seeds significantly increased the number of leaves (8.0) at the age of 2 months after planting. The results are on par with that of Aydi *et al.*, (2023) who noted that melon plants when cultivated on date palm trunk compost as organic substrate showed maximum number of leaves (50.76) on 5 months old.

The results were in consistence with Mazumder *et al.*, (2023) who assessed the multimetal contaminant in agricultural soil when amended with 100% of organic wastes (vegetable waste rotary drum compost (VWC), water hyacinth compost (WHC) and *Hydrilla verticillata* compost (HVC) on the growth *Solanum lycopersicum* plant and noted enhanced number of leaves /plant (66.00, 65.00 and 25.00). Application of (food waste compost supplied by BIOAXEL Co., Ltd) 10% BA compost + 90% soil was applied on the growth of lettuce (*Lactuca sativa* Var. Crispa L.) reported the maximum number of leaves (23.33 ± 1.15 leaves) (Kumngen *et al.*, 2023).

Similar to our results Calapardo and Bryl, (2024) observed that application of garden soil along with rice hulls and vermicompost has increased the number of leaves (104.83 at 45 days) in stevia. Similar outcomes were observed by Umeh *et al.*, (2024) that addition of poultry manure, rice husk, compost and cow dung has increased the number of leaves (30) in okra plants.

4.2.1.1.4 Number of Nodules

Moth bean (*Vigna aconitifolia* (Jacq.) Marechal) Var. RMO - 40

Among all the treatments, maximum number of nodules per plant was observed in treatment T6 (12.00) and treatment T3 (10.00) on 20 DAS, T6 (20.00), T3 (19.00) on

40 DAS and on 60 DAS (9.00, 8.00) in comparison with control (5.00, 10.00, 3.00) (Table - 11).

Black gram (*Vigna mungo* (L.) Hepper) Var. CO - 6

Number of nodules showed a significant increase up to 40 DAS and decreased gradually on 60 DAS. Maximum number of nodules were recorded in T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha), T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) and T5 (Raw coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha) on 20 DAS (10.00, 9.00, 8.00), 40 DAS (30.00, 25.00, 20.00) and gradual decrease in number of nodules was noted on 60 DAS (17.00, 15.00, 13.00) as compared to the Control (4.00, 11.00, 9.00) (Table -12).

Fenugreek (*Trigonella foenum-graecum* L.) Var. Lam Selection - 1

Significant increase in number of nodules up to 40 DAS after that it was declined in all the treatments as depicted in Table - 13. Maximum number of nodules were recorded in T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha), (14.00, 29.00) T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *P. florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) (12.00, 19.00) on 20 and 40 DAS with gradual decrease to 16.00, 13.00 on 60 DAS and least was noted in control (6.00, 11.00, 7.00) respectively.

The results are in correlation with that of Krouma and Abdelly, (2003) who observed that application of nutrient solution on soyabean plants increased the number of nodules as well as proved iron as an essential element for leghaemoglobin biosynthesis that transported oxygen within cells in the nodule.

Similar to our results Sivasankari, (2016) recorded high number of nodules (62.2) in *Vigna unguiculata* (L.) with treatment 3 (sand+ red soil 1:1 + 50% vermicompost + 50% NPK. These findings are similar to previous studies of Hasan *et al.*, (2021) who reported that nodule number and weight of the nodules was affected by the inorganic and organic fertilizer (N₃₀ + P₆₀ kg ha⁻¹) in bambara groundnut (*Vigna subterranean*). The present finding is in accordance with the result of Yadav *et al.*, (2017) who

confirmed significantly higher number of nodules (40.73/plant) in the treatment of vermicompost 2 t ha⁻¹ in chickpea (*Cicer arietinum* L.). Similar to our results Verma *et al.*, (2017) recorded maximum number of root nodules (14.95) in fenugreek with the application of vermicompost 4 t ha⁻¹.

The results are also in close conformity with the findings of Silpa and Vijayalakshmi, (2022) who recorded maximum number of nodules (14, 21.20 and 11.34) in jackfruit peel vermicompost T8 (Raw jackfruit peel + 10g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5 t/ha⁻¹) in *Vigna unguiculata* (L.) Walp on 25, 35 and 45 days after sowing.

The present finding is in accordance with the result of Pandey *et al.*, (2022) who recorded significant nodule number (25.67) with combined application of 10 ton/ha⁻¹ farm yard manure + 10 ton/ha⁻¹ vermicompost in green gram [*Phaseolus radiata* L.]. Similarly Khan *et al.*, (2022) recorded maximum number of nodules in chickpea with the integrated application of normal animal manure with half di-ammonium phosphate (DAP).

The results are in correlation with that of Karthiya and Vijayalakshmi, (2023) who observed an increase of root nodules (8.6, 14.0 and 4.6) in 20 kg soil + 100g (Toddy palm shells + microbial consortium + *Eisenia fetida* in cluster bean.

The result is in par with Joshi *et al.*, (2023) who observed that application of vermicompost at 6.0 t/ha enhanced the nodule number (32.8) in urd bean. The result is in par with that of Van Chuong, (2023) who observed that application of NPK + chicken manure 6t CM/ha + *Rhizobium* sp enhanced number of nodules (92.9) and weight of dry nodules (0.831g) in peanut.

4.2.1.1.5 Fresh weight and Dry weight of the whole plant

Moth bean (*Vigna aconitifolia* (Jacq.) Marechal) Var. RMO - 40

Application of the compost with microbial consortium significantly increased the fresh weight and dry weight of the whole plants in all the treatments (T1-T6).

A significant increase in fresh weight was noted in T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha), T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) and T5 (Raw coffee husk + 20g *Pleurotus florida* +

Eisenia fetida (5t/ha) on 20 DAS (4.83, 4.11, 3.93 g), on 40 DAS (8.98, 7.99, 7.61 g) and 60 DAS (15.47, 14.97, 13.41 g) as compared to the Control (2.97, 6.02, 10.79 g) as shown in Table - 15.

The highest dry weight content was registered in the treatment T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha), followed by T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) and T5 (Raw coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha) on 20 DAS (1.11, 0.99, 0.73 g), 40 DAS (3.56, 3.32, 2.50 g) and 60 DAS (4.37, 4.19, 4.03 g) over Control (0.45, 2.14, 3.09 g) respectively.

Table - 15

Influence of paddy and coffee husk as organic manure on the fresh weight and dry weight of whole plant of moth bean (*Vigna aconitifolia* (Jacq.) Marechal) Var. RMO - 40

Treatments	Fresh weight (g)			Dry Weight (g)		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
C	2.97	6.02	10.79	0.45	2.14	3.09
T1	3.54	6.85	11.34	0.54	2.32	3.74
T2	3.74	7.01	12.53	0.69	2.25	4.01
T3	4.11	7.99	14.97	0.99	3.32	4.19
T4	3.71	6.76	12.25	0.53	2.42	4.00
T5	3.93	7.61	13.41	0.73	2.50	4.03
T6	4.83	8.98	15.47	1.11	3.56	4.37
SEd	0.394			0.368		
CD (p<0.05)	0.796			0.744		
CD (p<0.01)	1.064**			0.995**		

** Significant at 1% (p<0.01) DAS- Days After Sowing)

C - Control

T1 - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T2 - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T3 - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T4 - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T5 - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Black gram (*Vigna mungo* (L.) Hepper) Var. CO - 6

A remarkable increase in the fresh weight on 20 DAS was registered in the treatment T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) (2.77g), T3 - Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) (1.99g) followed by T5 (Raw coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha) (1.71g), on 40 DAS (7.37, 6.16, 6.01g) and 60 DAS (15.39, 15.20, 13.19 g) as compared to Control (1.10, 4.01, 10.97 g).

Table - 16

Influence of paddy and coffee husk as organic manure on the fresh weight and dry weight of whole plant of black gram (*Vigna mungo* (L.) Hepper) Var. CO - 6

Treatments	Fresh weight (g)			Dry Weight (g)		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
C	1.10	4.01	10.97	0.19	2.01	3.07
T1	1.52	5.06	12.14	0.24	2.30	4.02
T2	1.51	5.17	12.09	0.28	2.15	4.00
T3	1.99	6.16	15.20	0.49	3.07	5.06
T4	1.66	5.39	12.13	0.20	2.09	4.01
T5	1.71	6.01	13.19	0.29	2.31	4.03
T6	2.77	7.37	15.39	0.52	3.67	5.73
SEd	0.193			0.075		
CD (p<0.05)	0.391			0.152		
CD(p<0.01)	0.523**			0.203**		

** Significant at 1% (p<0.01) DAS- Days After Sowing)

C - Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

The maximum dry weight was observed in treatment T6 followed by T3 and T5 on 20 DAS (0.52, 0.49, 0.29 g), on 40 DAS (3.67, 3.07, 2.31 g) and on 60 DAS (5.73, 5.06, 4.03 g) (Table-16). The lowest dry weight content was observed in Control (0.19, 2.01, 3.07 g).

Table - 17

Influence of paddy and coffee husk as organic manure on the fresh weight and dry weight of whole plant of fenugreek (*Trigonella foenum-graecum* L.) Var. Lam Selection -1

Treatments	Fresh weight (g)			Dry Weight (g)		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
C	0.87	2.01	5.31	0.29	1.08	2.00
T1	1.05	3.91	6.29	0.32	1.27	2.88
T2	1.61	3.13	5.77	0.34	1.49	2.93
T3	1.89	4.00	7.73	0.42	1.97	3.02
T4	1.03	3.11	6.18	0.31	1.32	2.34
T5	1.13	3.18	6.08	0.37	1.35	2.81
T6	1.97	4.21	7.92	0.55	2.93	4.87
SEd	0.147			0.176		
CD (p<0.05)	0.297			0.357		
CD(p<0.01)	0.397**			0.477**		

** Significant at 1% (p<0.01) DAS- Days After Sowing)

C - Control

T1 - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T2 - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T3 - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T4 - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T5 - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Fenugreek (*Trigonella foenum-graecum* L.) Var. Lam Selection - 1

Maximum fresh and dry weight of the plant was observed from 20 to 60 DAS in all the treatments (T1 to T6) as shown in Table - 17. Plant fresh weight significantly increased in T6 on 20 DAS (1.97 g), 40 DAS (4.21 g) and 60 DAS (7.92 g) followed by T3 on 20 DAS (1.89 g), 40 DAS (4.00 g) and 60 DAS (7.73 g) when compared to the

Control (0.87, 2.01, 5.31 g). Maximum dry weight was noted in T6 (0.55, 2.93, 4.87 g) followed by T3 (0.42, 1.97, 3.02 g) when compared to Control (0.29, 1.08, 2.00 g) on 20, 40, 60 DAS respectively.

Table - 18

Influence of paddy and coffee husk as organic manure on the Fresh weight and dry weight of whole plant of kalmegh (*Andrographis paniculata* (Burm.f.) Nees) Var. CIM - Megha

Treatments	Fresh weight (g)			Dry Weight (g)		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
C	1.31	6.09	9.31	0.39	1.11	1.41
T1	1.79	7.63	10.62	0.59	1.53	2.72
T2	1.73	7.32	11.36	0.61	1.57	2.27
T3	3.11	9.71	14.77	1.31	1.94	3.53
T4	1.92	7.61	10.77	0.94	1.71	2.21
T5	2.12	8.22	11.97	0.82	1.65	2.95
T6	4.81	10.92	16.89	1.61	2.23	3.76
SEd	0.201			0.030		
CD (p<0.05)	0.405			0.061		
CD (p<0.01)	0.542**			0.081**		

** Significant at 1% (p<0.01) DAS- Days After Sowing)

C - Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Kalmegh (*Andrographis paniculata* (Burm.f.) Nees) Var. CIM - Megha

Maximum fresh weight was registered in treatment T6 on 30 DAS (4.81 g), on 60 DAS (10.92 g) and 90 DAS (16.89 g), T3 (3.11, 9.71, 14.77 g) followed by T5 (2.12, 8.22, 11.97 g). The minimum fresh weight content was observed in control (1.31, 6.09, 9.31 g).

The maximum dry weight content was recorded in T6 (1.61, 2.23, 3.76 g) followed by T3 (1.31, 1.94, 3.53 g) when compared to the control (0.39, 1.11, 1.41 g) on 30, 60, 90 DAS respectively (Table-18).

The present findings are in par with that of Eriksen, (2005) who reported that when soil mixed with 50% cattle manure increased the dry weight of the broccoli leaves (16.04%) when compared with mineral fertilizer application. Wang *et al.*, (2010) reported that application of cow manure vermicompost improved marketable weight of chinese cabbage (*Brassica campestris* ssp. *chinensis*) when compared to the plants grown in control. The findings are in conformity with that of Jayanthi *et al.*, (2014) who observed that vermicompost @ 7.5t ha⁻¹ application enhanced the leaf dry weight (5.95g/plant) of stevia plant.

The result is also on par with that of Bhagat *et al.*, (2016) who observed rice straw mulching @ 6 tonnes/ha + 100% Nitrogen fertilizer on soil has increased the root and shoot fresh weight (9.1 & 97 g/pl) and dry weight (0.7 & 5.8 g/pl) of potato plant. Similar to our results Sivasankari, (2016) recorded high plant fresh (34.81 g) and dry weight (3.42 g) of *Vigna unguiculata* (L.) in the treatment 3 (sand + ressoil 1:1+ 50% vermicompost + 50% NPK).

Saha *et al.*, (2019) reported a remarkable improvement in root and shoot fresh weight (11.6 & 113.3 g) and dry weight (4.3 & 37.4 g) of *Andrographis paniculata* (kalmegh) when treated with lemongrass distillation waste biochar + full dose of recommended fertilizer. The results are positively correlated with that of Hassan and El-Azeim, (2020) who recorded maximum dry weight of the leaves (5.53 g) and fresh weight of the spike (12.92 g) when applied with plant residue compost (15t/fed) + microbein fertilizer + salisylic acid + vitamin C. The result is also on par with Suwanto and Asih, (2021) who identified *Pueraria javanica* legume crop fresh (11.014 g 20 m⁻²) and dry (2.280 g 20 m⁻²) weight was maximum when compared to *Casava mucunoides* (4.979 g 20 m⁻², 1.115 g 20 m⁻²) and *Cassava pubescens* (2.027 g 20 m⁻², 0.476 g 20 m⁻²) at 4 to 10 month after planting (MAP).

Similarly, Jarboui *et al.*, (2021) also observed that fermented food compost extract (1/8 dilution) has improved the fresh weight of the tomato plant (90.06 mg) compared to

control (86.21 mg). The results are in agreement with that of Sarkar *et al.*, (2022) who reported that the application of tea waste treated soil has promoted cowpea [*Vigna unguiculata* (L.) Walp.] stem and root fresh weight (9.76 & 4.61g), dry weight of stem and root (3.01 & 1.38 g).

The present results are in correlation with that of Voko *et al.*, (2022) who reported that application of seaweed extract [Kelpak® (KEL 0.6%) and smoke-water (SW 1:1000 (v/v) on cowpea (*Vigna unguicula*) watered once and thrice-a-week improved plant fresh weight (16.55, 23.99 & 30.30 g) and dry weight (2.78, 4.13 & 5.50 g). The present results are in agreement with that of Arrijani and Setyawati, (2023) who observed that the addition of cocopeat (50%) to the growing media of papaya seeds influenced the wet weight and dry weight (1.65 and 0.75%) of the 2 months old papaya plants. Application of 10% (food waste) BA compost + 90% soil on the growth of lettuce (*Lactuca sativa* Var Crispa L.), enhanced the fresh plant weight (113.03 ± 1.28 g) and dry plant weight (4.58 ± 0.14 g) as reported by Kumngen *et al.*, (2023).

Similarly, Calapardo and Bryl, (2024) also observed that the addition of rice hulls and vermicompost to the garden soil has increased the fresh weight (297.81g) and dry weight (78.61g) in stevia. The present results are in correlation with that of Rahman *et al.*, (2024) who documented that the application of compost (consisting of saw dust, kitchen garbage, rice straw and cow dung in equal proportions) supplemented with 300 g of wheat grain colonized *Trichoderma* has improved the fresh root weight (51.33 g), dry root weight (13.33g), fresh shoot weight (388.0 g) and dry shoot weight (122.7g) in tomato plants.

4.5 Yield parameters of selected plants

4.5.1 Influence of paddy and coffee husk as organic manure on the yield parameters of selected plants

4.5.1.1 Moth bean (*Vigna aconitifolia* (Jacq.) Marechal) Var. RMO - 40 (90 DAS)

The data presented in Table-19 and Plate - 13 revealed that the number of pods per plant, length of pod, number of seeds per pod, weight of seeds per pod, pod fresh weight and pod dry weight were superior in the treatment T6 when compared to other treatments and control on 90 DAS.

Maximum number of pods/plant (27.00), length of pod (5.7 cm), number of seeds/pod (6.10), weight of seeds/pod (2.89 g), pod fresh weight (1.65 g) and dry weight (0.98 g) was observed in T6 treatment as compared to control (15.00, 3.4 cm, 4.00, 2.01 g, 0.98 g, 0.52 g) respectively.

4.5.1.2 Black gram (*Vigna mungo* (L.) Hepper) Var. CO-6

It can be inferred from the Table - 20 & Plate - 13 that the number of pods per plant, length of pod, weight of pod, pod fresh weight and pod dry weight were maximum in treatment T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) on 90 DAS. Maximum number of pods per plant (39.00), length of pod (5.6 cm), number of seeds per pod (5.64), weight of seeds per pod (2.38 g), Pod fresh weight (2.95 g) and pod dry weight (1.19 g) were observed in T6 followed by other treatments when compared to control (29.00, 3.5 cm, 3.00, 1.01 g, 1.22 g, 0.67 g).

4.5.1.3 Fenugreek (*Trigonella foenum-graecum* L.) Var. Lam Selection -1

The highest number of pods per plant (26.00, 25.00), length of pod (5.0, 4.9 cm) number of seeds per pod (6.30,6.00), weight of seeds per pod (1.44,1.32 g), pod fresh weight (1.88, 1.72 g), pod dry weight (1.59, 0.98g) was recorded in T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) followed by T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) over the other treatments and Control (13.00, 3.0 cm, 4.00, 0.79 g, 1.01 g, 0.68 g) on 90 DAS respectively as data presented in Table-21 and Plate - 13

4.5.1.4 Kalmegh (*Andrographis paniculata* (Burm.f.) Nees) Var. CIM-Megha (120 DAS)

The data presented in Table - 22 and Plate - 13 revealed that the number of capsules per plant, length of capsule, number of seeds per capsule, weight of seeds per capsule, capsule fresh weight and capsule dry weight were significantly higher in treatment T6 followed by T3 when compared to other treatments and control on 120 DAS.

The highest number of capsules per plant (43.00, 39.00), length of capsule (2.0, 1.9 cm) number of seeds per capsule (14.00, 13.00), weight of seeds per capsule

(0.09, 0.07g), capsule fresh weight (1.21, 1.17g), capsule dry weight (0.72, 0.68g) was recorded in T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) followed by T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) over the other treatments and Control (30.00, 1.0 cm, 10.00, 0.03 g, 0.57 g, 0.23 g) respectively.

The present findings are in par with that of Eriksen, (2005) who reported that when soil was mixed with poultry manure, the total yield of broccoli (9.63 t/fed) was increased when compared with mineral fertilizer application (6.57 t/fed). The results are in consonance with those reported by Ogunlela *et al.*, (2005) who recorded that the application of cattle manure okra in semiarid and subtropical environment enhanced the yield of green pods.

The results are in par with the observations of Uma and Malathi, (2009) who recognized the application of 200g of vermicompost enhanced the growth of leaves (38.9) and yield (number of seeds 398.7) of *Amaranthus* species. Similar observations were reported by Dutta and Bandyopadhyay, (2009) that the maximum seed yield of 1085 kg/ha was obtained in treatment (Phosphorus 39.3kg/ha + biofertilizers) over control (no P input) in laterite soil under rainfed conditions. Ansari and Kumar, (2010) have observed that the combination of vermicompost and vermivash influenced the yield (69.11 g/plant) with higher response as comparison over control (24.69g /plant) in okra (*Abelmoschus esculentus*).

Similar to our work Joshi and Vig, (2010) observed in tomato plant that the application of vermicompost (Soil + 45% VC) increased the yield (1.2 kg/plant). Our results are in par with that of Hammad *et al.*, (2011) who identified that the combination of *Sesbania aculeata* green manure crop, poultry litter and sewage sludge (GM+PL+SS each @ 10 t /ha) gave maximum productive tillers (230.8), number of grain per spike (49.25) and 1000-grain weight (38.63g) in wheat. Azarpoor *et al.*, (2012) have observed that the highest seed yield (3831 kg/ha/ 65 plants per m²) was observed with the inoculation of nitroxin, 10t/ha vermicompost in soybean. Similar to our results Selvamurugan *et al.*, (2013) reported that the application of bio methanated distillery spent

wash and pressmud biocompost (BDS @ 100 m³ ha⁻¹) enhanced the pod (1774 kg ha⁻¹), grain (1272 kg ha⁻¹) and haulm yield 4668 kg ha⁻¹ respectively in groundnut as compared to recommended NPK as chemical fertilizers.

Similar findings are corroborated by Dzung *et al.*, (2013) who observed the effect of coffee husk biocompost (100% of chemical fertilizer + 3 kg of compost) on the yield of coffee (297.3kg/plot). Similar to our results Jayanthi *et al.*, (2014) has reported a higher yield of chilli (*Capsicum annuum* L.) with the application of vermifertilizer (VF 5 tons/ha) on clay loam soil. The results coincide with Dharani and Sarojini, (2014) who observed that the composting of coirpith using bacteria (*Pseudomonas* and *Streptococci*) and fungi (*Aspergillus* and *Rhizopus*) influenced the growth and productivity of sugarcane plant by 80%. Choudhary *et al.*, (2017) have also observed that application of FYM @ 5 t ha⁻¹ + vermicompost @ 2.5 t ha⁻¹ increased the number of capsules per plant (42.39), number of seeds per capsule (61.31), seed and stalk yield (2405.88 kg/ha) over rest of the treatments in *Sesamum indicum*.

Our results are in agreement with that of Thiyageshwari *et al.*, (2018) who observed that the application of composted rice husk + 50% RDF (recommended dose of fertilizer) + R (*Rhizobium*) + PSB (Phosphobacterium) increased the grain yield (994 kg/ha) of black gram. The present results are corroborated with that of Gul *et al.*, (2019) who recorded that the combined application of urea 75g + *Rhizobium japonicum* 2.5g enhanced the yield (22.3g/p), 1000 seeds weight (30.2g), yield (684.9kg/ha) of cluster bean. Similar findings are reported by Haridha *et al.*, (2020) who identified maximum crop yield of black gram (90.50%) with the application of goat manure and vermicompost (17 t ha⁻¹) on sandy clay loam soil.

The result is also on par with Bordoloi, (2021) who reported application of vermicompost @ 1.0 t/ha + 50% RDF (RDF: N: P₂O₅: K₂O:120: 80: 60 kg/ha) enhanced the yield (132 q/ha) of capsicum. Similar to our results Palia *et al.*, (2021) observed that the application of organic and inorganic fertilizers (20 tonnes farm yard manure + 5 tonnes poultry manure) on brinjal (*Solanum melongena* L.) increased overall vegetative parameters and yield parameters like average fruit weight (262.83g), length of fruit (16.78 cm), diameter of fruit (29.18 cm), fruit per plot (18.90 Kg), fruit per plant

(2.10 Kg) and fruit per hectare (472.67 ton). Similarly Sarkar *et al.*, (2022) also reported that the application of tea waste treated soil promoted cowpea [*Vigna unguiculata* (L.) Walp.] fruit fresh weight (9.86 g) and dry weight (1.83g).

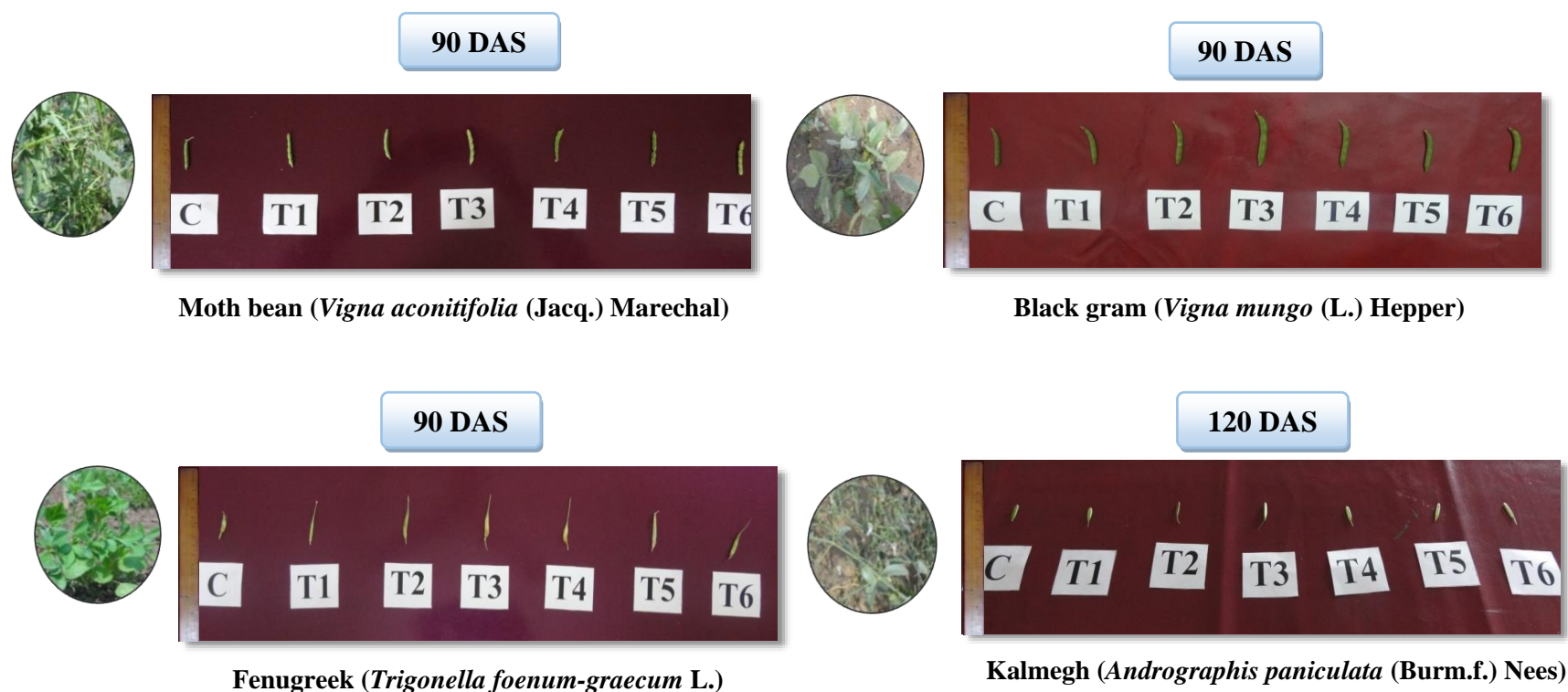
The results are in agreement with that of Libutti *et al.*, (2023) who observed that application of vermicompost alone in the soil increased total yield (2618 g fw m⁻²) followed by biochar from vine prunings + vermicompost (2461 g fw m⁻²) and biochar from wood chips + vermicompost (1898 g fw m⁻²) of leafy vegetable (*Beta vulgaris* L.). The results are on par with that of Aydi *et al.*, (2023) who noted that melon plants when cultivated on coconut fiber as organic substrate showed higher fruit yield (2.83 kg plant⁻¹).

The results were in consistence with Mazumder *et al.*, (2023) who assessed the multimetal contaminant in agricultural soil and noted that 100% of organic wastes (vegetable waste rotary drum compost (VWC), water hyacinth compost (WHC) and *Hydrilla verticillata* compost (HVC) Showed highest yield in VWC (2,987,624 h⁻¹) followed by WHC (947, 368 ha⁻¹) and HVC (4100 ha⁻¹) on the growth *Solanum lycopersicum* plant.

The present results are on par with Umeh *et al.*, (2024) who reported that application of poultry manure, rice husk, compost and cowdung enhanced the number of fruits (4.00) and fruit weight (13.80 g) in okra plants. The results are in agreement with that of Zapalowska and Jarecki, (2024) who observed that application of compost (sewage sludge (90 kg) + saw dust (10 kg) + garden and park waste (100 kg) + earthworms) increased cob length (200.3), thousand grains weight (264 .6 g) and grain yield per plant (52.9 g) in corn plants.

Plate - 13

Influence of paddy and coffee husk as organic manure on the yield parameters of test plants (90 and 120 DAS)



C - Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Table - 19
Influence of paddy and coffee husk as organic manure on the yield parameters of moth bean
(*Vigna aconitifolia* (Jacq.) Marechal) Var. RMO - 40 (90 DAS)

Treatments	Number of pods /Plant	Length of the Pod (cm)	Number of seeds /pod	weight of the seeds/pod (g)	Pod fresh weight (g)	Pod dry weight (g)
C	15.00	3.4	4.00	2.01	0.98	0.52
T1	17.00	4.3	5.00	2.16	1.31	0.66
T2	18.00	4.1	4.64	2.42	1.28	0.84
T3	23.00	5.0	5.23	2.68	1.54	0.94
T4	16.00	3.8	5.01	2.33	1.04	0.71
T5	19.00	4.2	5.04	2.12	1.03	0.63
T6	27.00	5.7	6.10	2.89	1.65	0.98
SEd	0.176	0.635	0.258	0.163	0.138	0.031
CD (p<0.05)	0.384	1.363	0.555	0.350	0.296	0.068
CD (p<0.01)	0.538**	1.891**	0.770**	0.486**	0.411**	0.095**

** Significant at 1% (p<0.01) DAS- Days After Sowing)

C - Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Table - 20
Influence of paddy and coffee husk as organic manure on the yield parameters of black gram
(*Vigna mungo* (L.) Hepper) Var.CO - 6. (90 DAS)

Treatments	Number of pods / Plant	Length of the Pod (cm)	Number of seeds / pod	weight of the seeds/pod (g)	Pod fresh weight (g)	Pod dry weight (g)
C	29.00	3.5	3.00	1.01	1.22	0.67
T1	36.00	4.0	4.00	1.88	1.61	0.83
T2	34.00	3.9	4.67	1.91	1.77	0.90
T3	37.00	5.1	5.21	2.01	2.87	1.10
T4	35.00	4.3	5.01	1.11	1.75	0.81
T5	36.00	4.7	4.25	1.22	1.67	0.72
T6	39.00	5.6	5.64	2.38	2.95	1.19
SEd	0.044	0.317	0.168	0.253	0.193	0.040
CD (p<0.05)	0.094	0.680	0.362	0.543	0.415	0.086
	0.130**	0.944**	0.502**	0.754**	0.576**	0.119**

** Significant at 1% (p<0.01) DAS- Days After Sowing)

C - Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Table - 21
Influence of paddy and coffee husk as organic manure on the yield parameters of fenugreek
(*Trigonella foenum-graecum* L.) Var. Lam Selection - 1. (90 DAS)

Treatments	Number of pods / Plant	Length of the Pod (cm)	Number of seeds / pod	weight of the seeds/pod (g)	Pod fresh weight (g)	Pod dry weight (g)
C	13.00	3.0	4.00	0.79	1.01	0.68
T1	17.00	3.7	5.01	0.84	1.21	0.72
T2	18.00	3.9	5.33	0.87	1.11	0.82
T3	25.00	4.9	6.00	1.32	1.72	0.98
T4	20.00	4.1	5.26	0.81	1.07	0.75
T5	19.00	4.3	4.11	0.92	1.17	0.85
T6	26.00	5.0	6.30	1.44	1.88	1.59
SEd	0.146	0.033	0.254	0.044	0.003	0.174
CD (p<0.05)	0.320	0.071	0.545	0.094	0.008	0.374
CD (p<0.01)	0.448**	0.098**	0.757**	0.130**	0.011**	0.519**

** Significant at 1% (p<0.01) DAS- Days After Sowing)

C - Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Table - 22
Influence of paddy and coffee husk as organic manure on the yield parameters of kalmegh
(*Andrographis paniculata* (Burm.f.) Nees) Var. CIM - Megha (120 DAS)

Treatments	Number of capsules / Plant	Length of the capsule (cm)	Number of seeds / capsule	weight of the seeds/capsule (g)	Capsule fresh weight (g)	Capsule dry weight(g)
C	30.00	1.0	10.00	0.03	0.57	0.23
T1	34.00	1.4	11.83	0.04	0.88	0.43
T2	35.00	1.5	12.00	0.03	0.77	0.47
T3	39.00	1.9	13.00	0.07	1.17	0.68
T4	33.00	1.7	12.01	0.04	0.66	0.38
T5	35.00	1.8	12.41	0.03	0.84	0.48
T6	43.00	2.0	14.00	0.09	1.21	0.72
SEd	0.176	0.239	0.296	0.003	0.032	0.029
CD (p<0.05)	0.384	0.512	0.634	0.006	0.070	0.062
CD (p<0.01)	0.538**	0.711**	0.881**	0.009**	0.097**	0.086**

** Significant at 1% (p<0.01) DAS- Days After Sowing)

C - Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Al- Tawarah *et al.*, (2024) have observed highest number of pods per plant (93.33), pod weight (15.92 g), seed weight (1.061 g) and the number of seeds per pod (13) in common beans with the inclusion of 100% vermicompost (VC 100%).

The effect of paddy and coffee husk biocompost has influenced, enriched all the vegetative and yield parameters of moth bean, black gram, fenugreek and kalmegh. The enrichment may be due to the uptake of micro and macro nutrients present in the vermicompost. The microbes and earthworms are the major contributors for the production of plant growth hormones like IAA, gibberellins and cytokinins and other plant hormones (PHRs) i.e., humates as the byproducts and are involved indirectly in the increase of root and stem length. Increased plant height and root length might be due to the stimulation of auxin like substances which are produced during vermicompost consumption by the plant.

The vermicompost is a major contributor of micro and macronutrients to soil, enriched certain metabolites and vitamins that help in plant growth because the vegetative stage of the plant requires a lot of macro and micro nutrients, so, it is clear that vermicompost constitutes a promising alternative to provide nutrients in promoting plant growth, specially root length, shoot length and number of leaves with the help of nitrogen, iron which are directly involved in the boosting of photosynthesis.

Vermicompost is a finely - divided peat - like material and when this fine structure are added to the plant potting media, it causes significant changes in the physical properties by altering water and air availability in the substrates, conditioning root growth. The macro nutrients like Nitrogen, Phosphorus and Potassium are the key components to hold out growth and yield in plants, they boost various functions which are essential for structural strength, crop quality and seed production in the plants. Due to the above reasons, it has been reported that microbes and earthworms may be important agents capable of influencing the production of plant growth regulators.

In the present investigation among biocompost treatments taken for the study, T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) and T3 - Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) has

exhibited enhanced growth characteristics, yield parameters when compared to other treatments and control. This significant influence on growth characters and yield parameters might be due to the uptake of available nutrients and the microbial populations which would have boosted along with the addition of paddy and coffee husk biocompost and the increase in total chlorophyll content in plants like moth bean, black gram, fenugreek and kalmegh when applied with paddy and coffee husk biocompost has lead to the enhanced photosynthesis. Chlorophyll is crucial for capturing light energy, which is then used in the process of photosynthesis to produce carbohydrates. This combination of increased chlorophyll content and nutrient availability has contributed to the enhancement of yield in crops like Moth bean, Black gram, Fenugreek, and Kalmegh.

PHASE - III

4.3 Biochemical Characters

4.3.1 Influence of paddy and coffee husk as organic manure on protein content in the leaves of cultivated test crops

4.3.1.1 Moth bean (*Vigna aconitifolia* (Jacq.) Marechal)

As shown in Figure - 7, among different treatment combinations T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) was numerically found to be better than the rest of the treatments at different intervals on 20 DAS (47.02 mg/g tissue), 40 DAS (62.68 mg/g tissue), 60 DAS (57.14 mg/g tissue) followed by T3 - Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) (45.66, 60.35, 54.29 mg/g tissue) whereas the Control gave the lowest protein content in leaves (21.94, 38.53, 30.14 mg/g tissue).

4.3.1.2 Black gram (*Vigna mungo* (L.) Hepper)

As shown in Figure - 8. Among all the treatments, T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) and T3 - Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*,

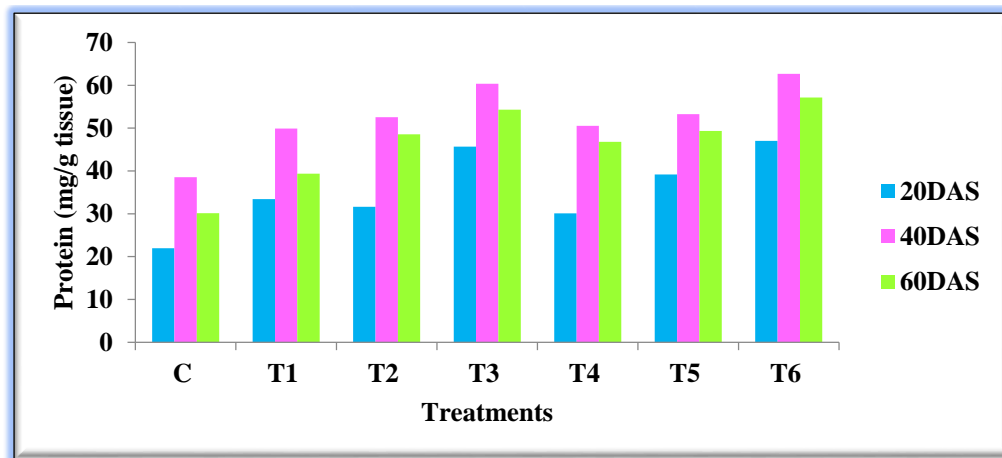
7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) followed by T5 (Raw coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha) showed the highest protein content on 20 DAS (43.38, 37.41, 33.42 mg/g tissue), on 40 DAS (69.97, 65.71, 59.99 mg/g tissue) and slight decrease in its content was noted on 60 DAS (55.76, 53.63, 49.99 mg/g tissue) over control (20.51, 49.99, 35.09 mg/g tissue).

4.3.1.3 Fenugreek (*Trigonella foenum-graecum* L.)

Among all the treatments, T6 - compost 6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) registered maximum protein content of 39.44 mg/g tissue (20 DAS) and 58.73 mg/g tissue (40 DAS) and gradual decrease of 50.71 mg/g tissue (60 DAS) followed by T3 - Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 35.45, 55.22 and 45.44 mg/g tissue on 20, 40 and 60 DAS over the Control (22.90, 36.13, 30.17 mg/g tissue) as shown in Figure – 9.

Figure - 7

Influence of paddy and coffee husk as organic manure on protein content in the leaves of moth bean (*Vigna aconitifolia* (Jacq.) Marechal)



C- Control

T1 - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T2 - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T3 - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T4 - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T5 - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Figure - 8

Influence of paddy and coffee husk as organic manure on protein content in the leaves of black gram (*Vigna mungo* (L.) Hepper)

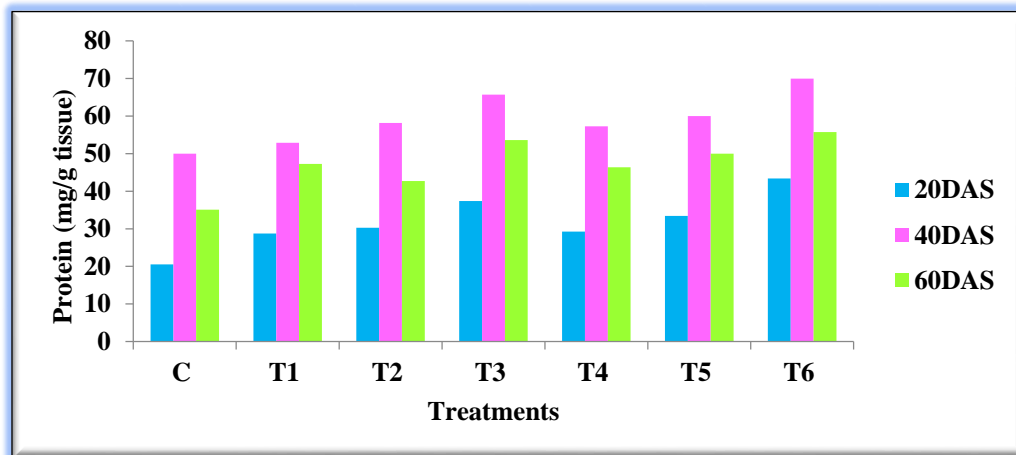
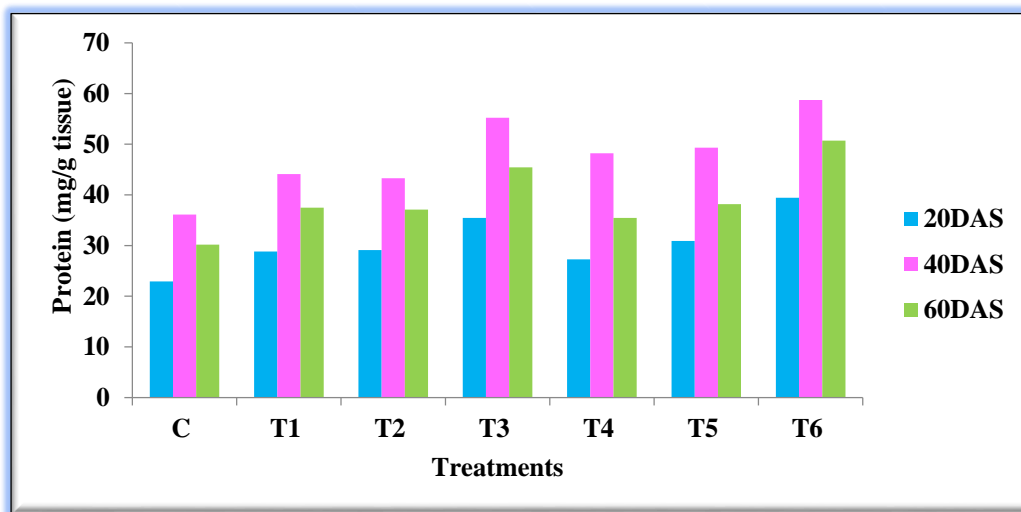


Figure - 9

Influence of paddy and coffee husk as organic manure on protein content in the leaves of fenugreek (*Trigonella foenum-graecum* L.)



C- Control

T1 - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T2 - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T3 - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

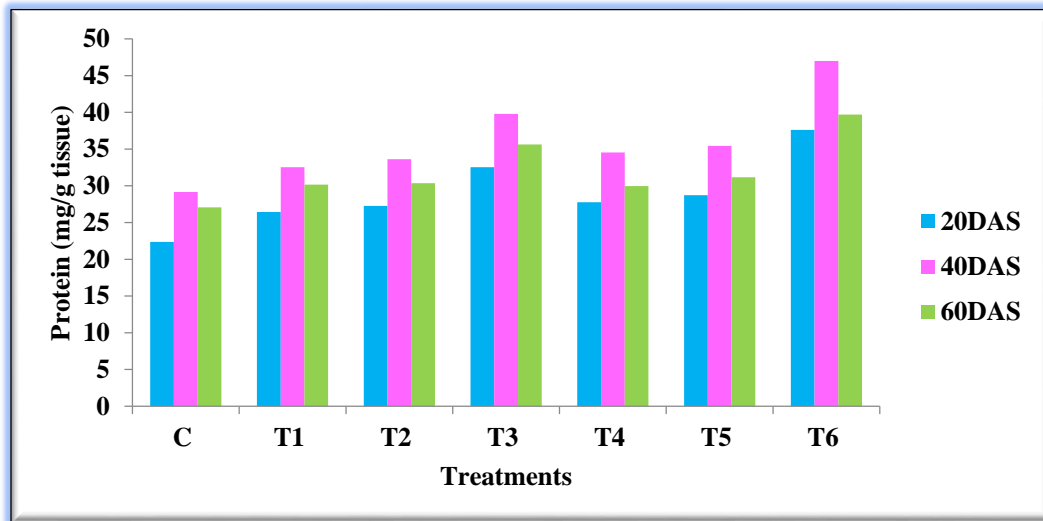
T4 - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T5 - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Figure - 10

Influence of paddy and coffee husk as organic manure on protein content in the leaves of kalmegh (*Andrographis paniculata* (Burm.f.) Nees)



C- Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

4.3.1.4 Kalmegh (*Andrographis paniculata* (Burm.f.) Nees)

An increasing trend in protein content was observed in the leaves of all the treatments from 30 to 60 DAS and after that there was decrease in its content on 90 DAS. The results were shown in the Figure - 10. Among all the treatments, T₆ (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) noted maximum protein content of 37.62 and 46.99 mg/g tissue followed by T₃ – Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 32.53 and 39.80 mg/g tissue on 30 and 60 DAS and after that the protein content in the leaves gradually declined to 39.71 mg/g tissue and 35.62 mg/g tissue on 90 DAS as compared to the Control (22.36, 29.17, 27.08 mg/g tissue).

Similar findings were corroborated by Manivannan *et al.*, (2009) who revealed that treatment T4 consisting of 50% vermicompost + 50% NPK significantly increased protein content (151 mg g⁻¹ fresh wt.) in the leaves of beans (*Phaseolus vulgaris*) as compared to the control, T1, T2 and T3 treatments. Ansari and Kumar, (2010) similarly recognized that the combination of vermicompost and vermiwash influenced protein content (7.15%) in leaves of okra (*Abelmoschus esculentum*). It is also reported by Reghuvaran and Ravindranath, (2010) that 75% coir pith compost along with 25% garden soil enhanced the protein content (0.75mg/g) in *Andrographis paniculata*.

Similar results were obtained by Kasthuri *et al.*, (2011) who recorded that application of municipal solid waste compost (MSWC) amendments at 500g enhanced the protein content in the leaves of green gram and fenugreek while 250g amendments with garden soil (6 kg) application increased the carbohydrate content. Badar and Qureshi, (2014) observed that composted rice husk (5 and 10 g) significantly increase the crude protein content in JUI 1 (*Trichoderma hamatum* (10¹¹ - 10¹² CFU mL)) on 30th day while JUR2 (*Brady rhizobium* sp - II (10¹¹ - 10¹² CFU per mL) showed maximum crude protein content on 60th day in sunflower plants. Kannahi and Ramya, (2015) similarly reported that biofertilizer (*Azospirillum*), vermicompost and biocompost enhanced protein (4.620, 4.367, 5.620 µg/g) content in the seedling of *Lycopersicum esculentus*.

Similar result was obtained by Ramya *et al.*, (2015) who observed an increase in protein (38%) in brinjal when treated with 1.5% of seaweed liquid extract of *Stoechospermum marginatum*. Baliah and Muthulakshmi, (2017) also support our results with the observations that an increase in protein (15.28 mg/g LFW) of *Abelmoschus esculentum* was noted when treated with vermicompost + *Azospirillum brasilense*. Similar results were noted by Voko *et al.*, (2022) the protein content of cowpea (*Vigna unguiculata*) increased with the application of seaweed extract [Kelpak® (KEL 0.6%) and smoke - water (SW 1:1000 (v/v)).

Similar findings were observed by Teja *et al.*, (2022) where increase in protein content (5.65%) of ashwagandha (*Withania somnifera*) was noted with the application of FYM, vermicompost and neem cake. Similarly Khan *et al.*, (2023) reported that the application of growth promoting rhizobacteria biofertilizers (PGPRs) on maize has

significantly improved proline (98%), phenolics (71%), flavonoids (85%) and protein (94%) in leaves. Kumngen *et al.*, (2023) reported food waste compost supplied by BIOAXEL Co., Ltd., 10% BA compost + 90% soil on the growth of lettuce (*Lactuca sativa* Var Crispa L.) enhanced leaf protein (443.38 µg/mL).

4.3.2 Influence of Paddy and Coffee husk as organic manure on carbohydrate content in the leaves of cultivated test crops

4.3.2.1 Moth bean (*Vigna aconitifolia* (Jacq.) Marechal)

The application of compost with microbial consortium found to be better treatment as compared to the other treatments. An increase in its content was noted in all the treatments from 20 - 40 DAS and then a slight decline in carbohydrate content on 60 DAS.

Among all the treatments, carbohydrate content in leaf was increased significantly in T6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) from 62.06 to 81.05 mg/g tissue followed by T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 59.34 to 77.61 mg/g tissue from 20 to 40 DAS and declined to 70.95 and 68.93 mg/g tissue on 60 DAS against the Control (39.63, 60.12 mg/g tissue and declined to 53.26 mg/g tissue) as shown in Figure - 11.

4.3.2.2 Black gram (*Vigna mungo* (L.) Hepper)

The carbohydrate content in leaves showed a gradual increase up to 60 days and thereafter a slight decrease was found in all the treatments.

Among the treatments, maximum carbohydrate content was registered in T6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) with 57.61 and 85.90 mg/g tissue, followed by T3 - Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 53.44 and 80.14 mg/g tissue on 20 and 40 DAS and after that the carbohydrate content declined gradually to 74.29 and 72.25 mg/g tissue on 60 DAS as compared to the Control (33.25 to 54.59 mg/g tissue on 20 and 40 DAS and 47.78 mg/g tissue on 60 DAS) as presented in Figure - 12.

Figure - 11

Influence of paddy and coffee husk as organic manure on carbohydrate content in the leaves of moth bean (*Vigna aconitifolia* (Jacq.) Marechal)

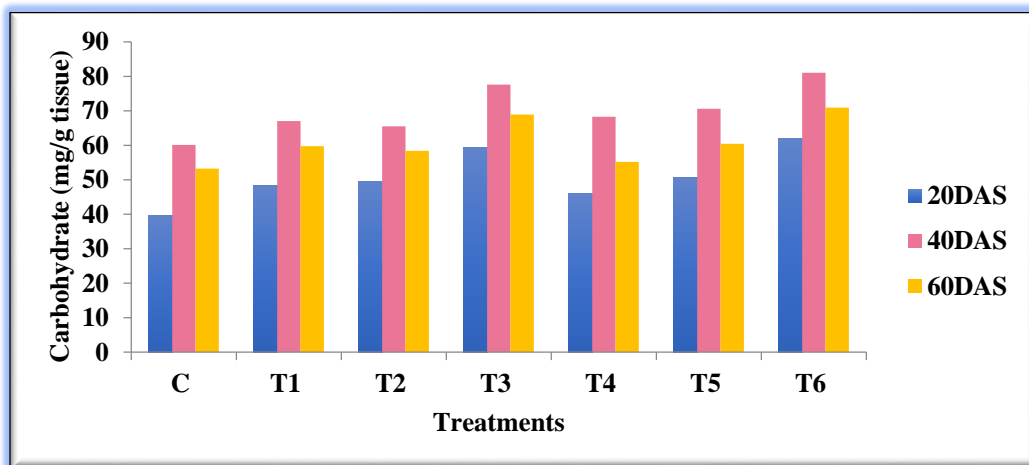
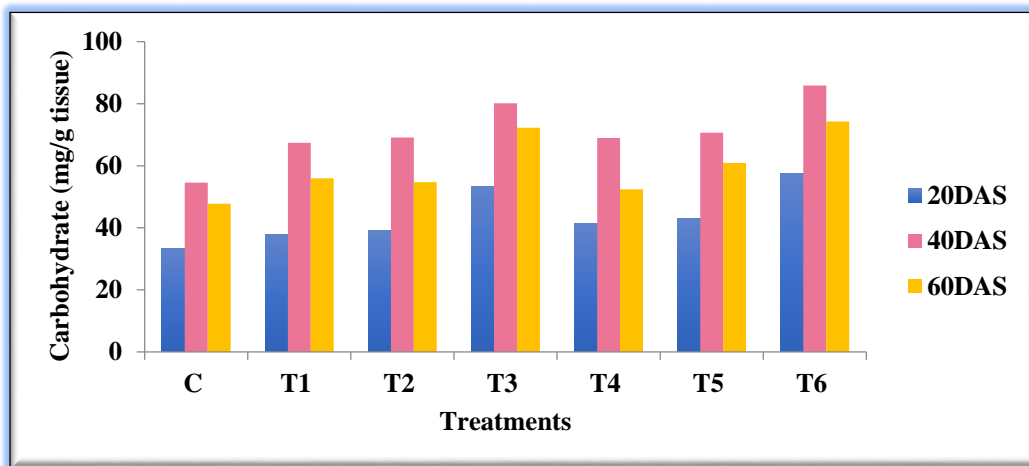


Figure - 12

Influence of paddy and coffee husk as organic manure on carbohydrate content in the leaves of black gram (*Vigna mungo* (L.) Hepper)



C- Control

T1 - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T2 - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T3 - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T4 - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T5 - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Figure - 13

Influence of paddy and coffee husk as organic manure on carbohydrate content in the leaves of fenugreek (*Trigonella foenum-graecum* L.)

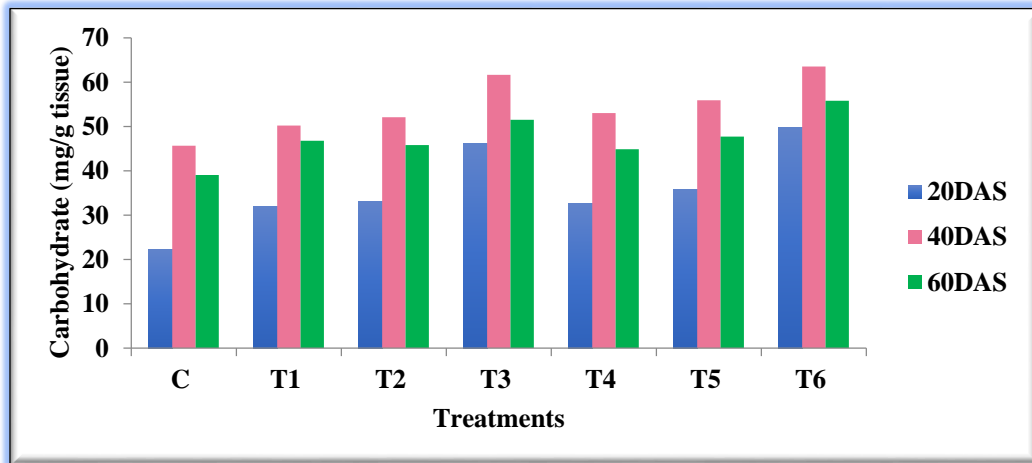
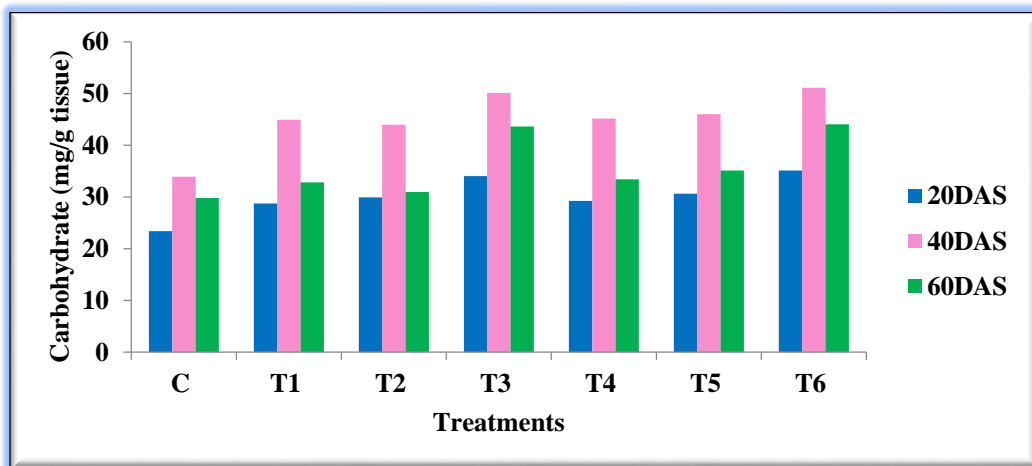


Figure - 14

Influence of paddy and coffee husk as organic manure on carbohydrate content in the leaves of kalmegh (*Andrographis paniculata* (Burm.f.) Nees)



C- Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

4.3.2.3 Fenugreek (*Trigonella foenum-graecum* L)

It was inferred from Figure - 13 that the total carbohydrate content in Fenugreek leaves showed a gradual increase up to 40 DAS and declined gradually thereafter in all the treatments.

The highest carbohydrate content was observed in T6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) which ranged from 49.77 mg/g tissue to 63.56 mg/g tissue followed by T3 - Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) from 46.19 mg/g tissue to 61.66 mg/g tissue on 20 and 40 DAS and declined to 55.81 mg/g tissue and 51.53 mg/g tissue on 60 DAS against the Control (22.29 mg/g tissue, 45.68 mg/g tissue and 39.07 mg/g tissue from 20 - 60 DAS).

4.3.2.4 Kalmegh (*Andrographis paniculata* (Burm.f.) Nees)

An increasing trend in carbohydrate content was noticed in all the treatments from 30 to 60 DAS and after that there was a decrease in its content (Figure -14). Among all the treatments, T6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) recorded maximum carbohydrate content of 35.11 and 51.11 mg/g tissue followed by T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 34.03 and 50.14 mg/g tissue on 30 and 60 DAS. After that its content declined gradually to 44.07 mg/g tissue and 43.64 mg/g tissue on 90 DAS when compared to the control (23.40, 33.93, 29.80 mg/g tissue from 30 to 90 DAS).

Manivannan *et al.*, (2009) revealed that treatment T4 consisting of 50% vermicompost + 50% NPK showed significantly increased sugar content (208 mg g⁻¹ fresh wt.) in the leaves of beans (*Phaseolus vulgaris*) compared to the control. Similar to our results Reghuvaran and Ravindranath, (2010) reported that 75% coir pith compost along with 25% garden soil enhanced the carbohydrate content (0.40 mg/g) in the leaves of *Phyllanthus amarus*. Kasthuri *et al.*, (2011) recorded that the application of municipal solid waste compost (MSWC) amendments at 250g enhanced the carbohydrate content in the leaves of green gram and fenugreek with garden soil (6 kg).

Similar results were reported by Badar and Qureshi, (2014) who observed that composted rice husk (5 and 10 g / 2 kg of soil / pot) significantly increased the total carbohydrate content from 46 to 243% in sunflower plants. Kannahi and Ramya, (2015) similarly recognized the effect of biofertilizer (*Azospirillum*), vermicompost and biocompost on carbohydrate (6.643, 4.69, 6.397 mg) in the seedling of *Lycopersicum esculentum*. The results coincide with Ramya *et al.*, (2015) who observed an increase in reducing sugar (201 %) in brinjal plants when treated with 1.5% of seaweed liquid extract of *Stoechospermum marginatum*.

Similarly Kumngen *et al.*, (2023) reported that the effect of food waste compost (supplied by BIOAXEL Co., Ltd., 10% BA compost + 90% soil) on the growth of lettuce (*Lactuca sativa* Var Crispa L.) significantly enhanced carbohydrate content (4,321.31 µg/mL) and reducing sugar (683.33 µg/mL) in leaves.

4.3.3 Influence of Paddy and Coffee husk as organic manure on chlorophyll content in the leaves of cultivated test crops

4.3.3.1 Moth bean (*Vigna aconitifolia* (Jacq.) Marechal)

Significant increase in Chlorophyll 'a', chlorophyll 'b' and total chlorophyll content of moth bean leaves from 20 to 40 DAS and then gradually decline was noted in all the treatments (T1 to T6) on 60 DAS when compared with Control (Figure - 15).

The treatment T6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) showed highest chlorophyll 'a' content which ranged from 0.990 to 2.216 mg/g tissue followed by T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) which ranged from 0.764 to 1.995 mg/g tissue, T6 0.479 to 0.894 mg/g tissue followed by T3 0.384 to 0.792 mg/g tissue (chlorophyll 'b'), T6 1.717 to 3.108 mg/g tissue followed by T3 1.566 to 2.748 mg/g tissue (total chlorophyll) on 20 to 40 DAS.

It was decreased gradually to 1.598 mg/g tissue (T6) followed by (T3) 1.189 mg/g tissue (chlorophyll a), T6 0.625 mg/g tissue and T3 0.521 mg/g tissue (chlorophyll 'b'), (T6) 1.982 mg/g tissue followed by (T3) 1.843 mg/g tissue (total chlorophyll) on 60 days after sowing. Minimum chlorophyll content was registered in Control 0.399, 0.953, 0.696

mg/g tissue (chlorophyll 'a'), 0.226, 0.604, 0.326 mg/g tissue (chlorophyll 'b') and 0.905, 1.231, 0.995 mg/g tissue (total chlorophyll).

4.3.3.2 Black gram (*Vigna mungo* (L.) Hepper)

Among all the treatments, T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) recorded maximum chlorophyll content from 20 to 40 DAS ranging from 0.986 to 2.095 mg/g tissue followed by T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) from 0.968 to 1.957 mg/g tissue (chlorophyll 'a'), (T6) 0.795 to 1.530 mg/g tissue followed by (T3) 0.717 to 1.424 mg/g tissue (chlorophyll 'b'), (T6) 1.335 to 3.231 mg/g tissue followed by (T3) 1.103 to 2.913 mg/g tissue (total chlorophyll)

It was gradually declined to (T6) 1.756 followed by (T3) 1.611 mg/g tissue (chlorophyll 'a'), (T6) 1.131 mg/g tissue and (T3) 1.032 mg/g tissue (chlorophyll 'b'), (T6) 2.832 mg/g tissue and (T3) 2.057 mg/g tissue (total chlorophyll) on 60 DAS. The least amount of chlorophyll was noted in Control 0.517, 0.984, 0.781 mg/g tissue (chlorophyll 'a'), 0.205, 0.594, 0.295 mg/g tissue (chlorophyll 'b') and 0.701, 1.342, 0.998 mg/g tissue (total chlorophyll) (Figure - 16).

4.3.3.3 Fenugreek (*Trigonella foenum-graecum* L.)

Among all the treatments, T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) significantly increased chlorophyll content from 20 to 40 DAS which ranged from 1.016 to 2.025 mg/g tissue followed by T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) from 0.991 to 1.824 mg/g tissue (chlorophyll 'a'), in T6 0.569 to 1.035 mg/g tissue followed by T3 0.494 to 1.005 mg/g tissue (chlorophyll 'b'), 1.136 to 3.395 mg/g tissue (T6) followed by T3 1.095 to 3.035 mg/g tissue (total chlorophyll).

It was decreased gradually in T6 1.152 mg/g tissue followed by 1.091 mg/g tissue T3 (chlorophyll 'a'), (T6) 0.836 mg/g tissue and (T3) 0.712 mg/g tissue (chlorophyll 'b'), (T6) 2.084 mg/g tissue followed by (T3) 2.000 mg/g tissue (total chlorophyll) on

60 DAS. Minimum amount of chlorophyll content was recorded in control 0.611, 0.892, 0.701 mg/g tissue (chlorophyll 'a'), 0.239, 0.410, 0.395 mg/g tissue (chlorophyll 'b') and 0.666, 1.015, 0.731 mg/g tissue (total chlorophyll) (Figure - 17).

4.3.3.4 Kalmegh (*Andrographis paniculata* (Burm.f.) Nees)

Chlorophyll 'a', chlorophyll 'b' and total chlorophyll content of kalmegh leaves increased significantly up to 60 DAS and then gradually a decline was observed in all the treatments (T1 to T6) when compared with control (Figure - 18).

The treatment T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) showed significant increase in chlorophyll content from 30 to 60 DAS which ranged from 1.615 to 2.131 mg/g tissue followed by T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) from 1.281 to 2.012 mg/g tissue (chlorophyll 'a'), 0.857 to 1.301 mg/g tissue (T6) followed by (T3) 0.735 to 1.255 mg/g tissue (chlorophyll 'b'), 2.653 to 3.710 mg/g tissue (T6) followed by (T3) 1.801 to 3.255 mg/g tissue (total chlorophyll).

It was declined gradually to 1.874 mg/g tissue (T6) followed by 1.651 mg/g tissue (T3) (chlorophyll 'a'), (T6) 1.140 mg/g tissue followed by (T3) 1.010 mg/g tissue (chlorophyll 'b'), (T6) 2.909 mg/g tissue followed by (T3) 2.521 mg/g tissue (total chlorophyll) on 90 DAS. The least amount of chlorophyll was recorded in control 0.687, 1.004, 0.851 mg/g tissue (chlorophyll 'a'), 0.284, 0.681, 0.602 mg/g tissue (chlorophyll 'b') and 1.001, 1.477, 1.362 mg/g tissue (total chlorophyll).

The present results are in par with that of Sanjutha *et al.*, (2008) who reported that application of FYM @ 15 t/ha + NPK @ 75:75:50 Kg/ ha + Panchagavya @ 3% as foliar spray significantly influenced chlorophyll content (52.42) in *Andrographis paniculata*. Manivannan *et al.*, (2009) revealed that treatment T4 consisting of 50% vermicompost + 50% NPK showed significantly increased chlorophyll content (389 mg g⁻¹ (fresh wt.) in beans (*Phaseolus vulgaris*) as compared to the control, T1, T2 and T3 treatments. Similar results were observed by Reghuvaran and Ravindranath, (2010) who studied that the application of 75% coir pith compost along with 25% garden soil influenced the chlorophyll content (0.210mg/g) in *Andrographis paniculata*.

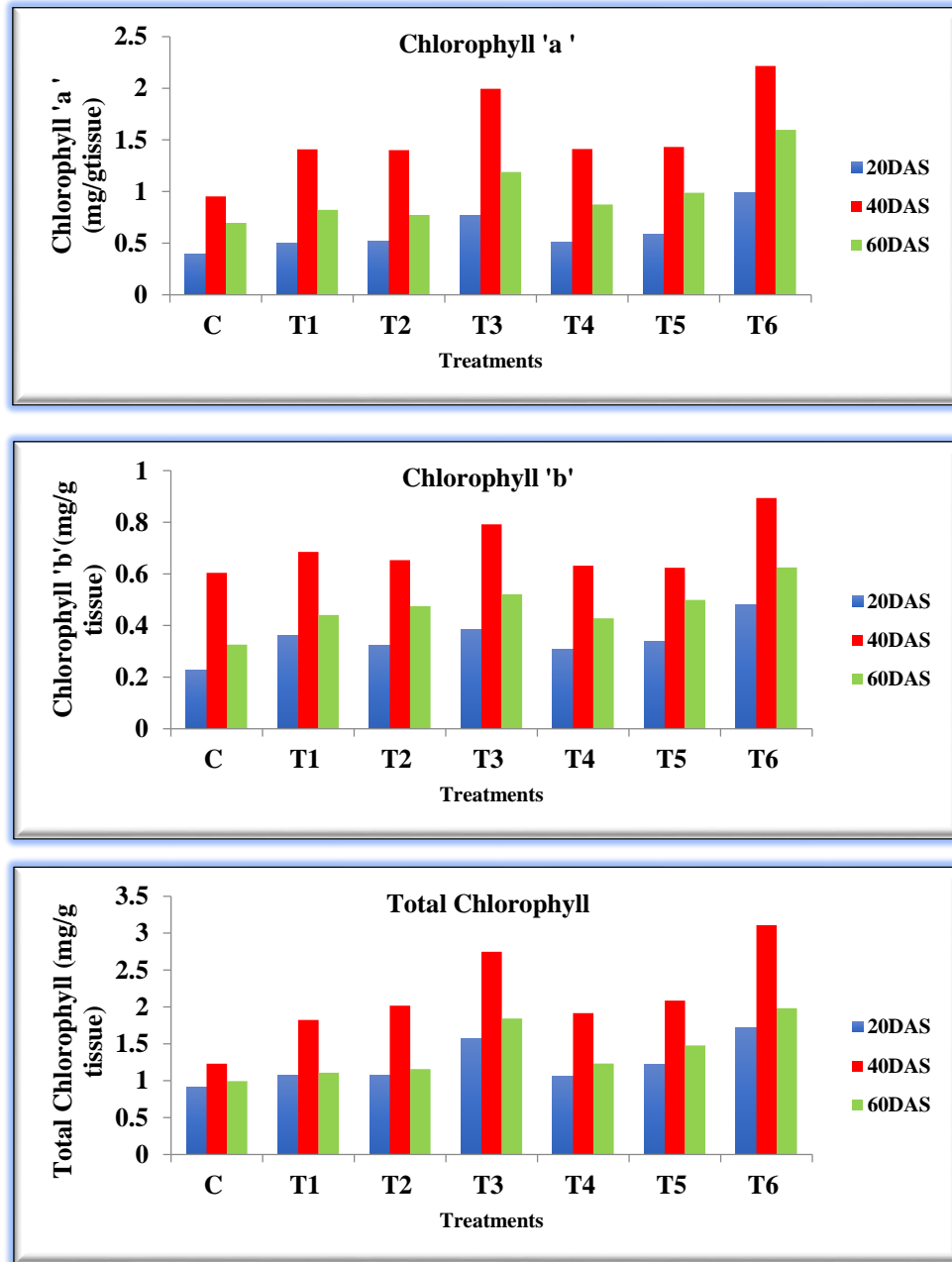
Similar results were reported by Babaeian *et al.*, (2011) that the highest chlorophyll content (14.9 and 16.4) in leaves was noted with the effect of water stress and micronutrients (Zn+Mn) in sunflower. Kasthuri *et al.*, (2011) recorded that the application of municipal solid waste compost (MSWC) amendments at 250g with garden soil (6 kg) enhanced the chlorophyll content (< 2mg /g) in the leaves of green gram and fenugreek. The results are consistent with that of Ranjan *et al.*, (2013) who found that combined application of vermicompost (1.92 kg/bed) + *Biospirillum* (10 ml/kg of seed) + Biophos (10 ml/kg of seed) + Biopotash (10 ml/kg of seed) enhanced the chlorophyll 'a' (3.055 mg/g), chlorophyll 'b' (0.556 mg/g) and total chlorophyll (3.627 mg/g) of baby corn under the north-west Himalayan conditions.

Similar findings have been supported by Badar and Qureshi, (2014) who observed that composted rice husk (5 and 26; 10 g/2 kg of soil/pot) showed significant increase in total chlorophyll content from 36 to 41% in sunflower plants. Kannahi and Ramya, (2015) similarly recognized the effect of biofertilizer (*Azospirillum*), vermicompost and biocompost enhanced the chlorophyll 'a' (12.00, 0.453, 0.0345 mg), chlorophyll 'b' (0.0598, 0.0389, 0.299 mg) and total chlorophyll (0.0678, 0.0452, 0.355 mg) in the seedling of *Lycopersicum esculentum*.

Similar result was obtained by Ramya *et al.*, (2015) who observed an increase in total chlorophyll pigments (77 %) in brinjal plants when treated with 1.5 % of seaweed liquid extract of *Stoechospermum marginatum*. Baliah and Muthulakshmi, (2017) also support our results with the observations that an increase in total chlorophyll (4.86 mg/g LFW) content was noted in *Abelmoschus esculentus* when treated with vermicompost + *Azospirillum brasiliense*. The results are in par with Gul *et al.*, (2019) who observed that combined application of urea 75g + *Rhizobium japonicum* 2.5g enhanced the chlorophyll 'a' (1.34 mg/g Fw), chlorophyll 'b' (0.44 mg/g Fw) and total chlorophyll (1.78 mg/g Fw) contents in cluster bean plant. Similar results were supported by Kiran, (2019) who observed enhanced chlorophyll 'a', chlorophyll 'b', total chlorophyll and carotenoid contents in lettuce (*Lactuca sativa* var. *crispa*) when applied with vermicompost (2.5 and 5%) under drought stress conditions.

Figure - 15

Impact of biocomposted paddy and coffee husk on chlorophyll 'a', 'b' and total chlorophyll content in the leaves of moth bean (*Vigna aconitifolia* (Jacq.) Marechal)



C- Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

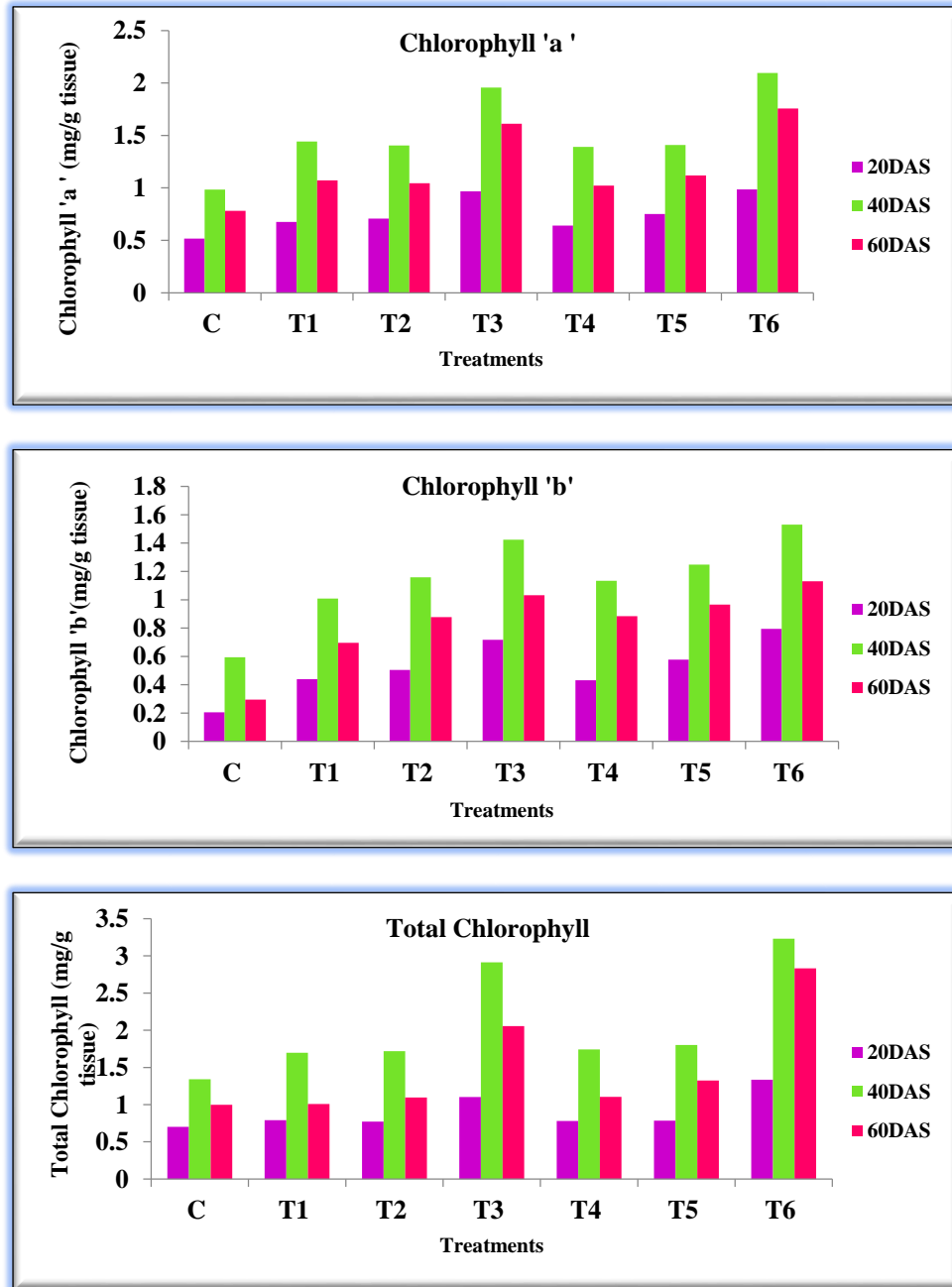
T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Figure - 16

Impact of biocomposted paddy and coffee husk on chlorophyll 'a', 'b' and total chlorophyll content in the leaves of black gram (*Vigna mungo* (L.) Hepper).



C- Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

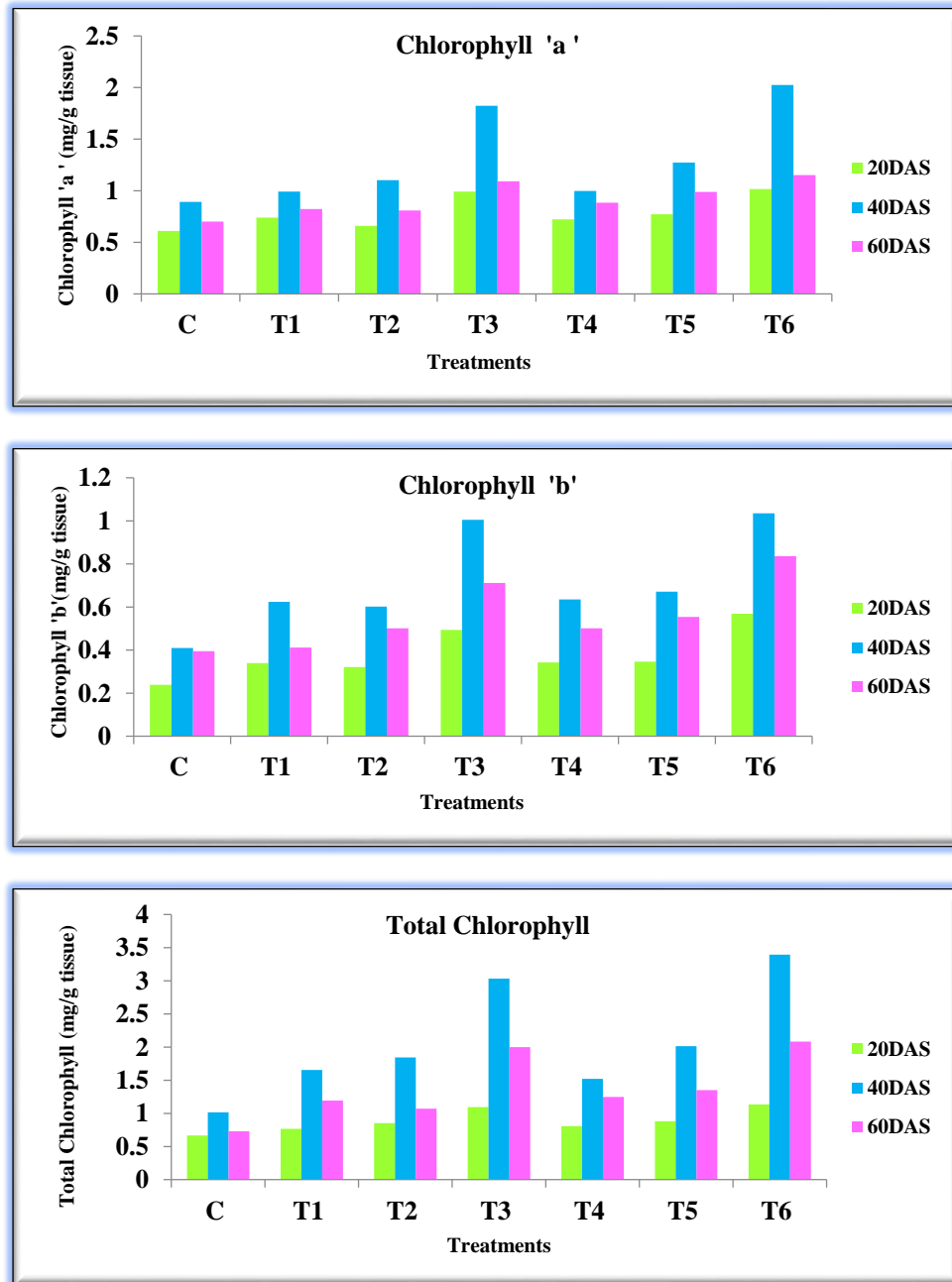
T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Figure - 17

Impact of biocomposted paddy and coffee husk on chlorophyll 'a', 'b' and total chlorophyll content in the leaves of fenugreek (*Trigonella foenum-graecum* L.)



C- Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

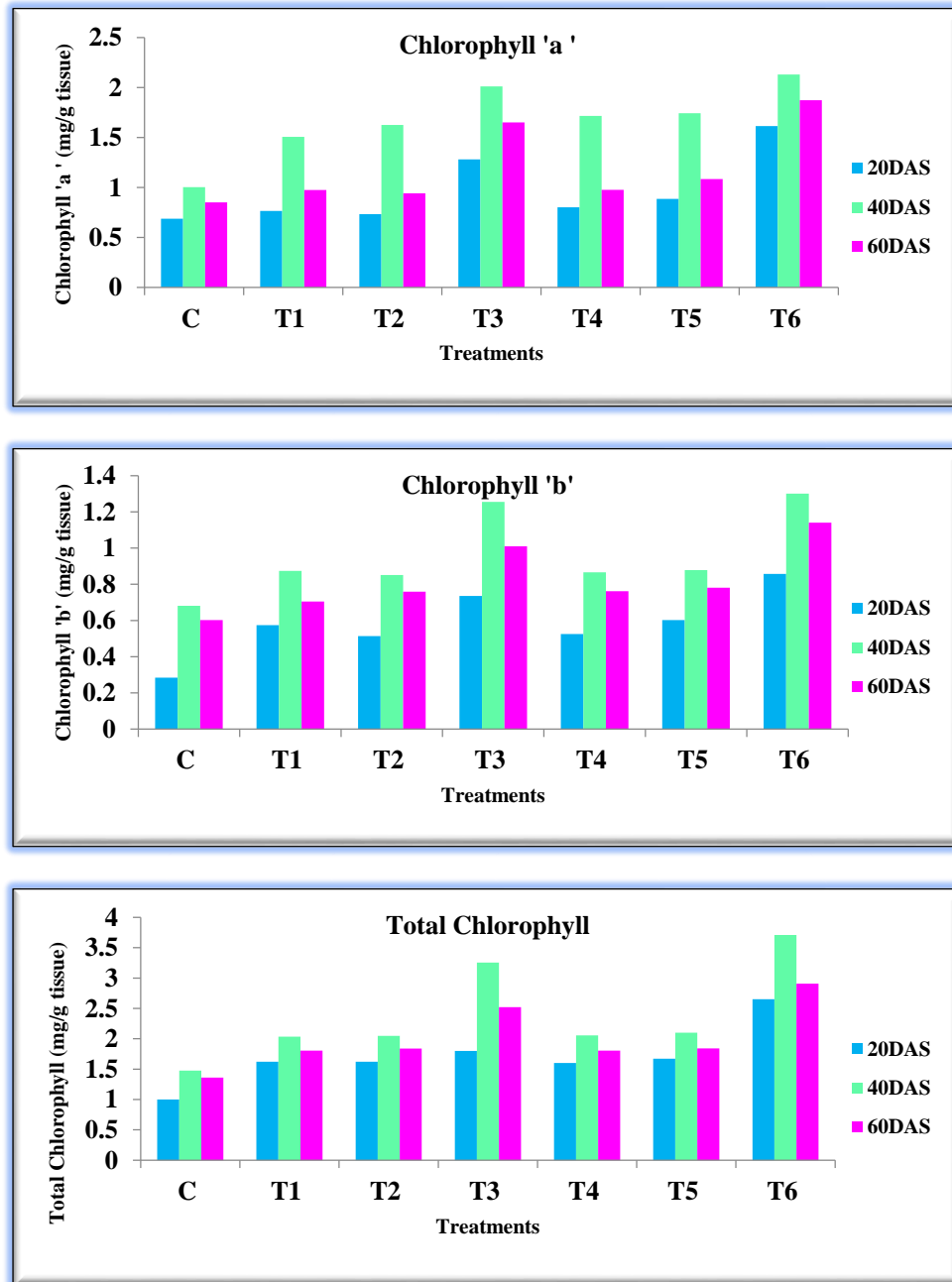
T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Figure – 18

Impact of biocomposted paddy and coffee husk on chlorophyll 'a', 'b' and total chlorophyll content in the leaves of kalmegh (*Andrographis paniculata* (Burm.f.) Nees)



C- Control

T1 - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T2 - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T3 - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T4 - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T5 - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Similar findings were observed by Mahmud *et al.*, (2019) who noted that commercial vermicompost (10 t ha⁻¹) promote chlorophyll 'a' (1.866 µg/g), chlorophyll 'b' (5.496 µg/g), total chlorophyll (7.362 µg/g) and chlorophyll a/b ratio (0.340 µg/g) in pineapple (*Ananas comosus* (L.) Merr.). Singh *et al.*, (2019) also supported the present study with the findings on mango ginger (*Curcuma amada* Roxb.) when applied with municipal solid waste vermicompost.

Similar results were reported by Mahmud *et al.*, (2020) that increased chlorophyll 'a' (0.977 µg/g), chlorophyll 'b' (3.094 µg/g) and total chlorophyll contents (4.071 µg/g) in fruit extracts of ex vitro MD2 pineapple plants when applied with vermicompost (10 t·ha⁻¹). Dizikisa *et al.*, (2022) observed that the application of vermicompost (0, 2 and 6 gr) in 3 doses to the 1000g of soil pot significantly increased total chlorophyll (3.126, 3.439, 4.391mg g⁻¹ FW) of corn (*Zea mays* L.) The results are in agreement with our findings of Naik *et al.*, (2022) who reported that combined application of 50% RDF + 25% *Rhizobium* + 25% *Azotobacter* on chickpea (*Cicer arietinum* L.) enhanced the chlorophyll content (348.67 µg/g).

The results are on par with that of Aydi *et al.*, (2023) who noted that total chlorophyll contents were higher in melon plants when cultivated with date palm waste and animal manure compost as organic substrate. Similarly Kumngen *et al.*, (2023) reported that chlorophyll 'a', 'b' and carotenoid content increases with the application of food waste compost (supplied by BIOAXEL Co., Ltd., 10% BA compost + 90% soil) on the growth of lettuce (*Lactuca sativa* L. Var Crispa). Chau and Diem, (2024) observed that the application of spent coffee waste, cow manure, abalone mushroom reisdue and rice husk ash has increased chlorophyll content measured at 39.6 SPAD units in spinach plants.

The results are on par with that of Elshaboury *et al.*, (2024) who observed that application of chicken manure (ChM) compost at the rate of 10 ton fed⁻¹ on soyabean has increased chlorophyll 'a'(1.136 mg g⁻¹) and chlorophyll 'b' (0.747 mg g⁻¹).

4.4 Leghaemoglobin

4.4.1 Influence of Paddy and Coffee husk as organic manure on leghaemoglobin content in nodules of legume test crops

4.4.1.1 Moth bean (*Vigna aconitifolia* (Jacq.) Marechal)

There was a significant increase in leghaemoglobin content in all the treatments (T1 to T6) up to 40 DAS and it was decreased gradually on 60 DAS as presented in Figure - 19

The leghaemoglobin content was significantly increased in T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) from 0.049 to 0.091 mg/g followed by T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) from 0.045 to 0.080 mg/g on 20 to 40 DAS and decreased gradually in T6 0.064 mg/g followed by T3 0.050 mg/g on 60 DAS as compared to the Control (0.021, 0.050, 0.036 mg/g).

4.4.1.2 Black gram (*Vigna mungo* (L.) Hepper)

The Figure - 20 presented leghaemoglobin content of black gram and substantial increase in its content was noted in all the treatments up to 40 DAS and gradual decrease was found on 60 DAS.

The leghaemoglobin content was found to be maximum in T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) ranging from 0.057 to 0.095 mg/g followed by T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 0.051 to 0.086 mg/g from 20 to 40 DAS and decreased gradually in T6 0.082 followed by T3 0.075 mg/g on 60 DAS as compared to Control (0.022, 0.041 and 0.025 mg/g).

4.4.1.3 Fenugreek (*Trigonella foenum-graecum* L.)

The leghaemoglobin content in fenugreek was significantly increased in T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 0.073 to 0.099 mg/g followed by T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 0.069 to 0.087 mg/g from 20 to 40 DAS and decreased

gradually in T6 0.079 followed by T3 0.072 mg/g on 60 DAS as compared to the Control (0.020, 0.034 and 0.027 mg/g) as showed in Figure - 21

The result is in par with Ott *et al.*, (2005) who reported in *Lotus japonicas* three symbiotic leghemoglobins (LjLb1, LjLb2, and LjLb3) in comparison with two non symbiotic leghemoglobins, (LjNSG1 and LjNSG2) showed that symbiotic leghemoglobins are proved to be crucial for nitrogen fixation in root nodules. Roy *et al.*, (2006) revealed that cobalt is an essential element in fixing the N by microorganism and its deficiency inhibit the formation of leghaemoglobin as well as N₂ fixation.

Araújo *et al.*, (2007) confirmed that application of composted textile sludge (0, 9.5, 19 and 38 t ha⁻¹) increased the nodulation and nitrogen fixation of soyabean and cowpea. Ali *et al.*, (2008) revealed that the application of the auxins (IAA or 4-Cl-IAA) improved the growth, leghaemoglobin content and nitrogenase activity in mung bean (*Vigna radiata* (L.) Wilczek) plants.

Similar work was done by Dutta and Bandyopadhyay, (2009) who found an increase in nodulation, leghaemoglobin content, nitrogenase activity of chick pea when phosphorus (26.2 kg/ha) and bio-fertilizers were applied under laterite soil. Padminie and Bandyopadhyaya, (2011) revealed that integrated application of *Rhizobium leguminosarum* and phosphate solubilizing bacteria increased the leghaemoglobin content and nodule number of French bean (*Phaseolus vulgaris* L.).

Similar findings were reported by Sharma *et al.*, (2011) who observed that inoculation of *Rhizobium* (IRC-6 strain) on groundnut (*Arachis hypogaea* L.) enhanced number of pink colored nodules, nitrate reductase activity and leghaemoglobin content at 50 days after sowing (DAS). Singh and Vijayalakshmi, (2013) confirmed that the application of composted coirpith (6.5 t/ha) + composted pressmud (6.5 t/ha) + farmyard manure (6.5 t/ha) increased the leghaemoglobin content (0.0560 mg/g) in the nodules of green gram on 45 days after sowing

Similar results were reported by Verma *et al.*, (2014) that the application of 6 t ha⁻¹ vermicompost and 40 kg of sulphur (ha⁻¹) enhanced the number of total root nodules (27.48), number of effective root nodules (15.87) and leghaemoglobin content (2.00 mg/g) of fenugreek plant.

Figure - 19
Influence of paddy and coffee husk as organic manure on leghaemoglobin content in nodules of moth bean (*Vigna aconitifolia* (Jacq.) Marechal)

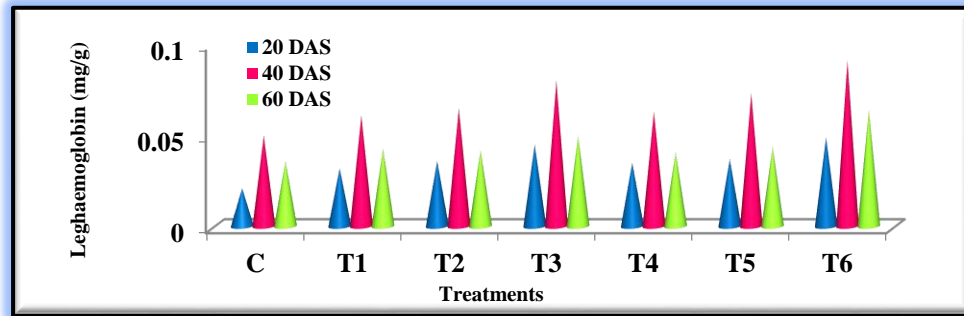


Figure – 20
Influence of paddy and coffee husk as organic manure on leghaemoglobin content in nodules of black gram (*Vigna mungo* (L.) Hepper)

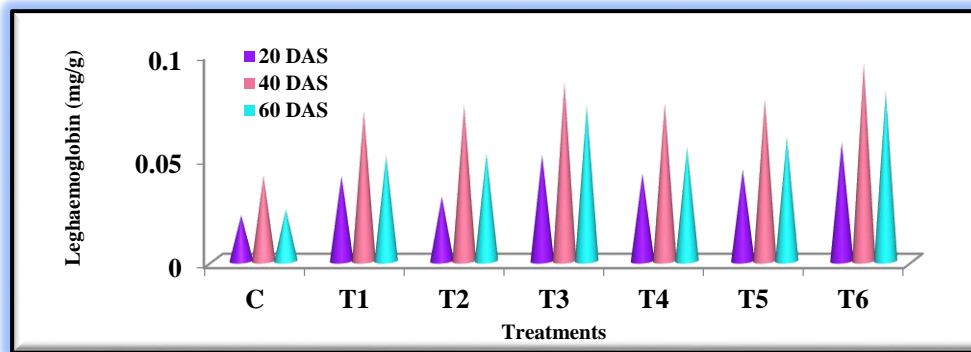
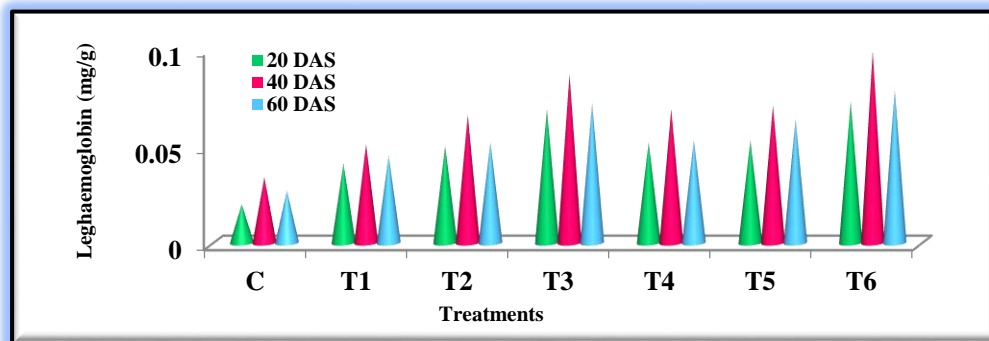


Figure – 21
Influence of paddy and coffee husk as organic manure on leghaemoglobin content in nodules of fenugreek (*Trigonella foenum - graecum* L.)



C- Control

T1- Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T2- Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T3- Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T4- Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T5- Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T6- Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

Similar result was supported by Adak and Kibritci, (2016) who observed combination of nitrogen (30 kg/ha) and phosphorus (80 kg/ha) levels on soil noted the highest nodule, nodule weight/plant in faba bean (*Vicia faba* L.). Similarly N'Zi *et al.*, (2016) reported that the highest number of nodules (11) per plant was observed in soyabean (*Glycine max* L.) Doko variety with inoculums treatment of IRAT - FA 3 *Bradyrhizibium japonicum* strain.

Seleiman and Abdelaal, (2018) also observed that application of biofertilizer increased the total nitrogen, total crude protein in chickpea (*Cicer arietinum* L.) variety Giza 195 cultivar. Similarly, Shekhawat *et al.*, (2018) observed in black gram (*Vigna mungo* L.) that leghaemoglobin content of root nodules was highest (2.69 mg g⁻¹) when treated with 40 kg P₂O₅ + Vermicompost 2.5 t ha⁻¹ + *Rhizobium* + PSB phosphorus. The findings are in par with Gomathinayagam *et al.*, (2021) who observed that *Rhizobium* + PB (phosphobacteria) mixed treatment enhanced the nitrate activities in both black gram and maize.

Voko *et al.*, (2022) reported that application of vermicompost leachate (VCL) and smoke - water (SW) induced a higher number of nodules at the lowest watering regime per week in cowpea (*Vigna unguicula*) and watered thrice-a-week improved leghaemoglobin. Similarly Khan *et al.*, (2022) also noted that normal animal manure with half di-ammonium phosphate (DAP) improved the leghaemoglobin contents (112.5 mM), protein contents, nodule count and nodule weight up to 78.38%, 147%, and 93.59% than the control. Similarly Van Chuong, (2023) observed that application of NPK + 6 t CM/ha + *Rhizobium* sp enhanced the number of nodules (92.9) and weight of dry nodules (0.831g) in peanut.

The main functions of leghaemoglobin is to facilitate oxygen supply to the nitrogen fixing bacteria, protect the nitrogenase enzymes from being inactivated by oxygen and it exhibits a well good coordination between host plant and the bacteria. Biocompost improve the process of symbiotic nitrogen fixation because of its activity in creating aeration and water infiltration which in turn enhances the activity of nitrogen - fixing bacteria. Biocompost increase the organic matter of the soil, which in turn help in the formation of nodules in plants, water holding capacity and favorable condition for the nitrogen fixing bacteria.

From the current experiments, it was clear that the application of T6 – Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) and T3 (Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) increased the leghaemoglobin

content when compared to the control. Leghaemoglobin content in moth bean, black gram and fenugreek increases up to 40 DAS and declined at 60 DAS. These fluctuations of increase and declining of leghaemoglobin levels is due to increased oxygen concentrations and nitrogenase enzyme inhibition which in turn results in poor nitrogen fixation.

4.5 Influence of paddy and coffee husk as organic manure on protein and carbohydrate content in seeds of selected test plants

4.5.1 Moth Bean (*Vigna aconitifolia* (Jacq.) Marechal)

The seed protein content of moth bean was found to be maximum in T6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 69.43 mg/g tissue followed by T3 - Raw paddy husk + 6.5g *Pleurotus eous*, 6. *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eiseniafetida* (5t/ha) of 66.44 mg/g tissue as compared to Control (43.19 mg/g tissue).

Table - 23

Influence of paddy and coffee husk as organic manure on protein and carbohydrate content in seeds of moth bean (*Vigna aconitifolia* (Jacq.) Marechal)

Treatments	Protein content (mg/g tissue)	Carbohydrate content (mg/g tissue)
C	43.19	50.13
T1	50.33	56.33
T2	53.27	64.72
T3	66.44	75.27
T4	56.61	66.37
T5	57.22	69.11
T6	69.43	79.14
SEd	0.016	0.018
CD (p<0.05)	0.035	0.039
CD (p<0.01)	0.048**	0.055**

** Significant at 1% (p<0.01), DAS- Days After Sowing)

C- Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

The carbohydrate content of moth bean seed noted highest in T6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 79.14 mg/g tissue followed by T3 Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 75.27 mg/g tissue when compared to the Control (50.13 mg/g tissue) (Table - 23).

4.5.2 Black gram (*Vigna mungo* (L.) Hepper)

The highest protein content was recorded in T6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) (59.99 mg/g tissue) followed by T3 - Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *P. florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) (52.72 mg/g tissue) as compared to Control (32.71 mg/g tissue).

Table - 24

Influence of paddy and coffee husk as organic manure on protein and carbohydrate content in seeds of black gram (*Vigna mungo* (L.) Hepper)

Treatments	Protein content (mg/g tissue)	Carbohydrate (mg/g tissue)
C	32.71	41.74
T1	46.35	50.06
T2	46.40	52.55
T3	52.72	63.29
T4	45.44	59.03
T5	47.02	60.13
T6	59.99	68.86
SEd	0.017	0.019
CD (p<0.05)	0.038	0.042
CD (p<0.01)	0.053**	0.060**

** Significant at 1% (p<0.01), DAS- Days After Sowing)

C- Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

The carbohydrate content was found to be maximum in T6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 68.86 mg/g tissue followed by T3 - Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 63.29 mg/g tissue when compared to the Control (41.74 mg/g tissue) (Table - 24).

4.5.3 Fenugreek (*Trigonella foenum-graecum* L.)

As presented in Table - 25, maximum protein content was noted in T6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 55.80 mg/g tissue followed by T3 – Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 51.93 mg/g tissue as compared to Control (43.26 mg/g tissue).

The carbohydrate content in fenugreek seed was found to be highest in T6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 64.43 mg/g tissue followed by T3 – Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 61.10 mg/g tissue when compared to the Control (49.21 mg/g tissue).

4.5.4 Kalmegh (*Andrographis paniculata* (Burm.f.) Nees)

The protein content of kalmegh seed was found to be maximum in T6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 29.11 mg/g tissue followed by T3 - Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 28.21 mg/g tissue as compared to Control (20.33 mg/g tissue).

The carbohydrate content was found to be more in T6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 42.71 mg/g tissue followed by T3 - Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) of 38.01 mg/g tissue as compared to the Control (27.21 mg/g tissue) as depicted in Table - 26.

Table – 25

Influence of paddy and coffee husk as organic manure on protein and carbohydrate content in seeds of fenugreek (*Trigonella foenum-graecum* L.)

Treatments	Protein content (mg/g tissue)	Carbohydrate content (mg/g tissue)
C	43.26	49.21
T1	48.62	56.81
T2	46.36	54.30
T3	51.93	61.10
T4	46.20	53.02
T5	48.17	57.54
T6	55.80	64.43
SEd	0.015	0.017
CD (p<0.05)	0.034	0.038
CD (p<0.01)	0.048**	0.053**

Table – 26

Influence of paddy and coffee husk as organic manure on protein and carbohydrate content in seeds of kalmegh (*Andrographis paniculata* (Burm.f.) Nees)

Treatments	Protein content (mg/g tissue)	Carbohydrate content (mg/g tissue)
C	20.33	27.21
T1	23.67	32.26
T2	24.34	30.39
T3	28.21	38.01
T4	23.98	31.46
T5	25.36	33.36
T6	29.11	42.71
SEd	0.146	0.147
CD (p<0.05)	0.320	0.321
CD (p<0.01)	0.448**	0.449**

** Significant at 1% (p<0.01), DAS- Days After Sowing)

C- Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

The results of current study are similar with the findings of Manivannan *et al.*, (2009) who revealed that treatment T4 consisting of 50% vermicompost + 50% NPK significantly increased protein and carbohydrate content (382 and 290 mg g⁻¹ fresh wt.) in the seeds of beans (*Phaseolus vulgaris*) when compared to the control, T1, T2 and T3 treatments. Similar results were reported by Thiyageshwari *et al.*, (2018) where protein content and crude protein (20.19 and 21.44%) was highest with the application of composted rice husk (CRH) + 50% RDF recommended dose of fertilizer + (R) *Rhizobium* + (PSB) phosphobacterium in black gram.

Similar work was supported by Palia *et al.*, (2021) who observed in brinjal that application of organic and inorganic fertilizers increased the protein content (1.44%). Similar result was obtained by Naik *et al.*, (2022) who noted an increased protein content in seed (24.30) of chickpea (*Cicer arietinum* L.) when treated with 50% RDF + 25% *Rhizobium* + 25% *Azotobacter*. The present results are in agreement with that of Shanker and Ram, (2023) that combined application of vermicompost (10 t/ha) + neem seed kernel extract (NSKE 5%) enhanced grain yield with greater values of protein (20.47 g), fat (6.04 g), carbohydrate (62.95 g), fiber (12.2 g) and sugar (10.78 g) in chickpea (*Cicer arietinum* L.)

Similarly Van Chuong, (2023) reported that application of NPK + (chicken manure) CM 6t /ha + *Rhizobium* sp enhanced yield quality of peanut (7.60 t/ha), oil (50.6%), seed protein percentage (26.8%) as well as NPK content in seed (4.32, 0.912 and 0.999%) respectively. Gopinath *et al.*, (2023) found that the application of organic (FYM + *Trichoderma viridae* at 2.5 kg ha⁻¹) and integrated (FYM + mineral fertilizers) enhanced the protein content in pigeon pea (19.6 and 20.0%) and green gram (21.8 & 21.4%) seeds.

Similarly Elshaboury *et al.*, (2024) reported that application of chicken manure (ChM) compost at the rate of 10 ton fed⁻¹ has increased the quality of seeds protein (33.02%) and carbohydrate (25.64%) in soyabean.

The present investigation revealed that the plant growth and yield is increased in the test plants treated with microbial enriched vermicompost Treatment 6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* +

Eisenia fetida (5t/ha). Further, the response also reflected in the increase of protein, carbohydrate and chlorophyll of the plants was due to the enrichment of the nutrients present in the vermicompost used in the growth of the test plants. Increase in protein and carbohydrate content might be due to the effect of paddy and coffee husk vermicompost on microbial activity which resulted in higher supply of nitrogen throughout the growth period resulting in higher protein and carbohydrate content. Because vermicompost is a nutritive 'organic fertilizer' rich in NPK, micronutrients and beneficial soil microbes are scientifically proved as 'miracle growth promoters & protectors of plants. The decrease in carbohydrates in plants after 60 days of applying biocompost could be attributed to several factors: one of them plant growth stage: during early growth stages, plants allocate more carbohydrates to root development and establishment. As the plants mature, carbohydrate allocation shift towards reproductive structures and storage organs, resulting in fluctuations in carbohydrate levels over time.

The increase in chlorophyll content up to 40 and 60 DAS in the leaves might be due to the incorporation of vermicompost which enhanced the nitrogen content of the soil, which is also constituent of important compounds like amino acids, ATP, ADP, chlorophyll and enzymes. The decline in chlorophyll content might be due to the breakdown of protein, ageing of the leaves and microbial cell lysis. Application of paddy and coffee husk vermicompost might have produced maximum photosynthate accumulation towards the leaf biomass. During initial stage, leaves are the most powerful structures than any other plant parts. In fact, leaf is the factory for the conversion of the solar energy into the chemical energy by the process of photosynthesis.

Nitrogen is a major constituent of the plant substances, especially in dry matter of protoplasm, amino acids, construction of proteins and also an essential constituent of chlorophyll. Nitrogen is the limiting nutrient for rapid growth of plants in agriculture. The increase in leghaemoglobin content might be due activity of the bacterial respiration and decline in leghaemoglobin gradually might be due to less nitrogenase activity by the bacteria and due to decrease in nodule number as growth of the plant progress. Like nitrogen, phosphorus also involved with many vital plant processes as a structural component of the nucleic acids as well as a constituent of fatty acids in membrane development and function. Phosphorus can also be used to modify the activity of various

enzymes by phosphorylation Phosphorus is concentrated at most actively growing points of a plant and stored within seeds in anticipation of their germination.

Increase in yield parameters might be due to the beneficial effect of paddy and coffee husk vermicompost on plant growth manifested with increased chlorophyll production, rate of photosynthesis as well as increased the nitrogen and phosphorus turnover in soil through nitrogen fixation and mobilized native soil nitrogen which resulted in better plant growth as well as qualitative yield attributes. The increase in protein and carbohydrate in yield might be due to the positive role of the organic manures with balanced supply of nitrogen throughout the life cycle of the crop.

4.6 Influence of coffee husk as organic manure on phytochemical analysis of selected medicinal plants

The study was conducted to screen the phytochemicals of the best treatment T6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida*(5t/ha) and control fenugreek seeds and kalmegh leaves using methanol extracts as presented in Table - 27.

4.6.1 Kalmegh (*Andrographis paniculata* (Burm.f.) Nees)

Phytochemical screening of the methanolic leaf extracts of Kalmegh (*Andrographis paniculata* (Burm.f.) Nees) revealed the presence of alkaloids, terpenoids, flavonoids, sterols, anthraquinone, carbohydrates, saponins, cardiac glycosides and glycosides in the treated plant whereas Control plant showed similar results with the exception of anthroquinone, terpenoids, cardiac glycosides and glycosides.

4.6.2 Fenugreek (*Trigonella foenum-graecum* L.)

Phytochemical screening in methanol seed extracts of Fenugreek (*Trigonella foenum-graecum* L.) revealed the presence of alkaloids, flavonoids, sterols, anthraquinone, carbohydrates, proteins, phenolic compounds, saponins, cardiac glycosides and glycosides in the treated plant. Control plant showed similar results with the exception of anthroquinone, terpenoids and phenolic compounds.

Phytochemicals play an important role in plant growth, development with the anti oxidant and medical properties. They are involved in manufacturing of various medicines

that give a way for the study and identification of phytochemicals. The recent studies have shown the thrust for the study on phytochemicals and their place in medicine.

The study was positively correlated with the findings of Tarozzi *et al.*, (2006) who reported that organically grown red oranges showed the presence of phytochemical constituents i.e., phenolics, anthocyanins and ascorbic acid than integrated red oranges. Ghosh *et al.*, (2008) reported that methanolic leaf extracts of *Polyalthia longifolia* showed the presence of steroids, alkaloids, biterpenoids, carbohydrates, amino acids, essential oil, phenolics and flavonoids as major phytochemicals. Perumal *et al.*, (2012) reported the preliminary phytochemical screening of *Cayratia trifolia* and showed the presence of alkaloid, flavonoids, tannins, saponins and phenolic compounds in ethanolic extract.

Similar results were obtained by Mbaebie *et al.*, (2012) who observed the presence of tannin, alkaloid, steroids, glycosides and saponins in *Schotia latifolia*. The study was positively correlated with the findings of Syed *et al.*, (2013) who observed the presence of alkaloids, triterpenes, tannins, saponins, glycosides, phenolic compounds and flavonoids in *Pisonea aculeata* leaf.

Similarly Uckoo *et al.*, (2015) observed the levels of phytochemicals of Meyer lemons (*Citrus meyeri* Tan.) cultivated on organic and conventional manner, results indicated that organically grown lemons contain significantly higher levels of hesperidin, didymin and ascorbic acid. Patil *et al.*, (2015) also recorded the presence of proteins, starch, amino acids, fats and fixed oils, glycosides, tannins, alkaloids and flavonoids in the aerial parts (leaves and stem) of *Trigonella foenum-graecum* L., Similar results were reported by Gupta *et al.*, (2016) and revealed the presence of phytochemical contents of 25 moth bean (*Vigna aconitifolia*) seed accessions and it was revealed there was significant variation in the contents of phytochemicals,

Similarly Hariharan *et al.*, (2021) reported the presence of Saponins, tannins, phlobatannins, hydrolysable tannins, phenols, alkaloids, terpenoids, flavonoids and glycosides in *Andrographis paniculata* aqueous extract. The results are on par with that of Aydi *et al.*, (2023) who reported that when compost of date palm trunk and coconut fiber used as soil less substrate improved phytochemical composition of flavonoid contents showing values ranging from 10 to 23 mg g⁻¹ and polyphenol contents that

showed between 30 and 43 mg g⁻¹ of melon (*Cucumis melo* L). Similar pattern of results were observed by El-Hefny *et al.*, (2023) who reported that leaf methanolic extracts showed phenolic compounds and flavonoid compounds with the combined application of compost (50 and 25%) and metallic nanoparticles (30 mg/L) of *Asclepias curassavica*.

Table - 27

Influence of paddy and coffee husk as organic manure on preliminary phytochemical screening of best treatment and control leaf and seed extracts of kalmegh and fenugreek

S.No	Name of the Phyto-chemical	<i>Andrographis paniculata</i>		<i>Trigonella foenum-graecum</i>	
		Best treatment Leaf extract (T6)	Control Leaf extract (C)	Best treatment Seed extract (T6)	Control Seed extract (C)
1	Alkaloids	+	+	+	+
2	Flavonoids	+	+	+	+
3	Sterols	+	+	+	+
4	Terpenoids	+	-	+	-
5	Anthraquinone	+	-	+	-
6	Anthocyanin	-	-	-	-
7	Proteins	-	-	+	+
8	Phenolic compounds	-	-	+	-
9	Quinones	-	-	-	-
10	Carbohydrates	+	+	+	+
11	Tanins	-	-	-	-
12	Saponins	+	+	+	+
13	Phytates	-	-	-	-
14	Cardiac glycosides	+	-	+	+
15	Glycoside	+	-	+	+
16	Lignin	-	-	-	-
17	Coumarins	-	-	-	-
18	Volatile oils	-	-	-	-

('+' indicates Present and '-' Absent)

From the present study, using biocompost treatment 6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida*(5t/ha) confirmed the influence of organic manures on the plant primary and secondary metabolites. These evidences show that the nutrients present in the biocompost specially NPK play an important role in plant metabolism. These nutrients confer the addition of nutritional value for fruits, seeds etc. The phytonutrient composition is highly dependent on soil conditions as well as agricultural practices. Phytochemicals help in the protection of plants from germs, fungi, bugs etc. In this experimental study, appropriate amount of phytochemicals has been improved in test plants with the application of coffee husk vermicompost along with *Pleurotus species* and *Trichoderma*. The correlation between pulses and medicinal plants lies in the bioactive compounds present in pulses that contribute to their health benefits, similar to the bioactive constituents found in medicinal plants. Both pulses and medicinal plants contain compounds that can have therapeutic effects.

Biocomposts T1 – T6 vermicomposts are rich in NPK, micronutrients and beneficial soil microbes, so it is attracting the attention as a greener replacement for chemical fertilizers to maintain and improve soil quality. In our study, it is proved that the application of vermicomposted paddy and coffee husk not only produced healthier plants, but it also increased plant resistance by improving the secondary metabolites. Vermicompost provides nutrients to the plants in readily available forms and enhances the plant nutrient - uptake.

PHASE -IV

4.7 Influence of coffee husk as organic manure on Antioxidant activity in seeds and leaves of selected test plants

All the above analyzed data were found to be statistically significant in all the biocomposts as compared to the control treatment. Among the six types of biocomposts, Treatment T6 (Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida*(5t/ha) was found to be an efficient organic manure when compared to other treatments. The treatment T6 over all enhanced the compost maturity, microbial population, biometric, yield and biochemical, leghaemoglobin content and physico-chemical parameters of pre and post-harvest soil of the selected plants namely moth bean, black gram, fenugreek and kalmegh.

Considering the above result, antioxidant and antibacterial activity was carried out using aqueous and methanol seed (Moth bean, Black gram and Fenugreek) and leaf (Kalmegh) extracts grown under best treatment (T6) and control.

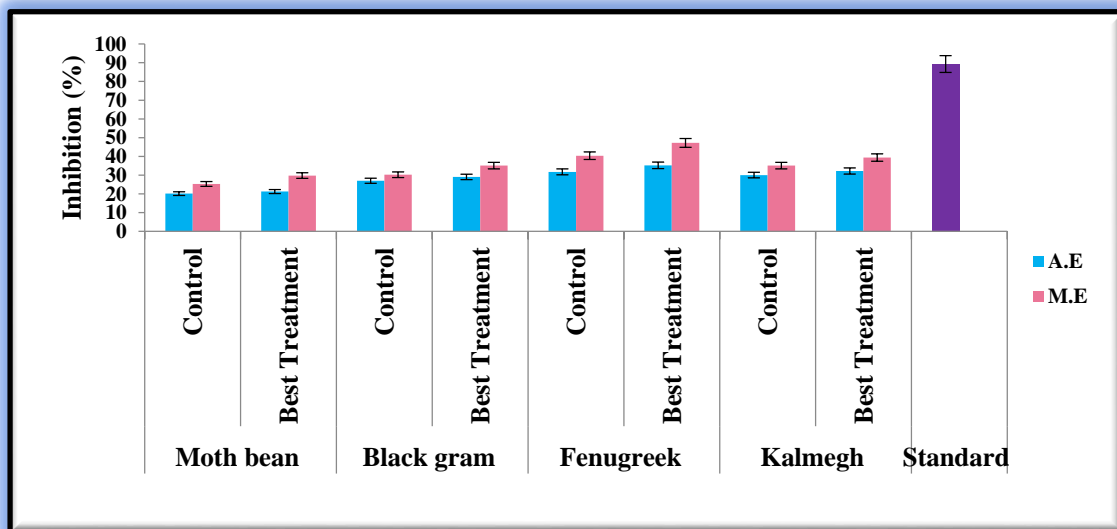
4.7.1 Hydrogen peroxide scavenging activity in seeds and leaves of selected test plants

The H₂O₂ scavenging activity of moth bean, black gram, fenugreek and kalmegh were carried out in seeds and leaves of aqueous and methanol extracts. The results were depicted in Figure - 22. The ability of aqueous and methanol seed extracts to scavenge the non-radical oxidant hydrogen peroxide was assessed in the present study. Among the selected four plants, it was observed that the scavenging percentage was higher in the best treatment methanol and aqueous seed extract of *Trigonella foenum-graecum* (47.23 % and 35.22 %) followed by control methanol and aqueous seed extracts of fenugreek (40.36 % and 31.72 %) respectively.

It was also observed that all the extracts are likely to have hydrogen peroxide scavenging activity in the order *Trigonella foenum-graecum* > *Andrographis paniculata* > *Vigna mungo* > *Vigna aconitifolia*.

Figure - 22

Hydrogen peroxide scavenging activity in seeds and leaves of selected plants



C - Control Sample

B - Best Treatment (T6) - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5 t/ha).

Standard - Ascorbic acid

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

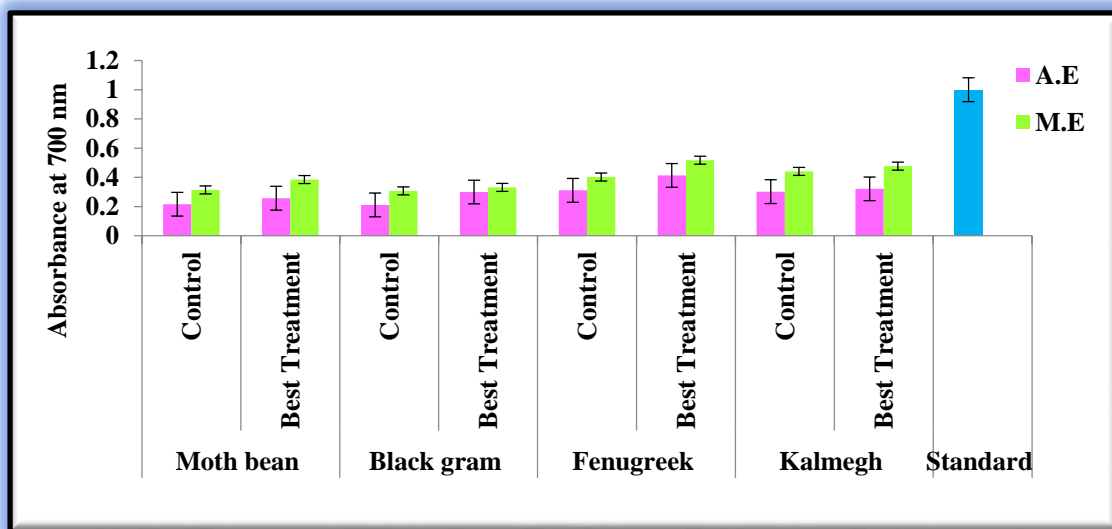
4.7.2 Reducing power assay in seeds and leaves of selected test plants

The ability of reducing power was assessed in the best treatment T6 - (Raw Coffee husk, 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) and Control plant seeds and leaves as presented in Figure - 23. Among the four selected plants, reducing power was maximum in *Trigonella foenum-graecum* methanol seed extract (0.517) as compared to aqueous extract (0.413). The reducing power assay was moderate in control methanol seed extract (0.402) followed by aqueous seed extract (0.311) as compared with ascorbic acid as standard. It was observed that all the extracts have reducing power assay in the order *Trigonella foenum-graecum* > *Andrographis paniculata* > *Vigna aconitifolia* > *Vigna mungo*.

This may be due to the biologically active compounds in the extracts which possess potent donating abilities. Reducing power of a compound may serve as a significant indicator of its potential antioxidant activity.

Figure – 23

Reducing power assay in seeds and leaves of selected test plants (absorbance at 700nm)



C - Control Sample

B - Best Treatment (T6) - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5 t/ha).

Standard - Ascorbic acid

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

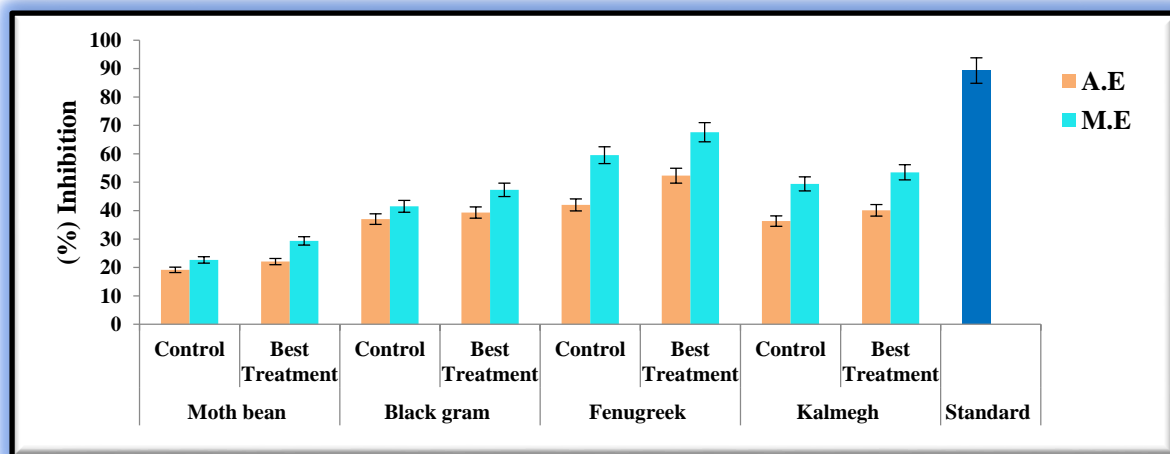
4.7.3 Nitric oxide radical scavenging activity in seeds and leaves of selected test plants

The nitric oxide radical scavenging activity was found in all the selected plants which are grown under best treatment and moderate activity was observed in Control. Among the four plants, significant nitric oxide radical scavenging activity (67.61 %) was recorded in methanol extracts of *Trigonella foenum-graecum* followed by aqueous seed extracts (52.33%) in T6 treatment (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha). The nitric oxide radical scavenging activity was moderate in control methanol seed extract (59.52) followed by aqueous seed extract (42.01) of fenugreek and the values were compared with ascorbic acid as standard. It was concluded that all the plant extracts are likely to have nitric oxide scavenging activity which is shown in Figure - 24.

The activity was in the order *Trigonella foenum-graecum* > *Andrographis paniculata* > *Vigna mungo* > *Vigna aconitifolia*. The results revealed that all the plants have the property to counteract the harmful effects of nitric oxide and other reactive nitrogen species (RNS). This could be due to the antioxidant principles in the extract that compete with oxygen to react with nitric oxide, there by inhibiting the generation of nitrite.

Figure – 24

Nitric oxide radical scavenging activity in seeds and leaves of selected test plants



C - Control Sample

B - Best Treatment (T6) - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5 t/ha).

Standard - Ascorbic acid

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

4.7.4 DPPH radical scavenging activity in seeds and leaves of selected test plants

The antioxidant activity was assessed in the selected test crop seeds (moth bean, black gram and fenugreek) and leaves (kalmegh) of control and best treatment in aqueous and methanol extracts using DPPH assay and are indicated in Figures - 25 to 28. In the DPPH assay, the antioxidants were able to reduce the stable DPPH radicals to the yellow coloured diphenyl - picrylhydrazine.

The DPPH scavenging activity of the aqueous and methanol extracts of four test plants at varying concentrations from 20, 40, 60, 80, and 100 µg/mL was determined using ascorbic acid as the standard. From the above result, highest values were recorded in methanol as well as aqueous extracts at 100 µg/mL concentration and it was found that all the selected plant seeds of methanol extract showed maximum ability followed by aqueous extracts. The activity was in the order of *Trigonella foenum – graecum* > *Andrographis paniculata* > *Vigna mungo* > *Vigna aconitifolia*.

4.7.4.1 Moth bean

Control: As per the results, an aqueous and methanol seed extracts showed significant DPPH scavenging activity of 19.16 % & 21.26 % at 20µg/mL, 26.21 % & 27.22 % at 40 µg/mL, 30.13 % & 32.31 % at 60 µg/mL, 34.14 % & 36.15 % at 80 µg/mL, 39.28 % and 41.21 % at 100 µg/mL.

Best treatment (T6): The aqueous and methanol seed extracts of moth bean determined appreciable DPPH scavenging activity of 23.26 % & 25.22 % at 20 µg/mL, 31.03 % & 33.17 % at 40 µg/mL, 40.12 % & 41.16 % at 60 µg/mL, 42.17 % & 46.14 % at 80 µg/mL, 45.16 % aqueous and methanol extract (48.58 %) at 100 µg/mL. The maximum radical scavenging activity was recorded at methanol seed extracts followed by aqueous extract of best treatment as compared to control as presented in Figure -25

4.7.4.2 Black Gram

Control: DPPH scavenging activity of aqueous and methanol seed extracts of black gram showed significant scavenging activity of 18.16 % & 21.71 % at 20 µg/mL, 23.22 % & 29.33 % at 40 µg/mL, 31.77 % & 34.91 % at 60 µg/mL, 38.04 % & 43.46 % at 80 µg/mL, 41.22 % and 46.01 % at 100 µg/mL

Best treatment (T6): The aqueous seed extracts of black gram indicate 23.01 %, 29.17 %, 37.61 %, 43.44 %, 45.09 % and methanol extract of 27.11 %, 32.12 %, 39.51 %, 48.26 % and 47.41 % DPPH scavenging activity at 20, 40, 60, 80 & 100 µg/mL. The maximum radical scavenging activity was recorded at methanol seed extracts followed by aqueous extract as compared to control (Figure -26).

4.7.4.3 Fenugreek

Control: DPPH scavenging activity of aqueous and methanol seed extracts showed significant scavenging activity of 20.11 % & 23.01 % at 20 µg/mL, 26.05 % & 29.33 % at 40 µg/mL, 32.66 % & 37.39 % at 60 µg/mL, 43.18 % & 47.26 % at 80 µg/mL, 47.25 % and 49.22 % at 100 µg/mL.

Best treatment (T6): The aqueous and methanol seed extracts of fenugreek determined appreciable scavenging activity of 31.21 %, 34.01 %, 41.23 %, 45.22 % & 49.96 % in aqueous and methanol extract of 34.26 %, 39.26 %, 45.03 %, 49.24 % & 51.51 % at 20, 40, 60, 80 & 100 µg/mL. The maximum radical scavenging activity was recorded at methanol seed extracts followed by aqueous extract as compared to control as presented in Figure - 27.

4.7.4.4 Kalmegh

Control: DPPH scavenging activity of aqueous and methanol seed extracts noted significant scavenging activity of 19.21 % & 20.22 % at 20 µg/mL, 24.30 % & 26.89 % at 40 µg/mL, 30.49 % & 35.39 % at 60 µg/mL, 39.04 % & 40.15 % at 80 µg/mL, 47.12 % and 48.35 % at 100 µg/mL.

Best treatment (T6): The aqueous leaf extracts of kalmegh indicate appreciable DPPH scavenging activity of 30.11 %, 37.81 %, 40.27 %, 45.87 %, 49.01 % and methanol extract 31.21 %, 38.11 %, 42.31 %, 48.31 % & 50.43 % at 20, 40, 60, 80 & 100 µg/mL. The maximum radical scavenging activity was recorded at methanol seed extracts followed by aqueous extract as compared to control as depicted in Figure - 28.

Figure -25

DPPH free radical scavenging activity of aqueous and methanol seed extracts of moth bean (*Vigna aconitifolia* (Jacq.) Marechal)

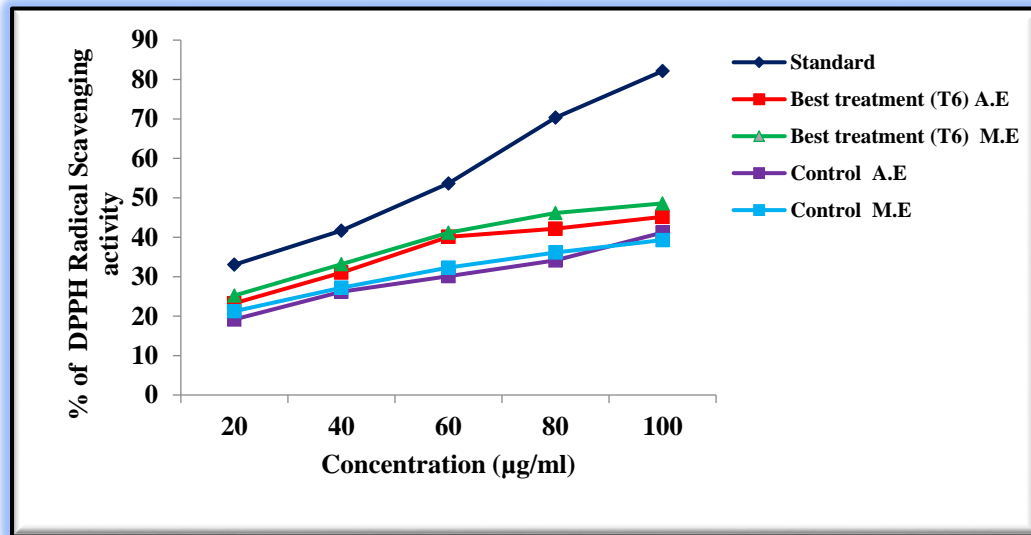
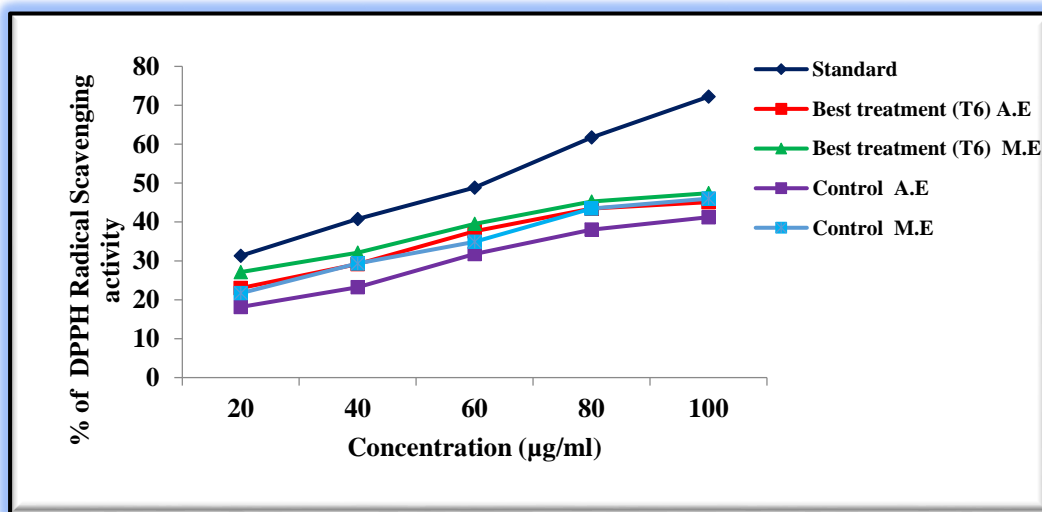


Figure - 26

DPPH free radical scavenging activity of aqueous and methanol seed extracts of black gram (*Vigna mungo* (L.) Hepper)



C - Control Sample

B - Best Treatment (T6) - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5 t/ha).

Standard - Ascorbic acid

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

Figure - 27

DPPH free radical scavenging activity of aqueous and methanol seed extracts of fenugreek (*Trigonella foenum-graecum* L.)

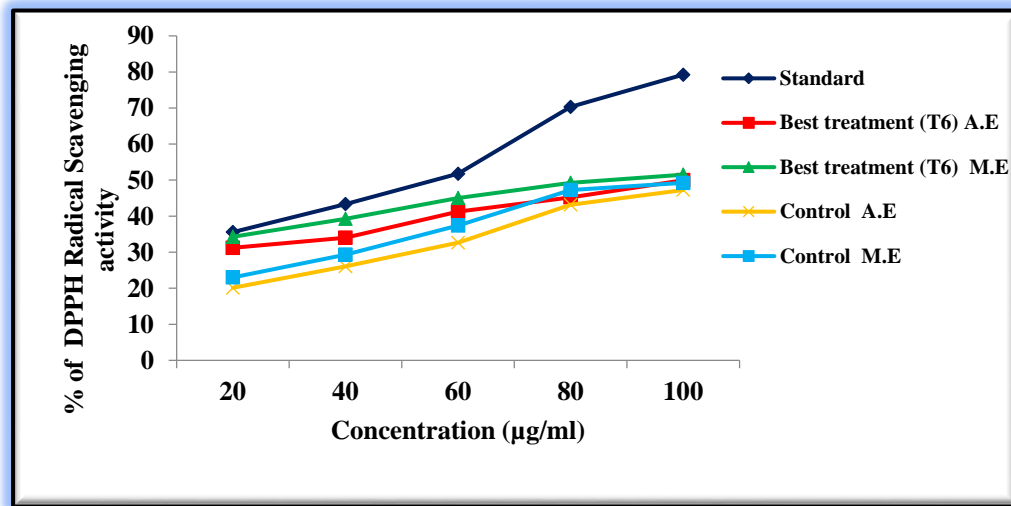
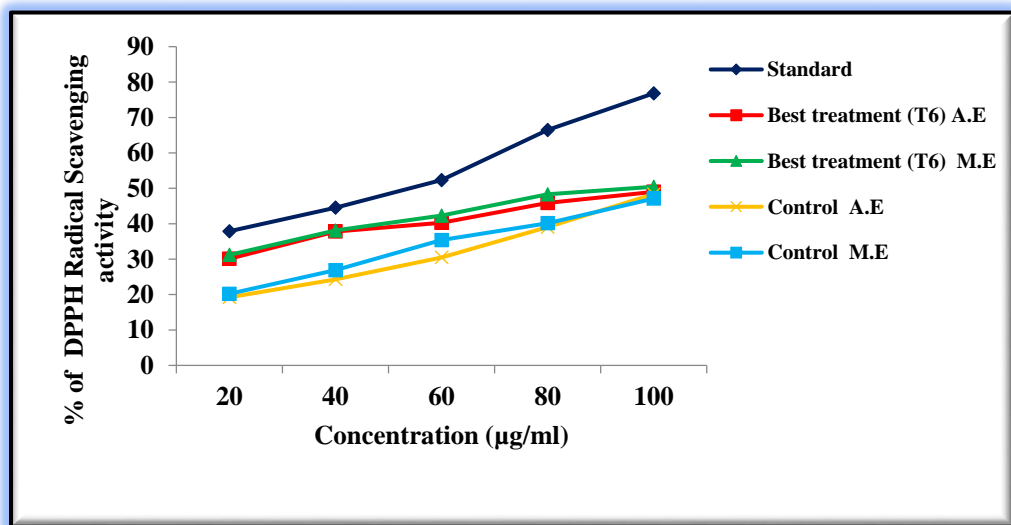


Figure - 28

DPPH free radical scavenging activity of aqueous and methanol leaf extracts of kalmegh (*Andrographis paniculata* (Burm.f.) Nees)



C - Control Sample

B - Best Treatment (T6) - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5 t/ha).

Standard - Ascorbic acid

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

From the above studies, it was clearly indicated that the methanol seed extract of fenugreek possesses significant free radical scavenging activity followed by aqueous extract. Hence, the IC₅₀ value for DPPH free radical scavenging assay was tested for methanol seed extracts of fenugreek alone (Table -28 and Figure - 29).

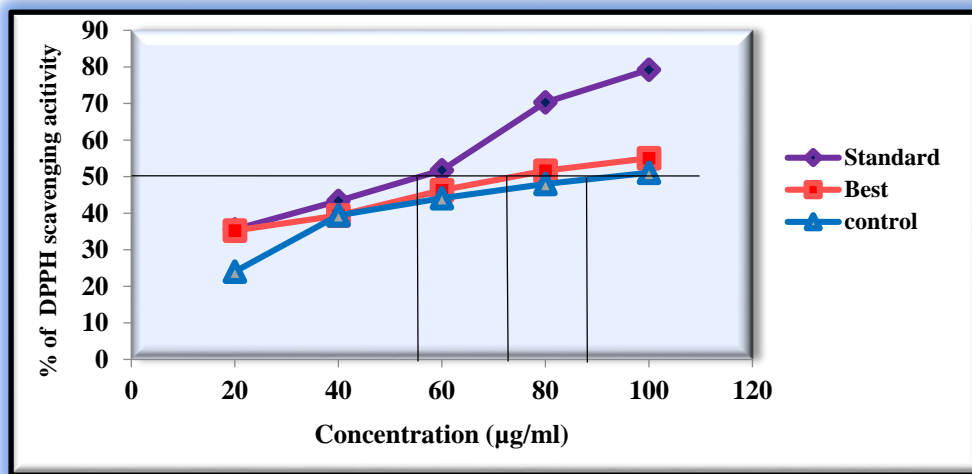
Table - 28

IC₅₀ value for the DPPH radical scavenging activity of methanol seed extract of fenugreek (*Trigonella foenum-graecum* L.)

Samples	Graded concentrations of the samples (µg/ml)					IC ₅₀ Value
	20	40	60	80	100	
Standard	35.57	43.34	51.76	70.32	79.24	57.13
Best Sample	34.26	39.26	45.03	49.24	51.51	76.71
Control	23.01	29.33	37.39	47.26	49.22	89.03

Figure - 29

IC₅₀ value for the DPPH radical scavenging activity of methanol seed extract of fenugreek (*Trigonella foenum-graecum* L.)



C - Control Sample

B - Best Treatment (T6) - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5 t/ha).

Standard - Ascorbic acid

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

Maximum scavenging activity was observed in methanol extracts of best treatment grown plant seeds. The methanol seed extracts of *Trigonella foenum-graecum* possibly contained some substrates that are electron donors and react with free radicals to convert them to more stable products and terminate the radical chain reaction.

IC₅₀ value of best treatment grown *Trigonella foenum-graecum* seeds (76.71 µg/ ml) showed significant antioxidant activity as compared to the Control treatment (89.03 µg/ ml). The above results were compared to the standard Ascorbic acid (57.13 µg/ ml).

From the above studies, it is evident that the free radical scavenging activity of the plant varies with the solvent used for extraction and also different plants exhibited different levels of radical scavenging potential.

The organic fertilizer especially paddy and coffee husk biocompost improved the nutritional quality, higher production of secondary metabolites and antioxidant content in plants along with improving the soil health. The functional quality and antioxidant constituents of tested plants are strongly influenced by environmental factors, mineral, nutrition and microbial activity. Our results in antioxidant activity of tested plants reveal that antioxidant enzyme activity of hydrogen peroxide scavenging activity, reducing power assay for the selected plant seeds and leaves, nitric oxide radical scavenging activity and DPPH free radical scavenging activity of aqueous and methanol seed extracts was significantly higher in the seeds of fenugreek which received raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* 5t/ha (T6 - best Treatment).

The present studies are in correlation with that of Asami *et al.*, (2003) who observed the different levels of antioxidants in freeze dried and air dried marion berry, strawberry and corn plants and found that higher levels of total phenol in organically (620 mg/100 g) and sustainable agriculture (630 mg/100 g) grown foods as compared to those produced by conventional agricultural practices in marion berry. Similar to this result Wang and Lin, (2003) also observed that the application of compost as soil supplement significantly enhanced the ascorbic acid, vitamin C content than chemically fertilized soil grown crops.

The results are in conformity with Meda *et al.*, (2005) who recorded total phenolic, flavonoid, proline contents and radical scavenging activity in 27 different Burkina Fasan honey samples. The IC₅₀ values (1.63 to 29.13 mg/ml) and highest DPPH RSAs were found in all *Vitellaria* honeys. Similarly, Tarozzi *et al.*, (2006) also reported that organically grown red oranges have a higher phytochemical content (i.e., phenolics, anthocyanins and ascorbic acid), total antioxidant activity and bioactivity than non – organically integrated grown red oranges.

Similar to our results Sreeramulu *et al.*, (2009) studied the antioxidant activity of commonly consumed cereals, millets, pulses and legumes in India. Finger millet (*Eleusine coracana*), rajma (*Phaseolus vulgaris*) showed highest ferric reducing antioxidant power (FRAP 471.71, 372.76), reducing power DPPH scavenging activity (1.73, 1.07). Wang *et al.*, (2010) confirmed that application of cow manure vermicompost on chinese cabbage (*Brassica campestris* ssp. *chinensis*) improved the antioxidant activity by 2, 2-Dipenyl-1-picrylhydrazyl-scavenging activity, hydroxyl (OH[•]) scavenging activity.

Deshpande *et al.*, (2011) found increase in scavenging activity of hydrogen peroxide (H₂O₂) (0.309), reducing power assay (0.132) and DPPH radicals (0.129) at 250µg/ml concentration by methanol fruit extract of *Coccinia grandis* L. Voigt. The present study is in conformity with that of Perumal *et al.*, (2012) who found highest DPPH free radical scavenging activity and the IC₅₀ value of 74 ± 0.83 µg/mL in ethanol extract of *Cayratia trifolia*.

Similar to our results Borguini *et al.*, (2013) reported that alcohol and aqueous extracts from organic tomatoes presented higher antioxidant activity in the DPPH test (25.43 and 14.28 %) than the conventionally grown tomatoes (19.52 and 11.33 %). Deepak *et al.*, (2014) also studied the antioxidant activity of *Andrographis paniculata* with 2 extracts (DCM and Methanol), the result showed the IC₅₀ values of 69.32 µg/ml and 82.23 µg/ml in DPPH assay. The findings are on par with that of Zambrano-Moreno *et al.*, (2015) who reported that the antioxidant activity was high in organically cultivated (77.20 mg GAE/100 g FW) egg plant than conventionally (63.99 mg GAE/100 g FW) grown plant. Similar result was observed by Mohd Din *et al.*, (2017) who assessed the effect of compost on pak choi (*Brassica rapa* cv. *chinensis*) and higher antioxidant capacity was observed at non-aerated compost extract (NCE) + inorganic fertilizers.

Petkova *et al.*, (2017) also observed the great differences between 8 medicinal plant species in antioxidant activity and the highest antioxidant activity was recorded by *Arctium lappa* L. of 245.12 mM TE g⁻¹dw, followed by *Tussilago farfara* L. and *Mentha piperita* L. extracts. Similar to our results Yaldiz *et al.*, (2017) reported that organic manure - treated out of the four medicinal plants of Lamiaceae family *Melissa officinalis* L. recorded the highest antioxidant activity.

The plants grown with vermicompost showed the higher IC₅₀ values in DPPH scavenging activity (3.139 mg/mL), ABTS (7.290 mg/mL) and ferric reducing antioxidant power assay (FRAP) (0.276 mg FE/g dE) than plants grown on chemical fertilizer (Mahmud *et al.*, 2019). Similar results were reported by Mahmud *et al.*, (2020) where the supplementation with vermicompost increased the IC₅₀ value in DPPH scavenging activity (8.250 mg/ml) when compared to control (6.022 mg/ml) in methanol extract of pineapple fruits produced from ex vitro MD.

Similar to these findings Chaturvedi and Pandey, (2021) found that there was a positive effect of bioinoculant and vermicompost on total antioxidant activity of *Mentha arvensis* L when compared to control. The results are in line with that of Uthirapandi *et al.*, (2021) who observed that the application of seaweed (*Sargassum wightii* Greville) liquid extracts enhanced antioxidant activity of *Andrographis paniculata* (Burm f.) Nees (53.94 µg/ml DPPH activity and 44.94 % of nitric oxide activity).

Similar findings were observed by Lahbouki *et al.*, (2022) who recorded the enhancement of phenolic and DPPH antioxidant activity by 58, 52 and 33% in prickly pear cactus (*Opuntia ficus-indica*) under the arbuscular *mycorrhizal* fungi and vermicompost supplementation.

The results are positively correlated with that of Libutti *et al.*, (2023) who observed that use of vermicompost to the soil both alone and in a mixture with biochar from vine prunings significantly increased the reducing power (23.6 to 48.8 TE 100 g⁻¹) and DPPH scavenging activity (4.7 to 10.9 TE 100g⁻¹) of leafy vegetable *Beta vulgaris* L.

Similar to our results Verrillo *et al.*, (2023) also reported that humic substances (HS) and compost teas (CTs) extracted from artichoke (ART) and coffee ground (COF) biomasses when recycled and employed on *Ocimum basilicum* plants noted higher

antioxidant capacity (55 and 49 μmol) at 100 mg L^{-1} . The present results are on par with that of Aydi *et al.*, (2023) who reported that when compost of date palm trunk are used as soil less substrate, it improved antioxidant activity (26 mg GAE g^{-1} DW) of gallic acid per gram of dry matter in melon (*Cucumis melo* L).

Similar to our results Elshaboury *et al.*, (2024) also reported that application of chicken manure (ChM) compost at the rate of 10 ton fed^{-1} improved the peroxidase activity (2.819 mg^{-1}) in the leaves of soyabean.

4.8 Antibacterial activity - zone of inhibition against selected microbes in the aqueous and methanol seed and leaf extracts of selected plants

The antibacterial activity of Best Treatment (T6), Control methanol and aqueous extracts were determined using Mueller - Hinton agar to assess the antibacterial activity of moth bean, black gram and fenugreek (seeds) and kalmegh (leaf). Antibacterial activity of the test crops was evaluated using two gram negative bacterial strains such as *Escherichia coli*, *Vibrio cholerae* and a gram positive bacterial strain i.e., *Staphylococcus aureus*. Choosing these specific strains because of their pathogenicity, prevalence, diverse modes of infection, research focus and they provide a comprehensive assessment of the potential effectiveness of antibacterial agents against diverse pathogens with significant implications for human health.

Inhibition zone of the reference antibiotic and the extracts are shown in Plate - 14 to 18 and Figures - 30 to 33. Both the extracts showed better antibacterial activity in all the four plants investigated.

4.8.1 Positive and Negative control

Standard antibiotic Streptomycin was maintained as positive control and distilled water as negative control on separate plates on all the reference bacterial cultures. The standard antibiotic Streptomycin showed the zone of inhibition of 32 mm, 29 mm and 31 mm against *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus*, the negative control distilled water showed no inhibition on all the test bacterial cultures (Plate - 14).

4.8.2 Moth Bean (*Vigna aconitifolia* (Jacq.) Marechal)

Control (without treatment)

As per the result, aqueous seed extract showed the inhibition zone of 15 mm, 10 mm and 10 mm for *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus* respectively. Methanol seed extracts showed the highest inhibition zone of 17 mm, 11 mm and 11 mm on *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus* respectively.

The highest inhibition zone of 17 mm was noticed against *Vibrio cholerae* in methanol seed extracts followed by aqueous extract.

Best treatment (T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

The aqueous seed extract showed the inhibition zone of 17 mm, 11 mm and 15 mm for *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus* respectively where as methanolic seed extracts showed the inhibition zone of 19 mm, 13 mm and 16 mm for *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus* respectively. The highest zone of inhibition (19 mm) was found against *Vibrio cholerae* in methanol seed extracts followed by aqueous extract. The zone of inhibitions was moderately different from each other as compared to the standard antibiotic as shown in Plate - 15 & Figure - 30.

4.8.3 Black gram (*Vigna mungo* (L.) Hepper)

Control (without treatment)

As per the result, the aqueous seed extract showed the inhibition zone of 14 mm, 10 mm and 10 mm for *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus* respectively. Methanol seed extracts showed the inhibition zone of 15 mm, 14 mm and 12 mm on *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus* respectively. The highest zone of inhibition (15 mm) was recorded against *Vibrio cholerae* in methanol seed extracts followed by aqueous extract.

Best treatment (T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

The aqueous seed extract showed the inhibition zone of 15 mm, 11 mm and 14 mm for *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus* respectively.

Methanol seed extracts showed the inhibition zone of 17 mm, 16 mm and 15 mm for *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus* respectively. The highest zone of inhibition (17 mm) was found against *Vibrio cholerae* in methanol seed extracts followed by aqueous extract. The zone of inhibition was moderately different from each other as compared to the standard antibiotic as depicted in Plate - 16 & Figure - 31.

4.8.4 Fenugreek (*Trigonella foenum-graecum* L.)

Control (without treatment)

The aqueous seed extract showed the inhibition zone of 13 mm, 14 mm and 14 mm for *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus* respectively. Methanol seed extracts showed the inhibition zone of 17 mm, 18 mm and 19 mm on *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus* respectively. The highest zone of inhibition of 19 mm was noted against *Staphylococcus aureus* in methanol seed extracts followed by aqueous extract

Best treatment (T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

The aqueous seed extract showed the inhibition zone of 16 mm, 15 mm and 16 mm for *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus* respectively. Methanol seed extracts showed the inhibition zone 20 mm, 21 mm and 20 mm for *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus* respectively. The highest zone of inhibition (21 mm) was found against *Escherichia coli* in methanol seed extracts followed by aqueous extract as shown in Plate - 17 & Figure - 32.

4.8.5 Kalmegh (*Andrographis paniculata* (Burm.f.) Nees)

Control (without treatment)

The inhibition zone of the aqueous leaf extract showed 17 mm, 14 mm and 13 mm for *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus* respectively. Methanol leaf extracts showed the inhibition zone of 19 mm, 18 mm and 18 mm against *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus* respectively. The maximum zone of inhibition of 19 mm being noted against *Vibrio cholerae* in methanol leaf extracts followed by aqueous extract

Best treatment (T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

The aqueous leaf extract showed the inhibition zone of 18 mm, 15 mm and 16 mm for *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus*, while methanol leaf extracts showed the maximum inhibition zone of 21 mm, 19 mm and 20 mm for *Vibrio cholerae*, *Escherichia coli* and *Staphylococcus aureus* respectively. The highest zone of inhibition (21 mm) was found against *Vibrio cholerae* in methanol leaf extracts followed by aqueous extract as shown in Plate - 18 & Figure - 33.

The selected plants showed positive antibacterial activity in both the extracts (methanol and aqueous), this is due to the presence of phytochemicals present in seeds and leaves. Phytochemical constituents such as alkaloids, flavonoids, tannins, phenols, saponins, steroids and aromatic compounds play a vital role in defense mechanism against many microorganisms. The antibacterial activity is due to the ability of phytochemicals acted by disrupting microbial membranes made of carvacrol, thymol, eugenol that involve in impairing the cellular metabolism. Antimicrobial activity of selected plant might be involved in inhibiting the bacterial capsule production (salicylic acid and its derivatives). Our results proved that application of coffee husk biocompost (Treatment 6) enriched the test crops of plant - derived compounds as well as their specific target sites along with traditional antimicrobials and subsequently exhibited defense mechanisms of action against selected microorganisms.

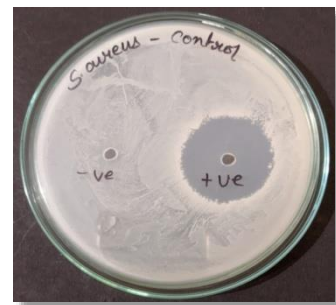
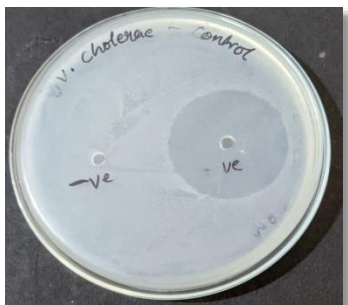
Plate - 14

Antibacterial activity - Control (zone of inhibition against selected microbes)

Vibrio cholerae

Escherichia coli

Staphylococcus aureus



+ Ve Control - (Standard) Streptomycin

-Ve Control - Water

Figure - 30

Antibacterial activity - zone of inhibition against selected microbes in the aqueous and methanol seed extracts of moth bean (*Vigna aconitifolia* (Jacq.) Marechal) at 150 μ L concentration

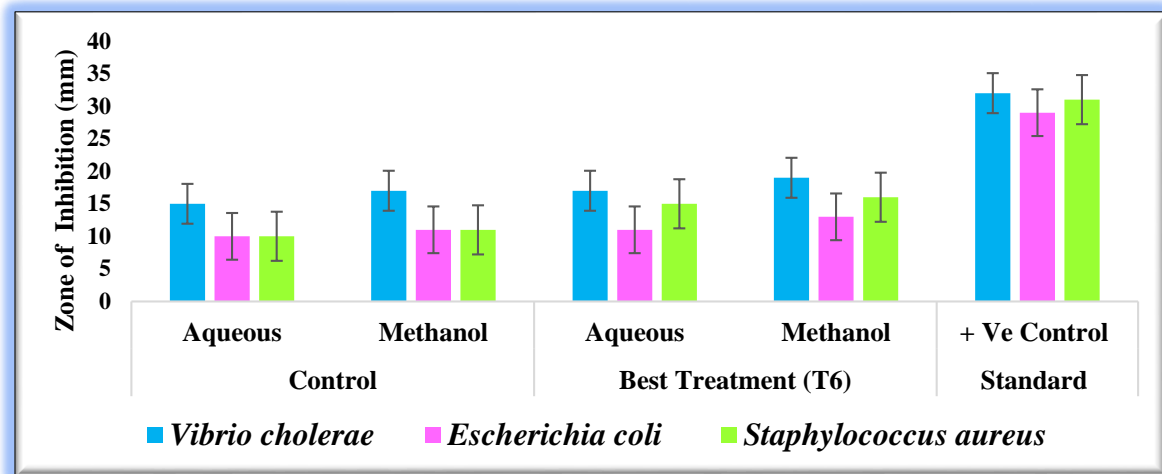
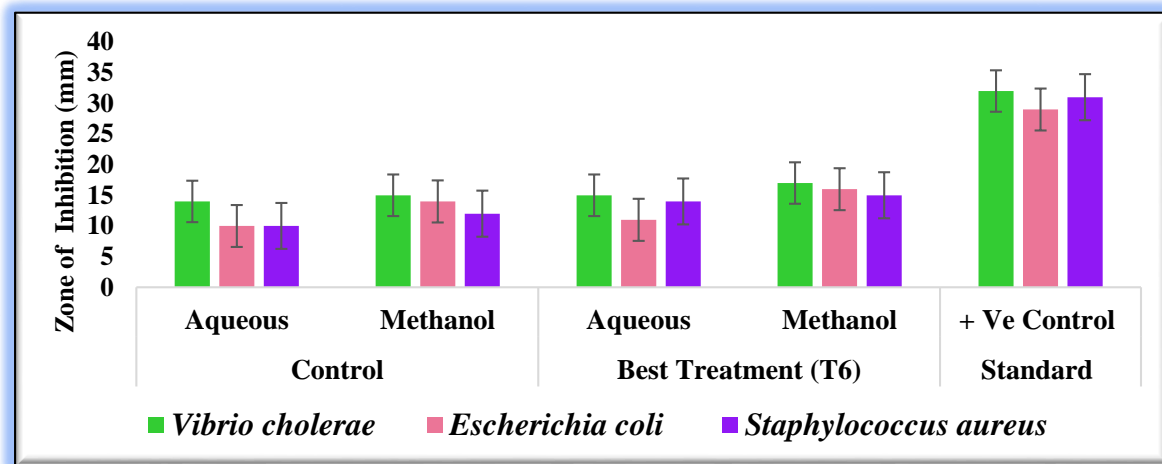


Figure - 31

Antibacterial activity - zone of inhibition against selected microbes in the aqueous and methanol seed extracts of black gram (*Vigna mungo* (L.) Hepper) at 150 μ L concentration



CA - Aqueous seed extract of Control plant,

CM - Methanol seed extract of Control plant

BA - Aqueous seed extract of Best treatment (T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g, *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha).

BM - Methanol seed extract of Best treatment (T6- Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g, *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha).

Plate - 15

Antibacterial activity - zone of inhibition against selected microbes in the aqueous and methanol seed extracts of moth bean (*Vigna aconitifolia* (Jacq.) Marechal) at 150 μ L concentration

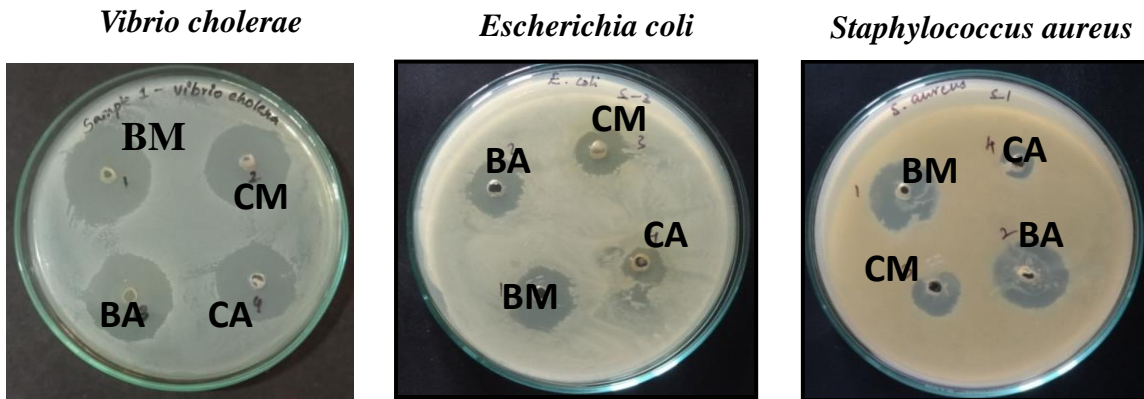
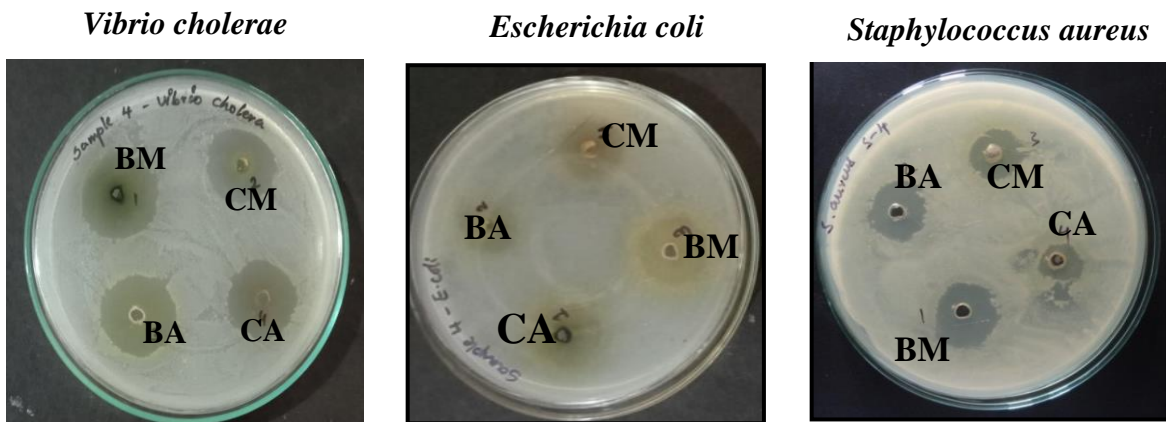


Plate - 16

Antibacterial activity - zone of inhibition against selected microbes in the aqueous and methanol seed extracts of black gram (*Vigna mungo* (L.) Hepper) at 150 μ L concentration



- CA - Aqueous seed extract of Control plant,
 CM - Methanol seed extract of Control plant
 BA - Aqueous seed extract of Best treatment (T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g, *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha).
 BM - Methanol seed extract of Best treatment (T6- Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g, *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha).

Figure - 32

Antibacterial activity - zone of inhibition against selected microbes in the aqueous and methanol seed extracts of fenugreek (*Trigonella foenum-graecum* L.) at 150 μ L concentration

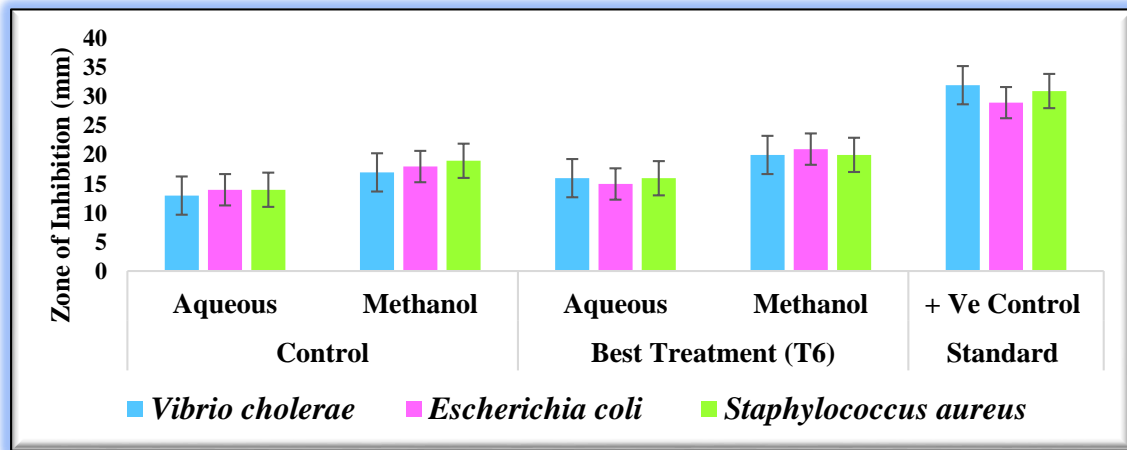
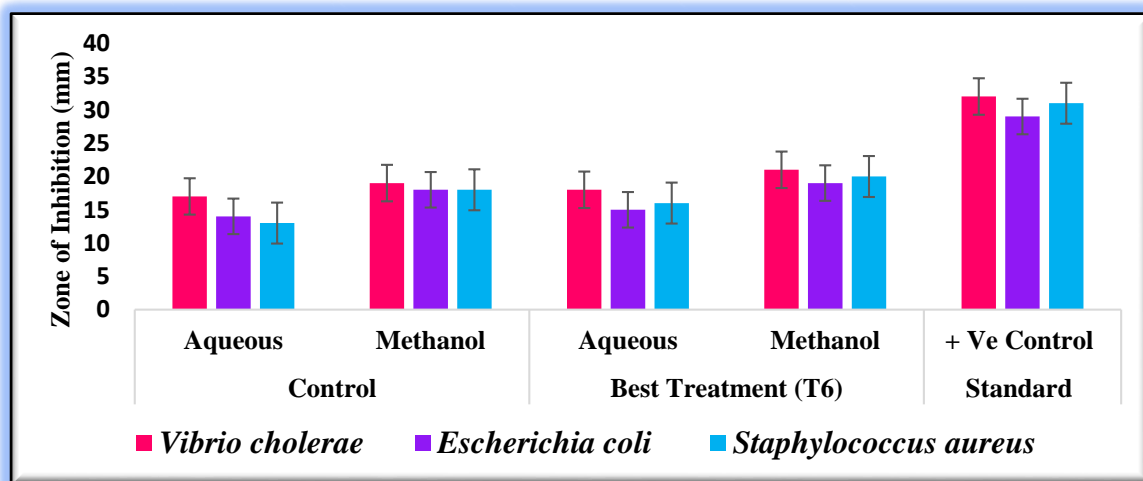


Figure - 33

Antibacterial activity - zone of inhibition against selected microbes in the aqueous and methanol leaf extracts of kalmegh (*Andrographis paniculata* (Burm.f.) Nees) at 150 μ L concentration



CA - Aqueous seed extract of Control plant,

CM - Methanol seed extract of Control plant

BA - Aqueous seed extract of Best treatment (T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g, *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha).

BM - Methanol seed extract of Best treatment (T6- Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g, *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha).

Plate - 17

Antibacterial activity - zone of inhibition against selected microbes in the aqueous and methanol seed extracts of fenugreek (*Trigonella foenum-graecum* L.) at 150 μ L concentration

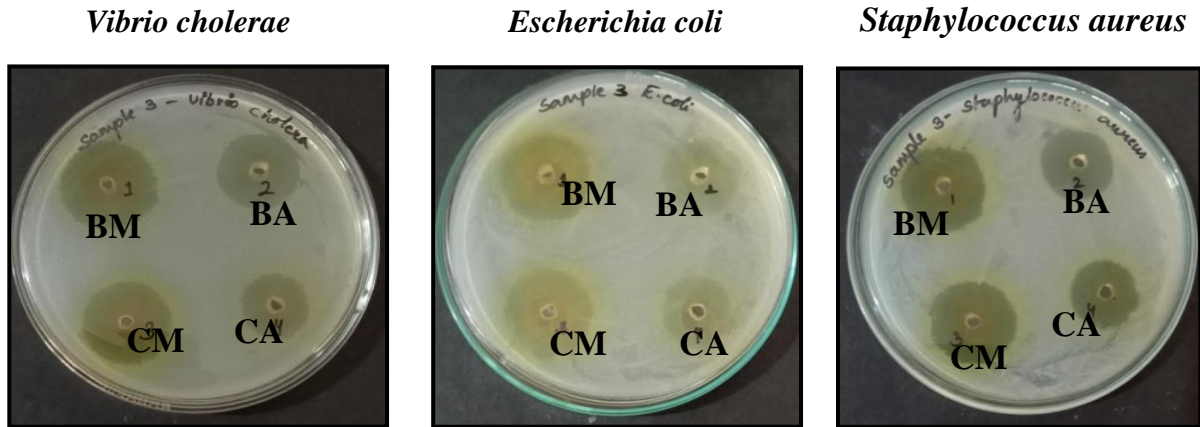
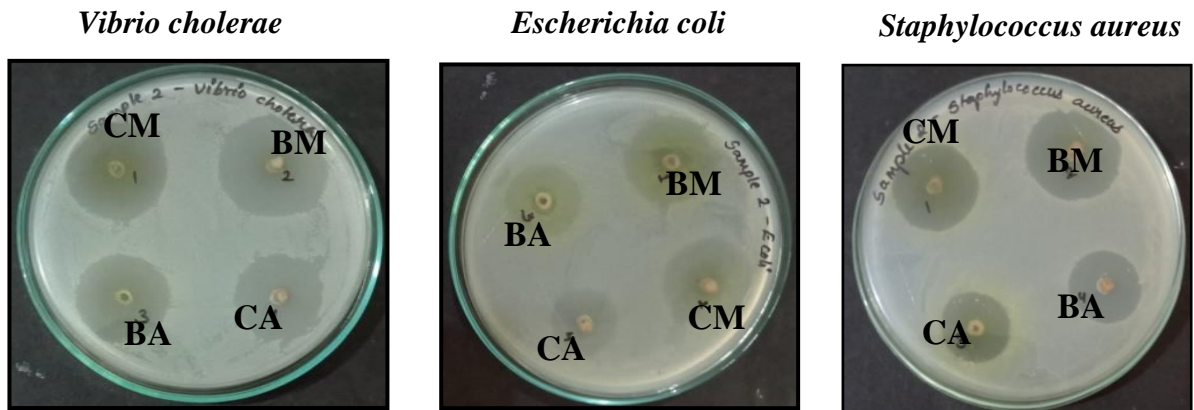


Plate - 18

Anti bacterial activity - zone of inhibition against selected microbes in the aqueous and methanol leaf extracts of kalmegh (*Andrographis paniculata* (Burm.f.) Nees) at 150 μ L concentration



CA - Aqueous seed extract of Control plant,
CM - Methanol seed extract of Control plant

BA - Aqueous seed extract of Best treatment (T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g, *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha).

BM - Methanol seed extract of Best treatment (T6- Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g, *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha).

The present results are in correlation with that of Ghosh *et al.*, (2008) who observed highest antibacterial activity in methanolic leaf extracts of *Polyalthia longifolia* against *Klebsiella pneumonia*. Soma *et al.*, (2010) reported that chloroform + HCl extract of *Andrographis paniculata* showed antibacterial activity against nine pathogenic bacterial strains. de Britto *et al.*, (2011) observed that methanol extracts of *Solanum nigrum*, *Solanum torvum* and *Solanum surattense* exhibited clear zone of inhibition against the tested microorganisms *Xanthomonas campestris* and *Aeromonas hydrophila*. Singh *et al.*, (2013) reported that chloroform extract of *Withania somnifera* stem (16.2 mm) showed minimum inhibitory concentration (MIC) against *Bacillus subtilis* than the root and leaf extracts.

The results coincide with Deepak *et al.*, (2014) that (Di chloro methanolic) DCM extract of *Andrographis paniculata* leaves showed the best antibacterial activity against the gram positive bacteria *Staphylococcus aureus* and *Streptococcus pyogenes* at 3 different concentrations (100, 200 & 500 µg/ml). Similar pattern of antimicrobial activity was observed by Dharajiya *et al.*, (2014) in methanol extract of *Withania somnifera* stem against *E. coli* of 17.67±1.52 zone of inhibition (ZOI) and activity index (AI) of 0.974 followed by *Bacillus cereus* of 15 ± 1.0 zone of inhibition (ZOI) and activity index (AI) of 0.993). Dangi *et al.*, (2016) also observed a strong antibacterial activity against *Bacillus subtilis* in *Trigonella foenum-graecum* L. Similarly, Dharajiya *et al.*, (2016) reported maximum antibacterial activity of *Trigonella foenum - graecum* leaf extracts against *Serratia marcescens* with zone of inhibition (ZOI) of 12.33 mm.

Polash *et al.*, (2017) reported best antibacterial activity in *Andrographis paniculata* (Kalmegh) aqueous stem extract against *E. coli* and *Bacillus subtilis* (21 mm, and 29 mm). Findings of Das *et al.*, (2022) intimated the antimicrobial activity of *Moringa oleifera* against *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Staphylococcus aureus*, *Proteus mirabilis* and exhibited a broad-spectrum of activity due to the presence of various phytochemicals.

The findings of Verrillo *et al.*, (2023) showed higher inhibition zones (mm) in methanol extracts of basil plants when treated with humic substances (HS-ART) and compost teas (CT-COF) from artichoke at 100 mg L⁻¹ concentration against *S. aureus* (11.4 and 17.1

mm), *E. faecalis* (12.4 & 9.2 mm), *E. coli* (10.2 & 9.7 mm), *Pseudomonas aeruginosa* (9.8 & 8.7 mm), *S. typhi* (8.6 & 7.9 mm) and *L. monocytogenes* (11.2 & 10.1 mm).

Similar pattern of antimicrobial activity was observed by El-Hefny *et al.*, (2023) in combined application of compost (50 and 25%) and metallic nanoparticles (30 mg/L) with highest antimicrobial activity in leaf methanol extracts LMEs (4000 mg/L) inhibition zones (IZs) against *Dickeya solani* (2.43 and 2.2 cm) and *Pectobacterium atrosepticum* (2.76 and 2.73 cm) of *Asclepias curassavica*. The present results are in par with that of Chandukishore *et al.*, (2023) who observed that the application of plant extract-based vermiwash (VW2) showed a notable inhibition zones against *Pseudomonas aeruginosa* (5.14 mm), *Klebsiella pneumonia* (5.91 mm), *Escherichia coli* (5.15 mm), *Staphylococcus aureus* (5.11 mm) and *Candida albicans* (4.18 mm) in *Capsicum annum* (bell pepper).

The present study concluded that coffee husk vermicompost showed a promising synergistic potential that validated itself as bio-stimulant in enhancing physiological and biochemical properties of test plants to certain level thus resulting in high yield and improved quality. The application of biocompost enriched with essential nutrients, beneficial microbes like *Trichoderma* spp., act as biological agents to control plant diseases, and enhanced bioactive compounds, antibacterial and antioxidant activities in plants like fenugreek, mothbean, blackgram, and kalmegh by improving soil fertility, nutrient uptake, and overall plant health and growth

4.9 Soil Analysis (Pre and Post harvest)

4.9.1 Experimental Soil and its analysis

The initial experimental soil samples of all the treatments were assessed for their characteristics. The changes in soil pH, electrical conductivity, available nitrogen, available phosphorus, available potassium of the initial soil is due to different treatments and combinations (Table-29).

The present result revealed that initial soil pH (6.7 and 6.6), electrical conductivity (4.33 & 4.13 dSm⁻¹), available nitrogen (158 & 156 kg/ha), available phosphorus (11.46 & 10.79 kg/ha), available potassium (92.35 & 89.38 kg/ha) were

recorded more in T6 (Raw coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) followed by T3 - Raw paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha) as compared to Control (6.1, 3.19 dSm⁻¹, 130 kg/ha, 9.33 kg/ha, 77.61 kg/ha).

Table - 29

Physico - Chemical analysis of the initial experimental soil

Treatments	pH	EC (dSm ⁻¹)	Available Nitrogen (Kg/ha)	Available Phosphorus (Kg/ha)	Available Potassium (kg/ha)
C	6.1	3.19	130	9.33	77.61
T1	6.2	3.44	137	10.21	80.36
T2	6.4	3.16	143	10.11	82.31
T3	6.6	4.13	156	10.79	89.38
T4	6.4	3.18	137	10.27	81.17
T5	6.3	4.02	149	10.34	83.49
T6	6.7	4.33	158	11.46	92.35

Table - 30

Post harvest soil analysis of moth bean (*Vigna aconitifolia* (Jacq.) Marechal)

Treatments	pH	EC (dSm ⁻¹)	Available Nitrogen (Kg/ha)	Available Phosphorus (Kg/ha)	Available Potassium (kg/ha)
C	6.2	1.62	156	10.30	90
T1	6.6	1.54	173	13.36	120
T2	6.3	1.32	166	13.17	119
T3	6.9	1.27	189	15.76	131
T4	6.5	1.41	171	14.36	122
T5	6.8	1.30	181	14.40	128
T6	7.1	1.20	190	15.91	133

C - Control

T₁ - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₂ - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₃ - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T₄ - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T₅ - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T₆ - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

4.9.2 Effect of paddy and coffee husk biocompost on post harvest soil analysis

4.9.2.1 Moth bean (*Vigna aconitifolia* (Jacq.) Marechal)

The data from the table - 30 revealed that significant increase in pH (7.1 and 6.9), EC (1.20 and 1.27 dSm⁻¹), available nitrogen (190 kg/ha and 189 kg/ha) available phosphorus (15.91 and 15.76 kg/ha) and available potassium (133 kg/ha and 131 kg/ha) was noted in T6 treatment followed by T3 treatment as compared to the control (6.2, 1.62 dSm⁻¹, 156 kg/ha, 10.30 kg/ha, 90 kg/ha) respectively.

4.9.2.2 Black gram (*Vigna mungo* (L.) Hepper)

The data presented in table - 31 revealed that highest pH (7.3 and 7.1), EC (1.01 and 1.09 dSm⁻¹), available nitrogen (191 kg/h and 188 kg/ha), available phosphorus (14.03 kg/ha and 13.89 kg/ha), available potassium (125 kg/ha and 120 kg/ha) was recorded in T6 treatment followed by T3 treatment as compared to the Control (6.3, 1.47 dSm⁻¹, 155 kg/ha, 11.01 kg/ha, 81 kg/ha) respectively.

Table - 31

Post harvest soil analysis of black gram (*Vigna mungo* (L.) Hepper)

Treatments	pH	EC (dSm ⁻¹)	Available Nitrogen (Kg/ha)	Available Phosphorus (Kg/ha)	Available Potassium (kg/ha)
C	6.3	1.47	155	11.01	81
T1	6.4	1.20	166	12.14	109
T2	6.7	1.34	170	12.21	117
T3	7.1	1.09	188	13.89	120
T4	6.8	1.18	169	12.01	101
T5	6.9	1.15	179	12.39	110
T6	7.3	1.01	191	14.03	125

C- Control

T1 - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T2 - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T3 - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

T4 - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)

T5 - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)

T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* 5t/ha)

Table - 32

Post harvest soil analysis of fenugreek (*Trigonella foenum-graecum* L.)

Treatments	pH	EC (dSm ⁻¹)	Available Nitrogen (Kg/ha)	Available Phosphorus (Kg/ha)	Available Potassium (kg/ha)
C	6.4	1.91	123	11.2	84
T1	6.5	1.31	173	12.9	110
T2	6.9	1.36	169	12.7	107
T3	7.0	1.11	183	14.3	127
T4	6.7	1.61	171	13.1	109
T5	6.8	1.31	178	13.5	114
T6	7.3	1.05	195	15.3	130

Table - 33

Post harvest soil analysis of kalmegh (*Andrographis paniculata* (Burm.f.) Nees)

Treatments	pH	EC (dSm ⁻¹)	Available Nitrogen (Kg/ha)	Available Phosphorus (Kg/ha)	Available Potassium (kg/ha)
C	6.3	1.71	149	10.0	83
T1	6.8	1.51	163	11.5	89
T2	6.7	1.77	160	11.3	88
T3	7.1	1.37	172	12.7	98
T4	6.5	1.61	166	11.1	89
T5	6.9	1.41	169	11.7	90
T6	7.2	1.13	174	13.0	99

C- Control

T1 - Raw Paddy husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)T2 - Raw Paddy husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)T3 - Raw Paddy husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)T4 - Raw Coffee husk + 20g *Pleurotus eous* + *Eisenia fetida* (5t/ha)T5 - Raw Coffee husk + 20g *Pleurotus florida* + *Eisenia fetida* (5t/ha)T6 - Raw Coffee husk + 6.5g *Pleurotus eous*, 6.5g *Pleurotus florida*, 7g *Trichoderma asperelloides* + *Eisenia fetida* (5t/ha)

4.9.2.3 Fenugreek (*Trigonella foenum-graecum* L.)

Among all the treatments, T6 observed the highest pH (7.3), EC (1.05 dSm⁻¹), available nitrogen (195 kg/ha), available phosphorus (15.3 kg/ha), available potassium (130 kg/ha) followed by treatment T3 pH (7.0), EC (1.11 dSm⁻¹), available nitrogen (183 kg/ha), available phosphorus (14.3 kg/ha), available potassium (127 kg/ha) as compared to the Control (6.4, 1.91 dSm⁻¹, 123 kg/ha, 11.2 kg/ha, 84 kg/ha) respectively as depicted in Table – 32

4.9.2.4 Kalmegh (*Andrographis paniculata* (Burm.f.) Nees)

The data from the table -33 clearly showed an increase in pH (7.2 and 7.1), EC (1.13 and 1.37 dSm⁻¹), available nitrogen (174 kg/ha and 172 kg/ha), available phosphorus (13.0 kg/ha and 12.7 kg/ha), available potassium (99 kg/ha and 98 kg/ha) was registered in T6 treatment followed by T3 treatment and other treatments as compared to the Control (6.3, 1.71dSm⁻¹, 149 kg/ha, 10.0 kg/ha, 83 kg/ha) respectively.

The present results are in accordance with previous report of Bokhtiar *et al.*, (2003) who observed an increase of organic matter, available N, P and K of the soil and productivity of a subsequent sugarcane (*Saccharum officinarum*) crop with the application of green manuring with dhaincha (*Sesbania aculeata*) and sunhemp (*Crotalaria juncea*). The present results are in par with that of Yaduvanshi, (2003) who reported that application of green manure (10 t FYM/ha) on rice - wheat cropping sequence resulted in higher removal of inorganic fertilizer in crops and increased soil N, P, K, organic C and reduced soil pH.

Similar pattern of improvement of soil pH and EC was discovered by Choudhary *et al.*, (2004) under semi arid conditions with application of gypsum and farmyard manure (FYM at 20 t ha⁻¹). The results are in par with that of Bohme *et al.*, (2005) who recorded that application of farmyard manure enhanced the soil organic matter and total nitrogen as reflected by hydrolytic enzyme activities and add an impact on the functional, structural soil microbial properties.

Abou El-Magd *et al.*, (2006) also observed that the application of organic manures (cattle and poultry) in the soil enhanced soil aggregation, soil aeration and

increased water holding capacity thus offered good environmental conditions for the root system of broccoli plants. Greater influence of agro industrial wastes (pressmud @ 12.5 t ha⁻¹) on soil fertility and yield of finger millet was observed by Rangaraj *et al.*, (2007). Similarly Parthasarathi *et al.*, (2008) noted increased pore space, reduced particle and bulk density, increased water holding capacity, cation exchange capacity, reduced pH and electrical conductivity, increased organic carbon content, available nitrogen, phosphorous, potassium and microbial population with the application of vermicompost on clay loam, sandy loam and red loam soil.

Manivannan *et al.*, (2009) reported that application of 50% vermicompost + 50% NPK enhanced the clay loam soil pore space (36.87%), water holding capacity (92.30%), cation exchange capacity (26.90 cmol (p⁺) kg⁻¹). Reduced particles size (1.44 Mgm⁻³), bulk density (1.09 Mgm⁻³), pH (7.11) and electrical conductivity (0.71 dSm⁻¹) and increased organic carbon (3.17%) and macro nutrients (N 201 Kgha⁻¹, P 15.3 Kgha⁻¹, K 267 Kgha⁻¹) coincides with our findings.

In correlation with our results Gopal *et al.*, (2010) reported that coconut leaf vermiwash (CLV) enhanced the available N, P and K content in post harvest soil. Similarly Prativa and Bhattarai, (2011) also observed that application of integrated nutrient management with ½ NPK + 15 m t/ha vermicompost increased the available nitrogen, phosphorus and potassium of soil. De Rezende *et al.*, (2012) observed that coffee husk manure decreased the C/N ratio in the soil and recorded better results for fresh and dry biomass in sorghum crop.

Similarly, the findings of Meena *et al.*, (2013) showed enhancement in soil nitrogen, phosphorus, potassium, zinc, iron and organic carbon when applied with FYM (20 t ha⁻¹) FYM 10 t ha⁻¹, vermicompost (5 t ha⁻¹) and vermicompost (10 t ha⁻¹) in green gram. Similar results were recorded by Jayanthi *et al.*, (2014) that application of vermifertilizer (VF 5 tons/ha) increase the pore space, water holding capacity, cation exchange capacity, organic carbon, available N, P, K, other micro-macro nutrients – Ca, Mg, Na, Fe, Mn, Zn, Cu and microbial population activity, humic acid content, reduced particle and bulk density, pH and EC in post harvest soil of chilli (*Capsicum annuum* L.).

Dhakal *et al.*, (2015) also observed that combined application of NPK enhanced early growth in mungbean (*Vigna radiata* L.), cell multiplication and absorption of more nutrients from the deeper layers of the soil. The findings of Bhagat *et al.*, (2016) also showed an improvement in soil organic content in rice straw mulched @ 6 tonnes/ha (0.32%) over unmulched (0.24%) soil samples and mineral nitrogen i.e., ammonia (235.2 kg/ha), nitrate (156.8 k/ha) and nitrogen at 90 DAS.

Similar to our results Wang *et al.*, (2017) observed that the application of vermicompost (30t/ha) increased the soil quality with higher pH (7.23) and lowered soil electrical conductivity (204.1 $\mu\text{S}/\text{cm}$). Similar result was supported by Mahmud *et al.*, (2018) who observed that second supplementation of vermicompost on sandy loam increased soil pH along with the improvement of total N (0.15%) P (0.04%), K (0.07%), Mg (0.06%), S (0.02%), Ca (0.08%), Fe (0.80%), Zn (37.63mg kg^{-1}), B (2.56mg kg^{-1}) and Al (3.48%) in the soils.

Similarly Kannika *et al.*, (2019) also observed that vermicompost application at 250 g influenced the pH value of 6.65, EC (2.45 mS /cm), moisture (1.50%), higher values in N (0.70%), P (0.11%), K (0.21%) and C (21.1%) after 30 days of incubation with poultry farm solid waste (PFSW). Findings of Das and Biswas, (2020) also showed improvement of nutrition and productivity of soil when combined application of organic and inorganic fertilizer (Phosphorus Solubilizing Bacteria (PSB) + *Azotobacter*) in sesame cultivation on red and lateritic soils.

Our results were in agreement with that of Haridha *et al.*, (2020) who noticed high potassium (K) and phosphorus (P) as compared with nitrogen (N) and better pore space as well as water holding capacity in sandy clay loam soil with the application of goat manure and vermicompost (17t/ha). The findings of Suwanto and Asih, (2021) showed an increase in organic carbon from 2.25 to 2.38% and soil bulk density ranged from 0.76 to 0.84 g cm^{-3} at 10 months after planting of legume crops under cassava canopy. The present results are in par with Singh *et al.*, (2022) who observed that organic farming enhanced the food quality and productivity than integrated nutrient approach, there was no perceptible change in phosphorus and potassium after the completion of five cropping cycles.

Similar results were recorded by Florence and Percy, (2023) who observed that the application of bioinoculants namely *rhizobia* colonize the rhizosphere and biologically fix N in soil by forming a symbiotic bond with the plant and convert the free N into ammonia for the plants to use thus making soils fertile for plant growth. Similar result was observed by Irin and Biswas, (2023) that residual effect of green manure (GM-Taman-Mustard) increased soil organic matter from 0.04 to 0.07%, Nitrogen (0.05%), K (0.2 to 0.5 meq/100 g) and P (2 ppm to 15 ppm).

Similar to our results Elashaboury *et al.*, (2024) observed that the application of chicken manure (ChM) compost at the rate of 10 ton fed⁻¹ increased the soil quality with high available Nitrogen (49.54 mg kg⁻¹), Phosphorus (11.81 mg kg⁻¹) and Potassium (248.81 mg kg⁻¹) in soyabean cultivation.

Vermicompost products have high antibiotic properties due to the biochemical substrates they produce, when it is applied in the soil, humic substances positively enrich the soil structure with more micro, macro nutrients, vitamins and enzymes. Our results revealed that the application of paddy and coffee husk biocompost regulates the soil pH, decrease electrical conductivity which retain the soil nutrients with high quality. Available nitrogen, phosphorus and potassium were obtained maximum in treatment 6 of moth bean, black gram, fenugreek and kalmegh when compared to other treatments and control.

The increase in available nitrogen status may be due to the application of paddy and coffee husk manure that enhanced the soil microorganisms leading to the conversion of organically bound nitrogen into inorganic forms and due to rapid mineralization it is made available to the crops. Increase of available phosphorus might be due to the production of the organic acids during the decomposition of the organic manure which solubilize phosphate and other phosphate bearing minerals thereby increasing phosphorus availability in the soil. The increase availability of potassium might be due to the solubilization action of certain organic acids produced during decomposition of organic manures and its greater capacity to hold potassium in available form in soil and also due to the interaction of organic matter.