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Summary and Conclusion

The present investigation entitled **"Bioconversion of Vegetable and Fruit waste and Its Effect on Growth and Yield Parameters of Black gram and Lablab"** was undertaken to study the effect of biocomposted Vegetable and Fruit waste as a growth promoter for legume plant and to find out means and solution for the profitable utilization and to reduce its environmental problem.

The ultimate goal of sustainable agriculture is to develop farming system that are productive and profitable, conserve the natural resource base, protect the environment and enhance health and safety measures. Hence, recycling of Vegetable and Fruit waste would be a good substitute of organic manures produced by *Pleurotus eous*, *Trichoderma asperelloides* and earthworm *Eudrilus eugeniae* Kinberg.

5.1 COMPOSTING

5.1.1 Microbial population

Summer composting

In summer composting, the total bacterial, fungal and actinomycetes count was increased significantly in C8- Fruit wastes + cowdung + *Pleurotus eous* + *Trichoderma asperelloides* + *Eudrilus eugeniae* (5 t/ha) which is followed by C4- Vegetable wastes + cowdung + *Pleurotus eous* + *Trichoderma asperelloides* + *Eudrilus eugeniae* (5 t/ha) when compared to control on 30th day with a remarkable increase on 60th day and declined slightly on 90th day.

Winter composting

In winter composting, the bacterial, fungal and actinomycetes population was found to be significantly higher in C8 treatment and C4 treatment on the 30th day while remarkable microbial population was noted on the 60th day with decreasing trend in population on 90th day when compared to control.

5.1.2 Physico-chemical composition of raw and composted banana peels waste

The Physico-chemical parameters such as lignin (%), cellulose (%), pH, Electrical Conductivity (millimhos cm^{-1}), Total nitrogen (%), Total phosphorus (%), Total potassium (%) organic carbon (%), calcium (%), magnesium (%) and C:N were analyzed in raw and

composted vegetable and fruit waste to assess the compost maturity during summer and winter composting. A significant difference was noted in raw and biocomposted samples. Lignin are the starting material for humus formation that can contribute to soil health and productivity. Cellulose is the main source of energy for biological transformation, rise in temperature and chemical changes in the compost. In summer and winter composting, a significant decrease in lignin, cellulose, EC, organic carbon and C:N ratio was noted in C8- Fruit wastes + cowdung + *Pleurotus eous* + *Trichoderma asperelloides* + *Eudrilus eugeniae* (5 t/ha) treatment followed by C4- Vegetable wastes + cowdung + *Pleurotus eous* + *Trichoderma asperelloides* + *Eudrilus eugeniae* (5 t/ha) treatment when compared to raw wastes sample. The increasing trend was noted in C8 and C4 treatment for pH, N, P, K, Ca and Mg. The changes in pH and EC value are due to the decomposition process and measuring the amount of nutrients in the compost in the form of salt.

5.1.3 FT-IR analysis

The main objective of adapting Fourier Transform Infrared (FT-IR) spectroscopic analysis is to identify the presence of functional groups in raw and composted vegetable and fruit wastes sample of winter and summer composting. The raw vegetable and fruit wastes sample has a deep peak when compared to a composted sample having a smaller or disappearing peak which may be due to the composting process. Functional group like O-H, C-H and C-O-C was found to be highest in summer composted sample over winter composted sample.

PHASE II

5.2 POT CULTURE EXPERIMENT

5.2.1 BIOMETRIC CHARACTERS

Black gram [*Vigna mungo* (L.) Hepper] grown in winter compost

A significant increase in shoot length was observed in T_8 treatment which is followed by other treatments when compared to Control on 15, 35 and 55 DAS. The highest root length was noted in T_8 treatment followed by T_4 treatment and Control on 15, 35 and 55 DAS. Maximum number of leaves per plant was noted in T_8 treatment over Control. Fresh weight and dry weight of the plant were found to increase significantly in T_8 treatment followed by T_4 treatment when compared to Control from 15 to 55 DAS. The increase in the number of nodules was noted in T_8 treatment when compared to Control on 25 and 50 DAS. A number of flowers/ plants was found to be maximum in T_8 treatment over Control on 55 DAS.

Lablab [*Lablab purpureus* (L.) Sweet] grown in winter compost

The highest shoot length, root length and a maximum number of leaves were noted in T_8 treatment which is followed by T_4 treatment over control on 15, 35 and 55 DAS. The fresh weight of the plant was noted highest in T_8 treatment which is followed by T_4 treatment as compared to Control. Similar results were also observed in dry weight, a significant increase was noted in T_8 treatment which is followed by other treatments and Control on 15, 35 and 55 Day After Sowing (DAS). The number of nodules was found to be maximum in T_8 treatment followed by other treatments and Control on 25 and 50 DAS and highest number of flowers/ plants was noted in T_8 treatment followed by T_4 treatment and other treatments on 55 DAS.

Black gram [*Vigna mungo* (L.) Hepper] grown in summer compost

The shoot length, root length and number of leaves increased significantly in T_8 treatment and T_4 treatment followed by other treatments when compared to Control on 15, 35 and 55 DAS. Fresh weight and dry weight of the plant significantly increase in T_8 treatment followed by T_4 as compared to Control from 15 to 55 DAS. The maximum number of nodules was observed in the T_8 treatment which is followed by other treatments and Control on 25 and 50 DAS. The number of flowers/plant increased significantly in T_8 treatment followed by T_4 treatment when compared to control on 55 DAS.

Lablab [*Lablab purpureus* (L.) Sweet] grown in summer compost

Maximum root length, shoot length and number of leaves were noted in T_8 treatment followed by T_4 when compared to the Control on 15, 35 and 55 DAS. Fresh weight and dry weight increased significantly in T_8 treatment and T_4 treatment followed by other treatments when compared to Control on 15, 35 and 55 DAS. A significant increase in the number of nodules was noted in T_8 treatment followed by T_4 treatment when compared to control on 25 and 50 DAS. A maximum number of flowers/plant was noted in the T_8 treatment when compared to the Control on 55 DAS

5.2.2 YIELD CHARACTER

Black gram [*Vigna mungo* (L.) Hepper] grown in winter compost

A maximum number of pods/plant, pod length and number of seeds/pod was observed in T_8 treatment and T_4 treatment followed by other treatment when compared to Control. The fresh and dry weight content of the pods increase significantly in T_8 treatment which is followed by T_4 treatment when compared to Control. The weight of the seed/ pod noted

maximum in T_8 treatment followed by T_4 treatment as compared to the other treatments and Control on 75 DAS.

Lablab [*Lablab purpureus* (L.) Sweet] grown in winter compost

A significant increase in the number of pods/plant, pod length and number of seeds/pods was noted in T_8 treatment which is followed by T_4 treatment when compared to Control. The fresh weight, dry weight of the pod and weight of the seed increased significantly in T_8 treatment followed by other treatments and Control on 75 DAS.

Black gram [*Vigna mungo* (L.) Hepper] grown in summer compost

The yield parameters (number of pods/ plant, pod length and number of seeds/pod) significantly increased in T_8 treatment and T_4 treatment followed by other treatments when compared to the Control. The fresh, dry weight of the pod and weight of the seeds/ pod increased significantly in T_8 treatment when compared to Control on 75 DAS.

Lablab [*Lablab purpureus* (L.) Sweet] grown in summer compost

In Lablab plant, the yield parameters such as number of pods/ plant, number of seeds /pod, pod length, seed weight/ pod, pod fresh weight and dry weight were found to be maximum in T_8 treatment followed by T_4 treatment when compared with other treatment and Control on 75 DAS.

PHASE III

5.3 BIOCHEMICAL CHARACTERS

Black gram [*Vigna mungo* (L.) Hepper] grown in winter compost

Biochemical parameters like protein, carbohydrates, chlorophyll 'a', chlorophyll 'b', and total chlorophyll contents in leaves were increased in T_8 treatment followed by T_4 treatment from 15 to 35 DAS and a decline in its content was noted on 55 DAS. Protein, carbohydrate and crude protein in the seed of the test crop were maximum in T_8 treatment followed by other treatments and Control on 75 DAS. Leghaemoglobin content in root nodules on 25 and 50 DAS was maximum in T_8 treatment which is followed by T_4 treatment when compared to the Control.

Lablab [*Lablab purpureus* (L.) Sweet] grown in winter compost

A significant increase in protein, carbohydrate, chlorophyll 'a', chlorophyll 'b' and 'total' chlorophyll content in leaves was observed in T_8 treatment followed by other

treatments when compared to Control in Lablab on 15, 35 DAS and a slight decrease on 55 DAS. Protein, carbohydrates and crude protein in seeds were found to be maximum in T_8 treatment and T_4 treatment when compared to Control on 75 DAS. Leghaemoglobin content in root nodules increased significantly in T_8 treatment which is followed by other treatments and Control on 25 and 50 DAS.

Black gram [*Vigna mungo* (L.) Hepper] grown in summer compost

From 15 to 35 DAS, an increase in protein, carbohydrate, chlorophyll 'a', chlorophyll 'b' and 'total' chlorophyll content was noted in T_8 treatment which is followed by T_4 as compared to the Control with a moderate decrease in its content on 55 DAS in leaves of black gram. A maximum increase in protein, carbohydrates and crude protein in seeds was observed in T_8 treatment followed by T_4 treatment as compared to Control. Leghaemoglobin content in root nodules (25 and 50 DAS) was maximum in T_8 treatment followed by T_4 treatment over Control.

Lablab [*Lablab purpureus* (L.) Sweet] grown in summer compost

In Lablab crop, protein, carbohydrate, chlorophyll 'a', chlorophyll 'b' and total chlorophyll content in leaves was increased significantly in T_8 treatment followed by other treatments and Control from 15 to 35 DAS and slightly lower on 55 DAS. Protein, carbohydrates and crude protein in seeds were maximum in T_8 treatment which is followed by T_4 when compared to Control on 75 DAS. The highest leghaemoglobin content in root nodules was noted in T_8 followed by T_4 treatment as compared to Control on 25 and 50 DAS.

PHASE IV

5.4 SOIL STATUS

5.4.1 Initial soil analysis

The initial soil pH, electrical conductivity, available nitrogen, available phosphorus, and available potassium were analyzed and noted more in T_8- Fruit wastes + cowdung + *Pleurotus eous* + *Trichoderma asperelloides* + *Eudrilus eugeniae* (5 t/ha) followed by T_4- Vegetable wastes + cowdung + *Pleurotus eous* + *Trichoderma asperelloides* + *Eudrilus eugeniae* (5 t/ha) when compared to Control in black gram and lablab grown in both winter and summer compost.

5.4.2 Post harvest soil Analysis

The soil pH, electrical conductivity, available nitrogen (kg/ha), phosphorus (kg/ha) and potassium (kg/ha) recorded maximum in T_8- Fruit wastes + cowdung + *Pleurotus eous* +

Trichoderma asperelloides + *Eudrilus eugeniae* (5 t/ha) followed by T_4- Vegetable wastes + cowdung + *Pleurotus eous* + *Trichoderma asperelloides* + *Eudrilus eugeniae* (5 t/ha) and Control in black gram and lablab grown in both winter and summer compost.

5.5 Antioxidant activity and Antibacterial activity

Among the eight types of biocompost, T_8 treatment was noted to be efficient compost when compared to other treatments and Control. The T_8 treatment enhanced the microbial population, Physico-chemical, biometrics, biochemical and yield parameters, initial and post-harvest soil analysis of black gram and lablab grown in both winter and summer compost. To support the above experimental results, antioxidant and antimicrobial activity was carried out in aqueous and methanol seed extract under the best treatment (T_8) and Control for the test crops grown in winter and summer composting.

Antioxidant activity:

The seed of black gram and lablab plant samples was analyzed for free radical scavenging assay such as DPPH radical scavenging activity, hydrogen peroxide scavenging activity, nitric oxide radical scavenging activity and reducing power assay in aqueous and methanol extract. Comparing the aqueous and methanolic extracts of the two plants grown in winter and summer compost, remarkable antioxidant activity was noted in methanol extract of black gram grown in summer compost which is followed by lablab grown in summer compost in the best treatment (T_8) when compared to Control respectively.

Antibacterial activity:

Antibacterial activity of black gram and lablab seed (best treatment (T_8) and control) were examined in aqueous and methanol extract against gram-positive (*Staphylococcus aureus*) and gram-negative (*Escherichia coli*) bacterial species. Methanolic seed extracts of lablab plant grown in summer compost showed the highest zone of inhibition against *Escherichia coli* in best treatment followed by lablab grown in winter compost methanolic seed extracts and aqueous seed extracts.

CONCLUSION

The present study brings out the possibility of recycling municipal solid waste like Vegetable and Fruit waste into biocompost by using *Pleurotus eous, Trichoderma* and *Eudrilus eugeniae* and found to be an efficient organic manure to enhanced the biometric, yield and biochemical parameters of *Vigna mungo* (L.) Hepper and *Lablab purpureus* (L.) Sweet grown in winter and summer compost.

From the results found above, it can conclude that the combined application of biocompost produced from Vegetable and Fruit waste increased the biometric, biochemical, leghaemoglobin content, yield parameters, antioxidant and antibacterial activity in the test crops namely black gram and lablab grown in both winter and summer compost over the control. This technology would provide an alternate solution for the disposal of municipal solid waste.

Vegetable and Fruit waste are readily available in home or vegetable market and fruit stall. We can utilize the waste as an inexpensive source to enrich soil fertility since it is available abundantly and as an alternative solution for the disposal of waste. Good compost with all the macro and micronutrients is the key to increase productivity and sustainability. Well decomposed organic matter, applied under the right soil moisture condition, would not only improve soil texture and structure but also provide the crop necessary resistance against pest and disease. The success of the study will be allowed to minimize the use of chemical fertilizer and pesticides to crop and encourage the farmer to use organic manure for healthy life and healthy environment.

RECOMMENDATION FOR FUTURE STUDY

- Compost generated from Vegetable and Fruit has physio-chemical parameters within permissible limits which can be used as nutrient enriched, pathogen free organic manure.
- The study can go further for field experiment to test the biocompost as manure on other plants, green leafy vegetables and medicinal plant that need high nitrogen supply within a short time period.
- The composting can be done in large scale since the waste is available in large quantities due to its efficient and economical solution to the current issue of waste management and disposal.
- The biocompost produced from Vegetable and Fruit waste can be sold to local farmers and gardener to impose an elegant or economical way to reduce the use of chemical fertilizers.
- Composting awareness regarding preserving natural resource, soil health, importance of organic manure and organically grown vegetable, fruits with development of more sustainable agricultural practises is highly needed.