
Summary and Conclusion

Biocompost plays an important role in organic farming as there is an immediate need for an alternative to chemical fertilizer and pesticides. The present research work entitled “**Effect of Biocomposted Cocoa Shell and Jack Fruit Peel Waste on Certain Crop Plants and Soil Fertility**”.

The present research is to brighten the bioconversion possibilities of Cocoa shell and jack fruit peel waste can be degraded with the help of microorganisms such as mushroom spawns (*Pleurotus eous* & *Pleurotus florida*) and earthworm (*Eudrilus eugeniae*). Pitcomposting (30 days) and vermicomposting (60 days) method was used to prepare eight different biocomposting units (C₁-C₈). The salient findings of this investigation are summarized in this chapter.

PHASE I

The total microbial population, bacteria, fungi and actinomycetes were enumerated at 30th, 60th and 90th days. The bacteria, fungi and actinomycetes count was conspicuously increased from 30th-60th days and from 60th - 90th days it was reduced. The maximum increase in total microbial population was noted in C₈ (Raw JFPW+10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5 t/ha⁻¹) and closely followed by C₄ (CSW+10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5 t/ha⁻¹).

Physico-chemical characteristics confirmed that among the eight different biocompost treatments, C₈ was found to be an efficient biocompost, because of the drastic reduction in, lignin, cellulose, organic carbon, EC, C:N ratio and significant increase in nitrogen, phosphorus, potassium, calcium and magnesium followed by C₄ as compared to the other treatments and control.

The raw and biocomposted CSW and JFPW have been characterized by FTIR and SEM. FTIR study indicate different characteristic strong bands and functional groups. Significant disappearance of functional group was observed in C₈ (Raw JFPW +10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹).

SEM analysis showed the surface morphological characterization and alterations in the pre and post-biocomposed CSW and JFPW. SEM results revealed greater surface changes appear on C₈ (Raw JFPW+10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹) followed by C₄ (Raw CSW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹) due to maximum mineralization and degradation of organic matter. Both the technique has provided highly sensitive information for the evaluation of biocompost maturity and stability.

PHASE II

The pot culture experiment was conducted in *Vigna unguiculata* L. Walp.Var. Co (CP) 7 (Cowpea), *Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc Var. NS-621 (Yardlong bean), *Clitoria ternatea* L. (Shankhpushpi) and *Amaranthus tricolor* L. Var. Arun (Red amaranth) to evaluate the efficiency of the biocomposted cocoa shell and jack fruit peel waste.

Pot culture experiment of cowpea recorded a maximum increase in root length, shoot length, number of leaves, fresh weight and dry weight of plant, number of nodules on 25 to 45 DAS, number of flower (45 DAS), at T₈ (Raw JFPW+10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹) followed by T₄ (Raw CSW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹) when compared with other treatments and control.

Yardlong bean showed highest root length, shoot length, number of leaves, number of nodules, plant fresh weight and dry weight on 25, 50 and 75 DAS and number of flowers on 65 DAS was noted at T₈ followed by T₄ as compared to other treatments and control. The number of nodules was decreased in all the treatments and control plants of cowpea on 45 DAS and yardlong bean on 75 DAS due to the increased O₂ concentration and nitrogenase enzyme inhibition, resulting in poor N₂ fixation.

Shankhpushpi showed an increase in root length, shoot length, number of leaves/plant, number of branches, fresh weight and dry weight of plant on 30, 60 and 90 DAS, the number of flowers/plants, on 90 DAS was recorded at T₈ followed by T₄ when compared with other treatments and control. Red amaranth showed the treatment T₈ have highest root length, shoot length, number of leaves/plant, fresh weight and dry weight of plant on 25 and 35 DAS when compared to the other treatments and Control.

The yield characters of vegetable crop cowpea (65 DAS), yardlong bean (90 DAS) and medicinal plant shankpushpi (120 DAS) showed maximum number of pods/plant, length of the pod (cm), the weight of pod (g), number of seeds per pod, the weight of seeds per pod (g), pod fresh weight (g) and dry weight (g) at T₈ (Raw JFPW+10 g *Pleurotus eous* + 10 g *Pleurotus florida* + *Eudrilus eugeniae* 5t/ha⁻¹) and T₄ (Raw CSW + 10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5t/ha⁻¹) respectively. However leafy vegetable and medicinally important crop of red amaranths showed an increase in root length, shoot length, the number of leaves, plant fresh weight and dry weight on 50 DAS at T₈ and T₄ as compared to the other treatments and control.

The phase II experimental analysis confirmed that increase in vegetative and yield parameters of test crops due to combined application of nutrient-enriched biocompost (T₈ &T₄). This might have improved the physico-chemical and biological properties of soil thus resulting in positive impact on plants.

PHASE III

The maximum protein, carbohydrate, chlorophyll a, b and total chlorophyll content in leaves of cowpea (25, 35 & 45 DAS), yardlong bean (25,50 &75 DAS), shankpushpi (30,60 & 90 DAS) and red amaranth (25 & 35 DAS) was recorded at T₈ treatment. Cowpea (25, 35 & 45 DAS) and yardlong bean (25,50 &75 DAS) observed increase in leghaemoglobin content at T₈ treatment as compared to the other treatments and control.

Similarly a maximum increase in protein and carbohydrate content in seeds of cowpea (65 DAS), yardlong bean (90 DAS) and shankpushpi (120 DAS) was noted at T₈. The crude protein content in seeds of cowpea (65 DAS) and yardlong bean was found to be maximum in T₈ followed by T₄ as compared to control. Red amaranth showed increased protein, carbohydrate and chlorophyll a, b and total chlorophyll content (50 DAS) recorded at T₈ treatment as compared to the other treatments and control.

Pre and Post-harvest nutrient analysis in soil (pH, electrical conductivity (millimhos cm⁻¹), available nitrogen (kg/ha), phosphorus (kg/ha) and potassium (kg/ha)) were obtained maximum increase at T₈ treatment of cowpea, yardlong bean, shankpushpi and red amaranth as compared to other treatments. Soil nutrients were found to be less in control.

PHASE IV

Antibacterial activity and antioxidant activity was carried out in T₈ treatment (best treatment) and control. All the above experimental results indicate that among the eight different types of biocompost, T₈ was found to be a more efficient organic manure as compared to other treatments and control.

Antibacterial activity was carried out in seeds of cowpea, yardlong bean and leaves of shankpushpi and red amaranth. Aqueous and methanol extracts of seeds and leaf were examined against gram-positive (*Staphylococcus aureus*) and gram-negative (*Escherichia coli*) bacterial species. Both extracts showed better antibacterial activity in best treatment grown test crops. Among the two extracts, methanol extracts of red amaranth showed the highest zone of inhibition against *Staphylococcus aureus* followed by the aqueous extract. The zones of inhibitions were moderately different from each other as compared to the standard antibiotics (Kanamycin).

Antioxidant activity of test crops was analysed for DPPH radical scavenging activity, hydrogen peroxide scavenging activity, nitric oxide radical scavenging activity and reducing power assay (free radical scavenging assays) in aqueous and methanol extracts. Methanol extracts of cowpea and yardlong bean seeds and shankpushpi and red amaranth leaf extracts showed promising antioxidant activity in T₈ (Raw JFPW+10 g *Pleurotus eous* + 10 g *Pleurotus florida*+ *Eudrilus eugeniae* 5 t/ha⁻¹) treatment. when comparing the aqueous and methanol extracts of the four plants, methanol leaf extracts of Red amaranth recorded significant free radical scavenging activity followed by Shankpushpi at T₈.

Medicinal value of Shankpushpi and Red amaranth is highly popular. Both these plants showed vast source of phytochemicals having potent health-promoting activities. The present study investigated the phytochemical screening of the best treatment (T₈) under grown Shankpushpi and Red amaranth leaves. Aqueous, methanol and ethyl acetate leaves extract of Shankpushpi and Red amaranth contains various phytochemicals such as alkaloids, anthraquinones, amino acids, flavonoids, glycosides, phenols, steroids and saponins.

Mineral composition of leaves of cowpea, yardlong bean, shankpushpi and red amaranth leaves showed the presence of microelements (iron, sodium) and macro elements

(calcium, phosphorus, potassium & magnesium). Maximum mineral content was recorded in T₈ (best treatment) as compared to control.

The experimental results demonstrated the successful use of agroindustrial wastes like cocoa shell and jackfruit peel to increase crop productivity. The combined application of *Pleurotus eous*, *Pleurotus florida* and *Eudrilus eugeniae* Kinberg was used to develop effective (organic manure) biocompost from cocoa shell and Jack fruit peel waste. Biocomposting is an eco-friendly process leading to the production of organic manure and its value-added enriched products value is great for the farmer's fields, which has multi-fold implications for generating wealth from the waste. The overall cost of production of CSW and JFPW biocompost is minimal as compared to chemical fertilizer. Increased biometric and biochemical characteristics of test crops may be strongly correlated with the association between improved accumulation of nitrogen, phosphorus and potassium content together with the utilisation of calcium and magnesium content in CSW and JFPW biocompost supplemented soil.

The present study CSW and JFPW have been digested by using *Pleurotus eous*, *Pleurotus florida* and *Eudrilus eugeniae* Kinberg. CSW and JFPW biocompost applied together provide rich essential nutrients and improve soil structure. These strategies are helpful for agroindustrial waste management problems. Biocomposted agroindustrial waste acts as a soil conditioner to improve crop quality, productivity to promote an environmentally friendly approach and reduce the risk of environmental pollution.

The present work is not only an alternate solution for the disposal of agroindustrial waste of cocoa shells and Jack fruit peel waste, but it minimises the increased application of chemical fertilisers to crops and encourages organic farming for sustainable crop production. The biocomposting process is a simple and low-investment technology. The present research work confirmed that combined applications of cocoa shell and Jack fruit peel waste biocompost (T₈&T₄) enhance the biometric, biochemical, antibacterial, antioxidant, phytochemical, and mineral composition of test crops and soil fertility when compared to the other treatments and control due to maximum increase in physical, chemical and microbial load of biocompost. Hence, it was concluded that cocoa shell and Jack fruit peel biocompost could be effectively used as organic manure to ensure the safe protection of plants in polluted soils.

RECOMMENDATION AND FUTURE ASPECTS

- ❖ The use of biocomposted agroindurstiral waste could be a better option to maintain organic nutrition of test crop plants.
- ❖ It is conceivable to research the long-term impacts of adding jackfruit and cocoa peels to different soils and agricultural systems, together with a variety of microbial consortiums.
- ❖ In the future, organic liquid fertiliser will likely be another excellent strategy. Therefore, it is important to continue looking into the idea of employing cocoa shell and jackfruit peel waste as organic liquid substitutes in soil with higher organic nutrition for crops.
- ❖ Similar research should be done on other crops and medicinal plants that small-holder farmers and households want to cultivate on terraces.
- ❖ Agroindustrial waste that has biodegraded and plants that have been cultivated organically must be made available to the farming community to aware of their value and potential.
- ❖ Nowadays, it is exceedingly challenging to get high-quality soil for plant growing in pots or containers. The most efficient way to solve these issues is by adding biocompost to the soil.
- ❖ The nutritional content and productivity of vegetable crops, medicinal plants, and garden plants can all be increased by using biocomposted cocoa shell and jack fruit peel.