Bioconversion of vegetable and jackfruit peel waste and its effect on the growth of Black gram and Green gram

By

A. INDHUMATHI

(Reg. No: 19PBO007)

The thesis submitted to the

Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore-641043

In Partial Fulfilment of the Requirement for the degree of

MASTER OF SCIENCE IN BOTANY

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Certified as bonafide research work

Signature of the Head of the Department

Signature of the Guide

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

CHAPTER-I

INTRODUCTION

Agriculture plays an important role in the over all socio-economic progress of India and is one of the largest economic sectors. Agriculture depends on several resources such as soil, water, nutrients and energy. India has a large number of successful sustainable agricultural practices that are consistent with ecological principles. It provides us food, nutritional security which is the backbone of our sovereign nation.

Application of organic manures increases the availability of macro and micronutrients. Recently, organic vegetable cultivation gets a special attention due to its bio-efficacy, sustainability and eco-friendly nature (Senthil kumar *et al.,* 2014).

Disposal of agro-industrial wastes is a major problem in many industries and dumping of industrial wastes in the vicinity of industrial areas causes environmental hazards. Frequent use of inorganic fertilizers alone has been found to be harmful to both soil fertility and quality of product.

Tonnes of municipal solid waste is disposed every year due to hot weather and lack of proper infrastructure for storage and it has been disposed off in every nook and corner of the street in the city. Disposal of large amount of industrial waste, municipal solid waste and agriculture waste all over the world became a major issue which affect the environment. Around 1,88,500 tonnes of municipal solid waste are wasted per day in India (Prashant, 2013).

Organic farming is the degradation of organic matter used in order to bring sustainable environment in the ecosystem. Intensive use of chemical fertilizers, has its side effect on polluting underground water, destroying microorganism and soil fertility in the ecosystem (Darzi *et al.,* 2012). Organic agriculture is one among the longest spectrum for the production of method that is implemented globally for its easy and cheap method.

Recycling of organic materials takes nutrients that would otherwise be lost and help sustain our resource. The best treatments and recovery option for organic waste is composting. It also supplies abundant amount of organic matter to improve the chemical and physical properties of soil with less quantity of NPK (Singh *et al*., 2018). A stable compost is maintained prior application to the soil because unstable compost leads to unstable growth of the plant (Wichuk and McCartney, 2010).

Composting is the process of biodegradation of organic matter and used in sustainable agriculture which provide the nutrients to the plant. Compost contains abundant amount of N, P, K and micro nutrients for the plant growth. Composting is the most economical and sustainable option for organic waste management.

The decomposition of complex organic waste resources into odour-free, humus-like substances through the action of earthworms species is termed vermicomposting. Vermicompost is the introduction of earthworm to the organic matter; casts produce by the earthworm contain proteins, vitamins, micro and macro elements. Vermicompost also increase microbial population in the soil and improve soil fertility which improve agronomic and horticulture crop yield (Chaoui *et al*., 2003; Sinha *et al.*, 2009). Vermicomposting can be done without wasting the organic waste that will increase the yield of the plant. In India, about 3000 million tons of organic waste is wasted every year (Achsah and Lakshmi Prabha, 2013).

Legumes are one of the important segments of Indian agriculture after cereals and oilseeds. Pulses are not only improved soil health by enriching nitrogen status, but also enhance the sustainability of the cropping system. It can also “fix” atmospheric nitrogen with the help of nodules. The nodules are the house of the microscopic *Rhizobium* that convert atmospheric nitrogen to nitrate and ammonia that can be used by plants (Oldroyd *et al*., 2011).

Leghaemoglobin is an oxygen carrier and a haemoprotein found in the nitrogen fixing root nodules of leguminous plants. It is produced by the legumes in response to the roots being infected by nitrogen-fixing bacteria called rhizobia as part of the symbiotic interaction between plants and bacterium.

The pulses are the chief sources of protein in a balanced diet in Indian conditions and contribute about 15 per cent of diet. A significant part of human population relies on legumes as staple food for subsistence, particularly in combination with cereals. India is the major pulses growing country and legumes are considered as important source of protein for vegetarians. Pulses have the ability to fix atmospheric nitrogen and also improve the soil health and help in cropping system. It is rich in nutrient content has high amount of protein, essential amino acids, starch, fatty acids, fibres, oligosaccharides, phytochemical, minerals and vitamins (Khan and Prakash, 2013).

Black gram (*Vigna mungo* L.) Var. VBN 8 (Plate – I (a)) is the third important pulse crop in India. It is the annual pulse crop and native to Central Asia. It is also extensively grown in West Indies, Japan and other tropical and subtropical countries. Black gram is a small shrub grows upto a height of about 30 cm and well branched. The leaves and stems are covered with rough reddish hairs and is slightly ridged. Black gram seeds were highly nutritious containing 26.2 per cent protein, 1.2 per cent fat and 56.6 per cent carbohydrate. It is rich in minerals

PLATE-I

(a) Habitat of Black gram (*Vigna mungo* L.)

(b) Habitat of Green gram (*Vigna radiata* L.)

having 185 mg calcium, 8.7 mg iron and 345 mg of phosphorous. It also contains 0.42 mg vitamins BI, 0.37 mg vitamin B2 and 2.0 mg niacin (Anonymous, 2006).

Green gram (*Vigna radiata* L.) Var. Co. (Gg) 7 (Plate – I (b)) commonly known as "moong" is an important short duration pulse crop in India. It belongs to the family Leguminosae. The native of green gram is Indian subcontinent. It is herbaceous annual plant, erect, 42–120 cm tall with a slight tendency to twining in its upper branches. Being a leguminous crop, green gram fixes 30 – 40 kg nitrogen/ha. After picking pods, it may be used as green manure. Green gram is a rich source of high-quality protein. It contains about 2.5 per cent protein, 46–50 per cent starch, 2 – 4 per cent oil and vitamins. It also contains amino acids such as Arginine, histidine, lysine, tryptophane, etc. It is highly digestable and palatable. In human food, its pods are used as green vegetables.

Organic farming is followed by many people since it produces eco-friendly compost without the use of any chemical fertilizers. Some people opt for chemical fertilizer which might give good yield but it affects the human health and pollutes environment. The present study is the production of eco-friendly compost from vegetable and jackfruit peel waste and its impact on the growth of Black gram and Green gram. The outcome of the study should also give eco-friendly manure and reduce the maximum use of chemical fertilizers in the field and get sustainable crop production.

The Objectives of the study are given below:

1. To analyse the physico-chemical properties of raw and composted vegetable and jackfruit peel wastes compost.
2. To analyse the impact of biocompost on biometric parameters of Black gram and Green gram 15, 25, 30, 35, 40 and 45 DAS.
3. To analyse the chlorophyll and nitrogen content using Plant Nutrient Analyser on 15, 25, 30, 35, 40 and 45 DAS.
4. To evaluate the leghaemoglobin content in the root nodules of the plant on 40 and 45 DAS.
5. To analyse the protein and carbohydrates in seeds of black gram and green gram on 65 DAS.

CHAPTER-II

REVIEW OF LITERATURE

The given literature pertaining to the influence of organic manure such as composted vegetable and jackfruit peel waste on the growth, biochemical properties and yield of Black gram (*Vigna mungo* L.) Var. VBN 8 and Green gram (*Vigna radiata* L.) Var. Co. (Gg) 7 and the influence of these manures in the leghaemoglobin content of nodules as relevant to the present investigation are reviewed and presented in this chapter.

REVIEW ON COMPOSTING AND PHYSICO-CHEMICAL PARAMETERS

Keener *et al*., (2000) reported that the composting process consisted of three steps (i)initial mesophilic phase in which sugars, amino acids, proteins are degraded (ii)thermophilic phase in which fats, cellulose, hemicellulose and some lignin are degraded and(iii) cooling phase, characterised by a decrease in temperature due to the reduction of the microbial activity which were able to degrade the remaining sugars, cellulose and hemicellulose.

Tolessa and Friesen (2001) determined combined application of enriched farm yard manure at 25 per cent and 50 per cent of recommended nitrogen (N) and phosphorus (P) fertilizers significantly enhanced the grain yield (40%) as compared to the conventional farm yard manure.

Cambardella *et al*., (2003) ascertained that the rate of inorganic N release to the soil from composted manure depended on the rate of decomposition of the organic matter and on subsequent turnover of the decomposed C and N in soil. Release of plant available N from manure in the soil was controlled by the balance of N immobilization and mineralization, which in turn was controlled to a large extend by the C:N ratio of the decomposting organic material.

Organic farming is mostly envisaged as the stoppage of synthetic inputs and their replacement by organic alternatives i.e., use of organic manures and natural methods of plant protection instead of using synthetic fertilizers/pesticides (Bhattacharyya and Chakraborty, 2005).

Ahmed *et al*., (2007) determined the physical and chemical properties of the composted sludge during treatments show the stability and maturity of end product and total metal content in the final compost were much lower than the limit values of composts to be used as good soil fertilizer.

Composting is generally defined as the biological oxidative decomposition of organic constituent in wastes under controlled conditions which allows development of aerobic micro-organisms that convert bio-degradable organic matter into a final product sufficiently stable for storage and application without adverse environmental effects (Adhikar *et al.,* 2008).

Narkhede *et al*., (2011) stated that vermicomposted municipal biodegradable waste enhanced the physiochemical parameters like pH, electrical conductivity, organic carbon, nitrogen, potassium, phosphorous, chlorides, TVC, bulk density, specific gravity, sodium and sulphate and increased the growth parameters of *Capsicum annum* on 15, 30, 45 & 60 days.

Selvamuthukumaran and Neelanarayanan (2012) confirmed the combination of vermicomposted poultry waste and groundnut husk (70:20:10) treated soil increased the level of total N, P, K and Na when compared to the raw poultry waste and pre-digested poultry waste.

Bhat *et al.*, (2016) concluded that vermicompost is nutrient – rich manure and it acts as a soil conditioner. Vermicompost application increased the available nitrogen, potassium, phosphorus, sodium, magnesium, calcium and soil fertility. Brown manuring replace 25 percent of nitrogenous fertilizer with the overall improvement of soil health without affecting the economical attributes and saving the soil health (Sarangi *et al.*, 2016).

El-Mahrouk and Dewir, (2016) reported that physico-chemical properties of four compost based squeezed grape fruit waste (SGFW). The results showed that 100% SGFW compost had a suitable pH and EC with 7.82 and $1.68 dsm^{-1}$ and highest organic matter, carbon percentage were observed on 80% SGFW+20%BH and coco peat substrates.

The chemical properties of the coconut leaf vermicomposting showed increase in pH on 15th (5.26), 45th (5.63), 75th (6.40) and 105th (6.60) days and Total phosphorus 15th (0.14), 45th (0.16), 75th (0.21) and 105th (0.22) days during vermicomposting. Total Nitrogen decreases during 45th days (1.32) and increase in 75th days (1.80) and 105th day (1.85) of vermicomposting. Total potassium, continue to decrease till 105th days (0.17) of vermicomposting (Gopal *et al*., 2017).

Ademola and Abioye, (2017) experimented the proximate composition, mineral content and mineral safety index of *Lablab purpureus*. The composition of major minerals is sodium (5.74), potassium (597), calcium (9.90), magnesium (10.4) and phosphorus (285) and crude protein content of *Lablab purpureus* was high at 19.4 g/100g.

Oluchukwu *et al.*, (2018) observed that, N,P,K content of sawdust plus cow dung increased from 4.82 %, 3.21 %, 2.81 % to 8.73 %, 7.84%, 8.89%, N, P and K content of sawdust plus watermelon increased from 1.41 %, 6.61 %, 4.72 to 2.67 %, 8.72 %, 6.83 % while N, P and K content of sawdust plus food wastes increased from 0.82 %, 5.82 %, 0.77 % to 1.88 %, 7.73 %, 2.31 %, the temperature of the composts increased beyond 50^{o}C after 30 days of composting, the highest pH recorded was 9.82from the composters taken after every five days.

Birajdar *et al*., (2018) investigate the physico-chemical parameters of organic compost and its impact on pigeon pea and jowar crop plants productivity and concluded the treatment of vermicompost, cow dung and FYM found significant difference among the treatment in jowar. Saleh *et al.,* (2018) studied the application of 80% of evapotranspiration was enough to increase green bean productivity and improve pod quality.

Brown manuring in association with pre-emergence herbicides destroy the weeds population and also help in improving the soil physio-chemical properties like organic matter, soil aggregation, available nitrogen, concentration of available nutrients in the root zone, reduces the bulk density, N-losses through leaching, soil erosion and decreases the moisture evaporation from the soil (Anupama Devi, 2020)

Ghinea and leahu, (2020) reported that in the first week of composting pH is acidic and electrical conductivity values are high for all three samples, and during the composting process the pH values increase, while electrical conductivity values decrease. The nitrogen content is low in all samples and will decrease during the first five weeks of the composting, then begin to increase slightly.

Hema and Vijayalakshmi, (2020) reported that physico-chemical parameters compost consisting of consortium of microorganisms *Trichoderma viride*, *Pleurotus florida* and *P. eous* (APK1) are found to be rich in all the minerals like N, P, K, Ca, Mg, Cu, Fe, Mn and reduced in cellulose & lignin content.

Kannan, (2020) reported that during the degradation period, the pH was slightly reduced and subsequently increased to neutral; reduction in EC, organic carbon, carbon: nitrogen ratio and increase in the nitrogen content.

BIOMETRIC, BIOCHEMICAL ANALYSIS AND YIELD PARAMETERS

Rajkhowa *et al*., (2000) observed that the application of nitrogen (75%) and vermicompost (5 t / ha) enhanced the number of nodule and dry weight in green gram. Atiyeh *et al*., (2000) observed that combined application of chicken manure compost and vermicomposted pig waste (20%) increased the growth of marigold and tomato seedlings.

Mahalakshmipriya and Vijayalakshmi (2001) stated that agro waste and pressmud individually and in combination with bio-fertilizer improved the growth parameters of *Vigna radiata.*

Ivanova and Vassilev (2003) investigate that biometric and physiological characteristics of chrysanthemum plants grown at different rate of nitrogen fertilization. The best result about growth and decorative behaviour were achieved at nitrogen fertilisation level of 100 kg N/ha.

Singh *et al*., (2002) noted that significant residual effect of FYM and pressmud on the plant height, number of pods per plant and thousand grain weight of lentil crop. Rajkumar *et al.*, (2003) stated that application of vermicompost (2.5 t / ha) + 75%) significantly enhanced the nodulation in green gram crop.

Integrated use of 75% NPK and pressmud at 1.5t ha-1recorded significantly higher grain and straw yields of sorghum (*Sorghum bicolor* L.) (Ghosh *et al*., 2003).

Youssef *et al*., (2004) investigated that the use of biological fertilizers containing the bacteria Azotobacter and Azospirillum in medicinal plant Salvia (*Salvia officinalis*) increased plant height and shoot dry weight. Arshad *et al*., (2004) revealed that the application of compost enriched with nitrogen and L-tryptophan in combination with (50%) additional dose of nitrogen fertilizer increases the growth and yield of hybrid maize.

Abira (2006) examined the effects of combined application of vermicomposted fruit waste (75 g) + biofertilizer enhanced chlorophyll ‘a’ (0.2600 mg / g), chlorophyll ‘b’ (0.4316 mg / g) and ‘total’ chlorophyll (0.4249 mg / g) content in soybean.

Kannan *et al*., (2006) suggested that farm yard manure, vermicompost and coirpith, applied at 50, 75 and 100 per cent combined with *Azospirillum* (2 kg / ha) enhanced the yield, nutrient uptake and crop quality of tomato cv. PKM1. They also found the application of 75 per cent vermicompost in combination with *Azospirillum* increased protein content (1.70%) and lycopene content (3.7 mg / 100 g).

Modi (2007) observed that effect of growth temperature on amaranths leaf yield and nutritional quality at different stage of plant. The leaf protein content differed significantly($P<0.01$) and the amount of both calcium, iron changed significantly ($P<0.05$) in different stages of plant development.

The application of phosphorus and bio-fertilizers influenced the growth attributes, nodulation, leghaemoglobin content, nitrogenase activity of chickpea nodules in laterite soil (Dutta and Bandyopadhyay, 2009).

Tantawy *et al.,* (2009) experimented the growth, productivity and pod quality response of green bean plants *Phaseolus vulgaris* to foliar application of nutrients and pollen extracts. The application of extracted natural materials such as pollen extracts of cabbage in combination with P, K, and B in concentration of 5.0 g/100 L gave the best improvement in plants growth and production.

Aziz *et al*., (2010) conducted a field experiment to study the effect of different sources of organic manures on soil nutrient status and growth of maize. The results of the experiment revealed that the addition of organic matter through all sources significantly improved the soil properties and maize growth.

Balakrishnan *et al.,* (2010) stated that the application of Suaeda compost in combination with FYM and phosphate solubilising bacteria (T_9) significantly increased the yield characteristics in *Arachis hypogaea* and improves the quality and fertility of the soil.

Youssef *et al.,* (2010) observed that the residual effect of compost applied alone or integrated with mineral NPK on seed yield was significantly increased by using all rates of compost compared with the control.

Zodape *et al.,* (2010) reported that the application of 15% seaweed (*Kappaphycus alvarezii*) extract increased the protein (19.43 mg/g tissue) and carbohydrate (61.99 mg/g tissue) of green gram than control.

Ondieki *et al.,* (2011) reported that the increased in the total yield of African nightshade may be due to increased soil aggregation, soil aeration, water holding capacity and good environmental conditions for the root system of spider plants.

Vijayalakshmi (2011) reported the growth parameters of *Lablab purpureus* shoot length, root length, number of leaves, number of nodules, fresh weight and dry weight with the application of (T_5) pressmud 5 mg +1% IAA showed maximum increase followed by (T_3) pressmud 2.5 mg + 1% IAA for shoot length, root length and number of leaves and (T_2)

pressmud + 2.5 mg *rhizobium* and (T_4) pressmud 5 mg + rhizobium for number of nodules, fresh weight and dry weight. The length of pod, weight of pod, number of seeds per pod and weight of the seeds per pod show increase yield in T_5 followed by T_4 and T_3.

Jaipaul *et al.*, (2011) revealed that the integrated nutrient management (recommended nitrogen, phosphorus and potassium + farmyard manure + biofertilizers) recorded highest yield since it provided a balanced and optimum amount of nutrients during various stages of crop growth.

Panda *et al.,* (2012) stated that organic amendments and beneficial bacteria improved the growth of cowpea.

Maboko and ploy (2012) studied the effect of plant density and harvesting method on the yield components of amaranths. The highest total leaf mass was observed at higher plant density of 25 plants/m^2 as well as 16 plants/ m^2 using the tipping harvesting method.

Dashora and Gupta (2012) revealed that the combined application of organic, inorganic fertilizer and biopesticides improves the soil fertility and increases the productivity of sugarcane and ratoon crops.

Manyuchi *et al*., (2013) suggested that vermicompost technology can be successfully used as a solid waste management system with corn pulp as the major organic waste.

Swarnam and Velmurugan (2013) reported that application of poultry manure (3.79 t/ha) and vermicompost (3.73 t/ha) increased the yield of maize better than the Gliricidia and coconut husk compost. Omidi *et al.,* (2017) experimented that peanut shells compost has a significant effect on number of flowers, plant height, dry weight of canopy, root fresh weight in comparison to control.

Amalraj *et al*., (2013), investigated the growth of *Cajanus cajan* using panchagavya, vermicompost and FYM. The seed treated with panchagavya showed enhanced length of root, shoot, dry mass and total chlorophyll (19.4 cm, 16.9 cm, 147 mg and 23 spad units) followed by vermicompost (14.5 cm, 15.8 cm, 133.6 mg and 23 spad unit) and FYM showed root length of 13.7 cm, dry mass of 116.3 mg and total chlorophyll of 18 spad units.

Befrozfar *et al*., (2013) observed that application of vermicompost (5 t/ha) increased the chlorophyll ‘a’ (17.17%), chlorophyll ‘b’ (13.77%) and yield (24.84 %) of *Ocimum basilicum* L.

Mishra and Jain, (2013) studied the combined application of biofertilizers (250 g) + NPK (50%) + vermicompost (5t/ha) & reported that the chlorophyll (5.9 mg/g) and protein content (7.2mg/g) in *Andrographis paniculata* was promoted.

Gangwar and Dubey, (2013) reported that the combined application of blue green algae (15 kg/ha) + farmyard manure (5 t/ha) + vermicompost (5 t/ha) + neem cake (2.5 t/ha) showed maximum increase in the carbohydrate content 78.45% and 77.62% in basmati rice.

Oyedeji *et al.,* (2014) observed that effect of NPK and poultry on growth, yield and proximate composition of three amaranths. The length, breadth and number of leaves, growth parameters and yield were NPK> PM>control. Amaranthus species grown with NPK and PM had better growth but differs in nutritional quality.

Rama Lakshmi *et al.,* (2014) suggested that combined application of 75% RDF + vegetable market waste compost (2.5t/ha) in kharif rice and 50% RDF to rabi green gram promoted the available micro nutrients (nitrogen, phosphorus and potassium) in the soil.

Sardoei (2014) concluded that application of vermicompost (50%) enhanced the chlorophyll 'a' (9.39 g / ml-1 fresh weight), chlorophyll 'b' (6.25 g / ml-1 fresh weight) and 'total' chlorophyll content (15.74 g / ml-1 fresh weight) in marigold.

Reghuvaran and Ravindranath (2014) found that the application of composted coirpith increased the protein content of ornamental plants *Bauhinia purpurea* (8.81 mg/g tissue) and *Hydechium coronarium* (6.90 mg/g tissue).

Lalander *et al.,* (2015) observed that food waste with cow manure and earthworm species *Eudrillus eugeniae* showed the material reduction was 45.9% and the waste-to-biomass conversion rate was 3.5% in the vermicomposting process on a total solid basis and hence vermicomposting was found to be a viable manure management method in small-scale urban animal agriculture.

The application of vermicompost increased shoot length, root length, number of root nodules and yield of green gram (Gopinathan and Prakash, 2015). Viji and Neelanarayanan (2015) reported that the combination of three lignocellulolytic fungi Rhizopus oryzae, Aspergillus oryzae, Aspergillus fumigatus degraded the paddy straw waste, which produce good quality compost containing higher amount of total nitrogen (1.55±0.03%), total potassium (1.57±0.01%) and total phosphorus (1.48±0.17%) content.

Ravimycin (2016) determined that to the application of earthworm and *Pleurotus sajor-caju* enhanced the increased availability of phosphorus which might have favorably influenced the nitrogen uptake by plants and ultimately accumulated in seed as protein and carbohydrate. The highest protein content in coriander (23.32 mg fresh weight) compared to control (16.48 mg fresh weight) on 90 DAS.

Kadir *et al*., (2016) experimented that the utilization of banana peel in the fermentation liquid in food waste composting. The high K and N content in banana peel compost reactor is to assist in obtaining high potential K and N nutrient source in the soil.

The biocompost prepared from the partially decomposed coirpith with *Pleurotus sajor-caju* and vermicompost prepared by using *Eudrilus eugeniae* enhanced the root length (60.1 cm) and shoot length (90.47 cm) on 75 DAS in *Solanum nigrum* (Sakthivigneswari and Vijayalakshmi 2016a).

Hussain *et al.,* (2016) observed that effect of various levels of NP fertilizers of maize under different moisture conditions. The treatment combination $N_3P_3.I_1N_3$ and I_3P_3 yielded maximum plant height, weight of grains ear^{-1} and grain yield.

Sokoto and John bosco (2017) investigate the growth and yield of amaranths as influenced by seed rate and variety in sokoto. This result showed that seed rate had no significant effect on plant height of amaranth at 2 weeks after planting and seed rate had significant ($p<0.05$) effect on fresh and dry weight of amaranths at harvest.

Nalluri and Karri (2018) found that 50% of groundnut shell compost to the vegetable plant is suitable for better yield. This compost effective alternative source to chemical fertilizer, to enhance the yield without affecting the fertility of the soil and environment.

Sakthivigneswari and Vijayalakshmi, (2018) recommended that the biocomposted corncob and coir pith used as effective organic fertilizer for enhancement of protein and carbohydrate in *Glycine max* L. (Merill). The treatment T_6 - (Raw coirpith predigested by using *Pleurotus sajor-caju* and *Eudrilus eugeniae* (5t/ha) showed increased protein and carbohydrate content followed by other treatments.

Suganya and Vijayalakshmi, (2018) recorded that post harvested soil analysis of black gram and green gram showed increased N, P and K in T_5 treatment (20 g of composted corncob).

Gayathri and Anitha (2018) evaluate the growth and yield of lady's finger by the application of different organic fertilizers. The growth and yield parameters were found to be significantly higher in the combination of organic fertilizers such as *Azospirillum*, VAM fungi and Phospho bacteria.

Akhila *et al.*, (2019) determine the impact of organic manure such as farmyard manure, vermicompost, poultry manure, neem cake and bio fertilizers on available NPK in soil and nutrients composition of okra fruit during kharif season. The result showed that good soil conditions, available NPK in soil and nutrients in okra are maintained by use of organic and biofertlizers.

Gayathri and Malathi, (2019) investigated the effect of different bio-fertilizers on the biochemical parameters of *solanum nigrum* L. and *Amaranthus viridis* L. The protein content in tomato plant was higher in T_2 on the 30th day, T_4 on the 45th day and T_3 on the 60th day and the carbohydrate content was found to be more in T_2 on the 30th day, T_1 on the 45th day and T_4 on the 60th day. In *Amaranthus viridis* L., the protein content was observed to be higher in T_2 on the 30th day and T_4 on the 45th day.

Pinky Raihing and Vijayalakshmi, (2020) observed that the combined application of Fruits waste + cow dung + *Pleurotuseous* + *Trichoderma asperelloides* + *Eudrilus Eugenia* (5t/ha) increased significantly vegetative, chlorophyll and yield parameters of Black gram.

Significant increase of chlorophyll a, chlorophyll b, total chlorophyll, protein, carbohydrate contents in the leaves (25, 35& 45 DAS) and seeds (65 DAS) were noted in the treatment T_8 and which is followed by T_4 treatment as compared to the other treatments and control (Silpa and Vijayalakshmi, 2020).

According to Silpa and Vijayalakshmi, (2020), T_4- cocoa shell waste + *Pleurotus eous* + *Pleurotus florida* + *Eudrilus eugeniae*) treatment significantly increased the vegetative and yield characters of the test crop and also increase the vegetative and yield characters of cowpea and availability of soil nutrients.

Maximum protein and carbohydrates content in seeds was observed in T_8 treatment (174.54 and 135.43 mg/g tissue) respectively and concluded that T_8 treatment gave effective results for the enhancement of protein and carbohydrates content in black gram (*Vigna mungo* L.) (Pinky Raihing and Vijayalakshmi, 2020).

Rajashri *et al.,* (2021) reported treatment consists of vermicomposted groundnut shell and vegetable waste (75g) shows significantly increased chlorophyll, protein and carbohydrate content.

LEGHAEMOGLOBIN CONTENT:

Appleby (1974) reported that the leghaemoglobin content of most of the legume root nodules is correlated with their nitrogen fixing ability.

Reddy *et al*., (2000) reported that the application glyphosate of 1.12 kg ha-1 for three weeks in glyphosate - resistant soyabean after planting did not affect nodule number or mass,2.24kg ha-1 reduced these parameters by 30-39% compared to untreated. Leghaemoglobin content of nodules was reduced (6 to 8%) by both glyphosate rates, but effects were inconsistent with rate.

Sharma and Bhandari (2002) reported that application of zinc sulphate (25 kg ha-1), mineral nutrients and *Brady rhizobium* inoculation are significantly increased the number of nodules per plant, fresh weight of nodules, leghaemoglobin content of nodules.

Ali and Bano (2008) reported that nodule senescence has mutual relationship with the protein content as well as the sugar assimilation in the host plant which in return delay the degeneration of red bacteroid tissue of nodules and the nitrogenase activity. Oxygen availability can be regulated by O_2 binding protein leghaemoglobin (Lb) or the variable oxygen diffusion barrier (ODB) in the nodule (Minchin *et al*., 2008).

Lopez *et al*., (2008) reported that the leghaemoglobin present in the root nodules of legumes reduce the amount of oxygen and also protect the nitrogenase enzyme. Leghaemoglobin is a red pigment protein that acts as a oxygen carrier within a bacteroid cells.

Beringer *et al.*, (2009) noted that leghaemoglobin is a red pigment protein that acts as an oxygen carrier within bacteroid cells. Nodules lacking this important protein invariably lack nitrogenase activity and therefore lack nitrogen fixing capability.

Akthar and Siddique, (2010) stated that combined application of Pseudomonas and Bacillus significantly increased the leghaemoglobin content (2.9 mg / g) in the cow pea root nodules over Pseudomonas alone.

Das and Bandyopadhyay, (2011) reported that the integrated application of *Rhizobium leguminosarum* and phosphate solubilizing bacteria increased the leghaemoglobin content of nodule with increase in the nodule number, fresh nodular weight and yield of fresh bean crop (*Phaseolus vulgaris* L.).

Navascues *et al*., (2012) analysed the biosynthesis of leghaemoglobin during nodule formation in soya bean (*Glycine max* L.) and reported that the modified leghaemoglobin is more abundant in nodules and have aberrant O_2 binding.

Anju Singh and Vijayalakshmi (2013) reported that the combined effect of composted coirpith (6.5 t/ha) + composted pressmud (6.5 t/ha) + farmyard manure (6.5 t/ha) enhanced the leghaemoglobin content (0.0560mg/g) in the nodules of green gram on 45 DAS after that it declined.

Lal *et al.*, (2014) observed the effect of phosphorus and sulphur fertilizer in chickpea and found application of 30 kg S / ha registered higher number of nodules (26.1 / plant), leghaemoglobin content (0.53 mg / g nodule), nitrogenase activity of nodules (5.3 m moles C_2H_4 / plant / hr) during both years followed by 60 kg P_2O_5 / ha in chickpea root nodules.

Kawashima *et al*., (2014) investigated that two types of leghaemoglobin genes (PSLbA and PSLbB) in pea genome which have different roles in the development in nitrogen fixation in pea nodules.

Verma *et al*., (2014) reported that application of vermicomposting (6 t / ha) increases the leghaemoglobin content 2 mg / g in fenugreek root nodules.

Khan *et al.*, (2015) reported that combined inoculation of cow pea with Rhizobium and PSB coupled with the application of vermicompost (6 t / ha) increased the total nodule number (16.56) and leghaemoglobin content (1.90 mg / gm) in cow pea.

CHAPTER-III

MATERIALS AND METHODS

The details of methodology carried out regarding pit composting, vermicomposting, effect of various treatments of vegetable and jackfruit peel waste as biocompost, physico-chemical composition, pot culture experiments, biometric characters, leghaemoglobin content in the nodules and yield parameters (biochemical and biometric) of the test crops (Black gram and Green gram) and the statistical analysis are presented in this chapter.

COLLECTION OF BIOWASTES

The vegetable and jackfruit peel waste were collected in large amount from near and around Avinashilingam Institute for Home Science and Higher Education for Women Coimbatore, Tamil Nadu (Plate-II). The collected wastes were chopped into small pieces. It was sun dried and stored in gunny bags.

COMPOSTING PROCEDURE

The composting is done in pits with 1 metre depth and 4 square feet wide. In this study, consortium of vegetables and jack fruit Peel waste compost was carried out with vermicomposting technology. The moisture content in the heap was maintained at about 60-70% by sprinkling water. To accelerate the decomposition process turning was manually done every week during composting. Vermicomposting was prepared by mixing the pre-decomposed consortium of vegetables and jack fruit Peel waste compost waste along with dry cow dung in ratio of 1:1 (1 kg of pre-decompost and 1 kg of cow dung. The substrates were maintained with 60-80% of moisture content and kept for 24 h stabilization. The vermicomposting process is followed from 30-90th days for the biodegradation of the sample. Fifteen healthy individuals of exotic earthworms (*Eudrilus eugeniae*) were inoculated after 30th day into the respective experimental tray. After 90 days, at the end of the composting the compost changes from dark brown to black colour with uniformly disintegrated structure. At the end of composting, they were separated by sieving (Plate – II).

EVALUATION OF COMPOST MATURITY

Physical and chemical analysis of composted vegetable and jackfruit peel waste was analyzed based on standard method. The methods have been proposed for estimating the degree of maturity. The compost was analysed for the following parameters.

PLATE- II

Raw and Composted vegetable and jackfruit peel waste

RAW SAMPLE

COMPOSTED SAMPLE

PHYSICAL PARAMETERS

pH and electrical conductivity of the composted materials were estimated by using a glass electrode and electrical conductivity bridge.

CHEMICAL PARAMETERS

1. Lignin (Goering and Vansoest, 1975)
2. Cellulose (Updegroff, 1969)
3. Total nitrogen (%) (Humphries, 1956)
4. Total phosphorus (%) (Jackson, 1973)
5. Total potassium (%) (Jackson, 1973)
6. Organic carbon (Walkley and Black, 1934)

POT CULTURE EXPERIMENT

A pot culture experiment was conducted with black gram (*Vigna mungo* L.) Var. VBN 8 and green gram (*Vigna radiata* L.) Var. Co. (Gg) 7 and as the test crops to evaluate the effect of biocomposted consortium of vegetable and jackfruit waste. Sandy clay loam soil was used for pot culture experiment.

COLLECTION OF SEEDS

Seeds of Black gram (*Vigna mungo* L.) Var. VBN 8 and Green gram (*Vigna radiata* L.) Var. Co. (Gg) 7 were collected from Tamil Nadu Agricultural University, Coimbatore.

TREATMENT DETAILS

C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

In all the treatments of test crops, biometric, leghaemoglobin content in the nodules, yield parameters and biochemical in seeds were recorded.

TREATMENTS APPLICATION AND CULTIVATION

The stones and pebbles were removed from the soil and all the pots were filled with 7 kg of sandy clay loam soil. The compost was applied to the respective pots and mixed thoroughly. About 10 viable seeds of black gram and green gram were sown in each pot for 15, 25,30, 35, 40 and 45 DAS. After germination five healthy plants were maintained per pot. Plant protection measures and other cultural practices were followed as per recommendation by Tamil Nadu Agricultural University, Coimbatore

BIOMETRIC PARAMETERS

On the 15, 25, 30, 35, 40 and 45 DAS (black gram and green gram) plants were uprooted from the pot and the following vegetative characters were noted.

1. Root length (cm)
2. Shoot length (cm)
3. Number of leaves
4. Number of nodules
5. Plant fresh weight (g)
6. Plant dry weight (g)

NUTRIENT CONTENT

Plant nutrition analyser, also known as crop nutrition diagnostic instrument was used to measure three parameters namely chlorophyll, nitrogen content and temperature in leaf. It is used to analyse the compost effectiveness to the plant.

PROCEDURE

The fresh plant sample was taken on 15, 25, 30, 35, 40, 45 DAS of plants growth and the leaves were washed. The plant nutrient analyser was clipped to the centre of the leaf. The upper part of the nutrient analyser was pressed for few second. The level of chlorophyll, nitrogen and humidity of the plant leaf was calculated.

YIELD PARAMETERS

On the 65th day, the plants were uprooted from the respective pots and the following yield parameters were observed.

1. Number of pods/plants
2. Length of pod (cm)
3. Number of seeds / pods
4. Pod fresh weight (g)
5. Pod dry weight (g)

BIOCHEMICAL ANALYSIS

1. **Protein:**

   Estimation of protein in seeds on 65 DAS (Lowry *et al.*, 1951).

2. **Carbohydrate:**

   Estimation of carbohydrates in seeds on 65 DAS (Hedge and Hofreiter, 1962).

3. **Leghaemoglobin:**

   Estimation of leghaemoglobin on 40 and 45 DAS in the root nodules (Appleby and Bergersen, 1980)

STATISTICAL ANALYSIS

The data obtained on biometrical observations (root length, shoot length, number of leaves, number of nodules, number of flowers / plant, number of pods / plant, fresh weight and dry weight of plant), biochemical analysis (65 DAS) in seeds and leghaemoglobin content (40 and 45 DAS), yield parameters (number of pods / plant, length of pod, weight of pod, number of seeds per pod, pod fresh weight and dry weight) on 65th day, were subjected to the statistical analysis (one way and two way ANOVA) and based on the results, inferences were drawn.

CHAPTER-IV

RESULTS AND DISCUSSION

The results and discussion pertaining to the composting of vegetable and jackfruit peel wastes on biometric parameters of the test crops [Black gram (*Vigna mungo* L. Var. VBN 8) and Green gram (*Vigna radiata* L. Var. Co. (Gg) 7] during vegetative growth, biochemical analysis in seeds, yield parameters, leghaemoglobin content in the nodules were analysed and presented in this chapter.

TABLE- I

Physico-Chemical composition of the Raw and Composted vegetable and jackfruit peel waste

Parameters	Raw	Composted
pH	6.52	7.30
Electrical Conductivity (milli mhos cm^{-1})	2.04	7.98
Organic carbon	52.2	34.5
N %	0.63	1.20
P%	0.15	0.80
K%	0.30	0.93
C:N	82.85	28.75
Lignin (%)	36.5	18.5
Cellulose (%)	24.2	12.8

Physico-Chemical composition of the Raw and Composted vegetable and jackfruit peel wastes (Table-I, Figure-I)

The physico-chemical parameters such as pH, electrical conductivity, nitrogen, phosphorous and potassium were analysed in raw and composted vegetable and jackfruit peel waste to assess the compost maturity.

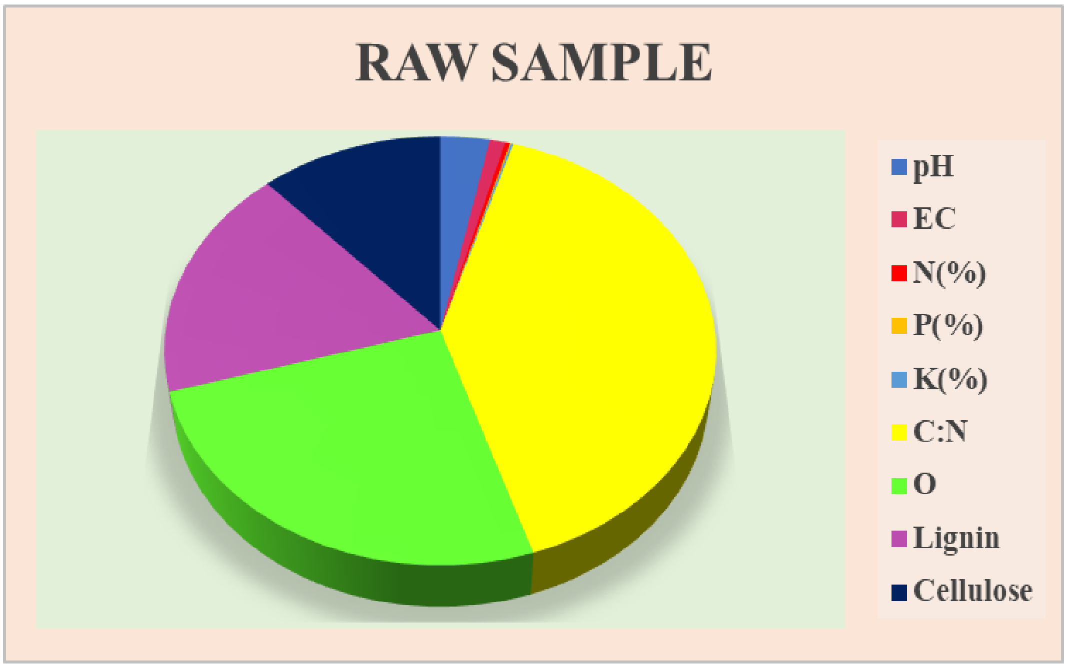
pH

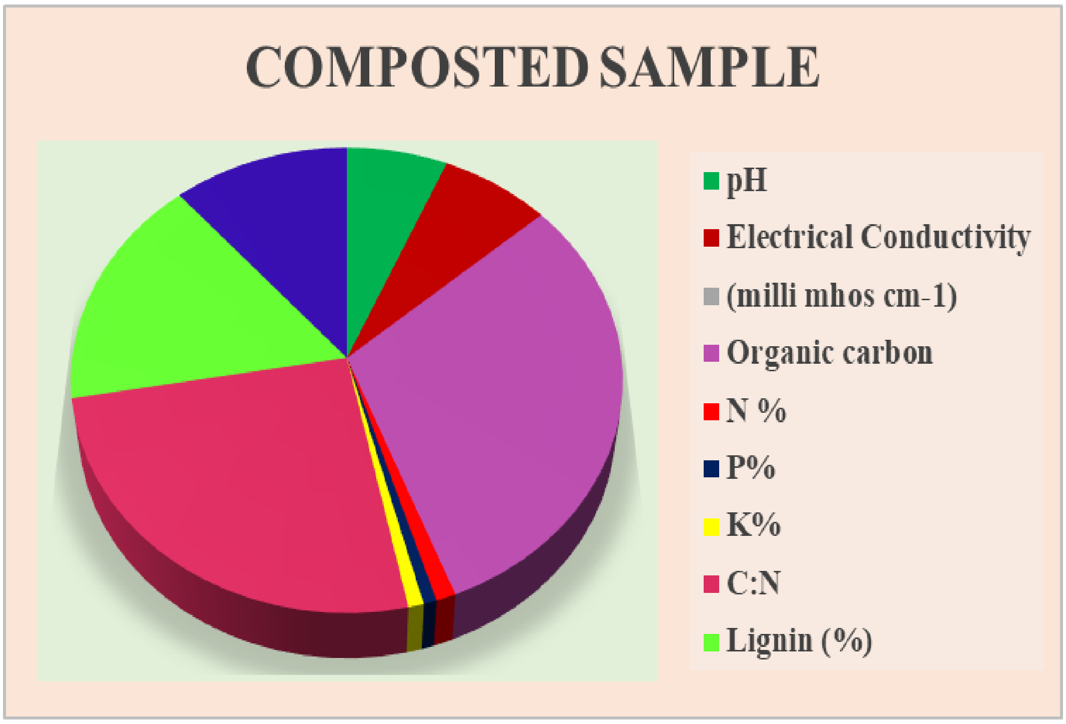
The pH value in raw vegetable and jackfruit peel waste is 6.52 and as the decomposition started, it increased to 7.30 in composted vegetable and jackfruit peel waste. The compost should maintain neutral value between 6 to 8 which tend to be more acidic on maturation.

The present result coincides with the result of Tiquia *et al.*, (2002), who observed a decrease in pH from 9.43 to 8.35 in fungal consortium inoculated urban solid waste compost over 40 days period of composting.

FIGURE-I

Physico-chemical composition of the raw and composted vegetable and jackfruit peel waste





Electric Conductivity

Electrical conductivity is used to measure the nutrient in the form of salt in compost. The EC value of raw vegetable and jackfruit peel waste is 2.04 millimhos cm^{-1} which increased to 7.98 millimhos cm^{-1} in composted sample as shown in table-I.

The present result coincides with the result of Shyamala and Belagali (2012) who observed an increase in EC from 2.4 dSm-1 to 7.7 dSm-1 at different maturity stages (10, 20, 30, 40, 50 and 60 days) of Municipal Solid Waste Compost (garbage and sewage). Similar result was observed by Omidi *et al*., (2017) the EC in peanut shell during composting showed a significant increase of 4.30 dS/m compared to raw sample of 1.38 dS/m.

Organic carbon

In the present study, the initial OC content showed a decreasing trend of biodegradation. A significant decrease in OC of 34.5 % was observed during decomposition of vegetable and jackfruit peel waste against the initial value of 52.2 % (Table – I).

Similar result was obtained by Viji and Neelanarayanan (2015**)** who obtained a maximum reduction in organic carbon content from 43.29 to 10.08 in vermicompost coirpith (pre-digested with *Pleurotus* sp.) and cow dung in 50:50 concentration.

This work is in harmony with the findings of Sivakumar and Karthikeyan (2016) who reported reduction in organic carbon in vermicompost. The decrease in organic carbon after biocomposting indicated the net organic matter stabilization in the substrate due to the combined action of microorganisms and earthworms.

Total Nitrogen Content

The initial nitrogen content of raw vegetable and jackfruit peel waste was 0.63 percent and it is increased to 1.20 percent in composted vegetable and jackfruit peel wastes. The results is in par with Hemalata (2012), the nitrogen content before composting is 0.210% which is increased to 2.3% in vermicomposted fruit waste plus paper sludge.

Similar result was obtained by Sunitha Kumari *et al*., (2013a) who observed a maximum increase in nitrogen content from 0.39% to 0.99% by *Pleurotus florida* inoculated coirpith sample.

Similar results were observed by Achsah and Lakshmiprabha (2013) that banana waste composted by *Eudrilus eugeniae* increase the nitrogen content in vermicompost over the control.

Total Phosphorus Content

Data presented in table-I stated that the total phosphorus content revealed a increasing value from 0.15 % to 0.80 % in raw and composted vegetable and jackfruit peel waste.

Similar results were observed by Huang *et al*., (2012), they investigated on raw and vermicomposted fresh fruits and vegetable. The phosphorus contents of raw banana peels (3.4 g/kg) and increased in vermicomposted banana peels (4.4 g/kg) over control (3.3 g/kg).

Similar increase in total phosphorus content was revealed by Thiruneelakandan and Subbulakshmi (2014) in biocomposted solid waste after 60 days of composting.

Total Potassium Content

As results shown in table-I, the potassium content gradually increases from 0.30 % (raw vegetable and jackfruit peel waste) to 0.93 % (composted vegetable and jackfruit peel waste).

Similar result was obtained by Sunitha Kumari *et al*., (2013b) who observed an increase in total potassium content from 0.61 per cent to 0.81 per cent in coirpith composted by *Pleurotus florida*. The present study is in accordance of Wani and Rao (2013) who observed an increase in total potassium content from 0.60% to 1.01% in kitchen waste inoculated with *Eisenia foetida.*

Similar results are in par with Sarkar and Rohatgi (2018) who observed Potassium content of soil slightly increased in the sample containing sweet lime (79 mg/kg) and greatly increased in the sample containing banana peels (299 mg/kg) over control (70 mg/kg).

C : N

C:N ratio is an important parameter that determine the extent of composting and degree of compost maturity. C:N ratio of the compost materials narrowed down from 82.85:1 to 28.75:1 with the advancement of the period of decomposition as depicted in table - I.

This is accordance with the findings of Jeyapriya and Saseetharan (2007) who reported a drastic reduction in C: N ratio from 30 : 1 to 19 : 1 in MSW (Muncipal Solid Waste) biocompost.

The present result coincides with the result of Muthurayar and Dhanarajan (2013) who obtained a drastic reduction in C: N ratio from 162: 1 to 21.8: 1 during degradation of coirpith, vegetable market waste and poultry waste along with cow dung.

POT CULTURE EXPERIMENT

A pot experiment was conducted with black gram (*Vigna mungo* L. Var. VBN 8) and green gram (*Vigna radiata* L. Var. Co. (Gg) 7) as the test crops to evaluate the effect of vegetable and jackfruit peel waste biocompost. The biocompost effect on test plants were compared against the control (without manures).

A number of biometric observations, biochemical analysis in seeds, yield parameters and leghaemoglobin content were recorded at different stages during the growth of Black gram and Green gram on 15, 25, 30, 35, 40, 45 and 65 DAS which is influenced by different treatments were statistically analysed.

BIOMETRIC CHARACTERS (Table- II to VII, Plate- III to X)

Effect of biocomposted vegetable and jackfruit peel waste on vegetative parameters of test crops

ROOT LENGTH

Black gram (*Vigna mungo* L. Var. VBN 8)

The root length of the test crops showed maximum in T_5 treatment (12.5 cm, 14 cm, 15.2 cm, 15 cm, 17 cm and 19.5 cm) when compared to control (2.8 cm, 4 cm, 4.2 cm, 5.6 cm, 7.3 cm and 9.1 cm) on 15, 25, 30, 35, 40 and 45 DAS.

Green gram (*Vigna radiata* L. Var. Co. (Gg) 7)

A gradual increase in root length was observed in all the treatments. Root length was significantly increased in T_5 (9 cm, 11.4 cm, 12.2 cm,15.5 cm,16.1cm and 16.7 cm) closely followed by T_4 (6 cm, 10.3 cm, 10.9 cm and 11.5 cm, 15.5 cm, 15.9 cm) as compared to the control (3 cm, 3.8 cm, 4.8 cm, 5.7cm, 7 cm and 13 cm) on 15, 25, 30, 35, 40 and 45 DAS respectively.

SHOOT LENGTH

Black gram (*Vigna mungo* L. Var. VBN 8)

The shoot length of the test crops showed highest increase in T_5 treatment (15 cm, 20.6 cm, 27.5 cm, 28.3 cm, 29.1 cm and 33.4 cm) when compared to control (5 cm, 8 cm, 13 cm, 15.5 cm, 18.5 cm and 18.9 cm) on 15, 25, 30, 35, 40 and 45 DAS as shown in table-II.

Green gram (*Vigna radiata* L. Var. Co. (Gg) 7)

A significant increase in shoot length is noted in all the treatments when compared to the control. Among the treatments (T_1 to T_5) maximum increase in shoot length was recorded in T_5 (12.5 cm, 17.9 cm, 27.4 cm, 28.6 cm, 30.5 cm and 33.8 cm) followed by T_4 (12.3 cm, 17.5 cm, 21.8 cm, 24.4 cm, 29.2 cm and 32.3 cm) as compared to the control (4.5 cm, 11.8 cm, 14.1 cm, 14.8 cm, 17.3 cm and 18.2 cm) on 15, 25, 30, 35, 40 and 45 DAS respectively.

The present findings are in conformity with the results of Pradeepa *et al.,* (2011) who reported that application of 50% vermicomposted food waste significantly increased the root length (4.4 cm) of *Vigna unguiculata*.

The present findings are in conformity with Singh and Chauhan (2009) who found a significant increase in root length of 30.34 cm in French bean over control treatment (18.56 cm) due to the application of vermicompost. The present findings is in conformity with Abdissa *et al*., (2012) who found a significant increase in tap root length of 13.37 cm over control of 12.88 cm in sweet potato with the application of farmyard manure at 20 t ha^{-1}.

Vanmathi and Selvakumari, (2012) reported that shoot length increased in T1-vermicompost 11.96 cm, 16.03 cm and 19.83 cm followed by T_2 - Urea 7.26 cm, 8.93 cm and 16.56 cm when compared to the control 5.30 cm, 8.53 cm and 12.16 cm on 20, 40 and 60 days in *Hibiscus esculentus* respectively. Similar results were obtained by Saikrithika *et al.,* (2015) the application of vermicomposted coirpith enhanced the root length (4.5 cm) over control in *Vinca rosea*.

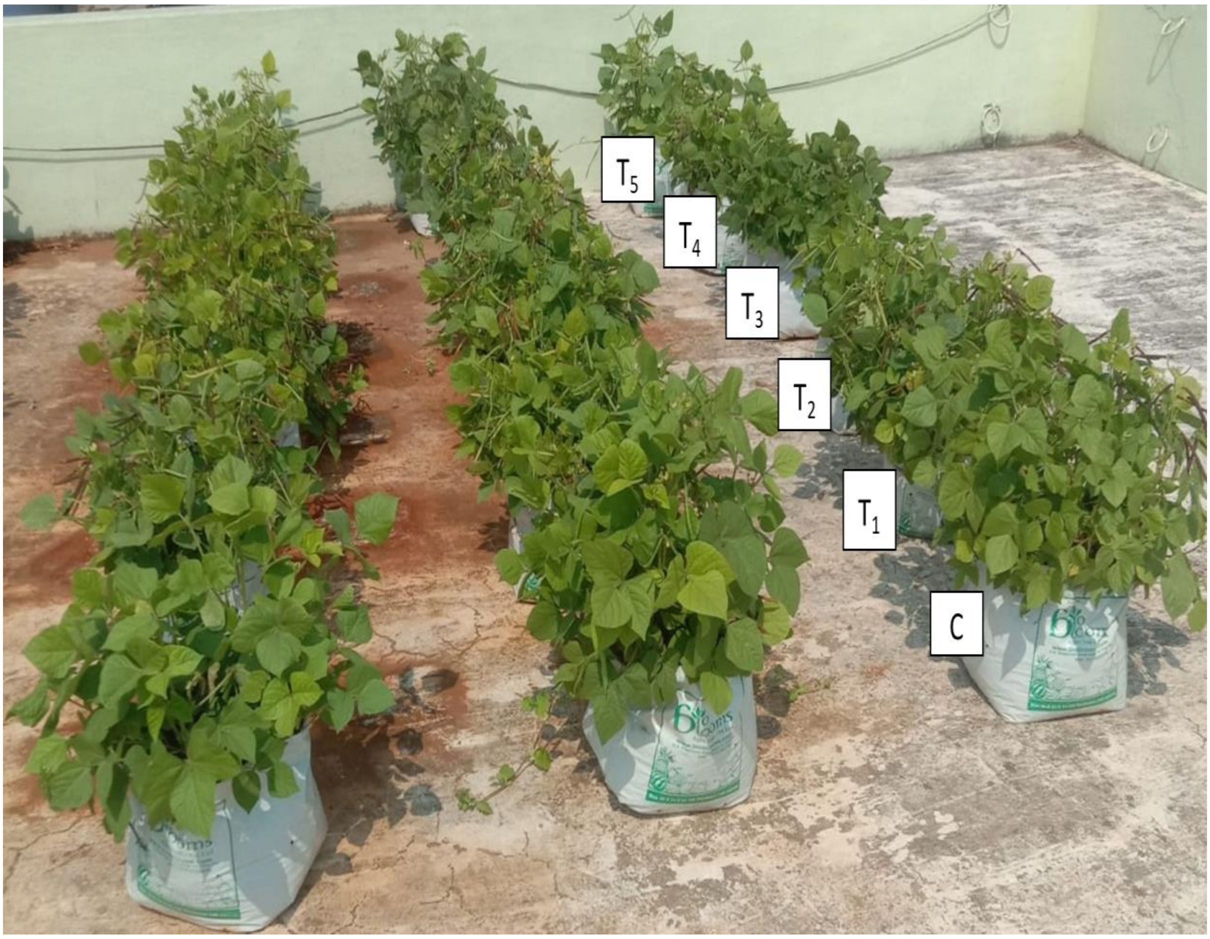
The present findings coincide with the results of Sakthivigneswari and Vijayalakshmi (2016) who observed that the application of compost T_6 (Raw coirpith predigested by using *Pleurotus sajor-caju* and *Eudrilus eugeniae* (5t ha-1)) and T_3 (Raw corncob predigested by using *Pleurotus sajor-caju* and *Eudrilus eugeniae* (5t ha-1) significantly increased root length on 25 DAS (18.60 cm), 50 DAS (41.53 cm) and 75 DAS (60.10 cm) in *Solanum nigrum*.

Similar work was done by Priyanga and Vijayalakshmi, (2020) who revealed biocomposted Banana peel manure significantly increase the root length of Amaranthus (6.05cm, 7.09 cm) on 15 to 30 DAS. The results were positively correlated with the findings of Gayathri and Malathi (2019) who reported that application of different bio-fertilizers promoted the shoot length (99.20 ± 4.35 cm) in *Amaranthus viridis.*

The result is in line with the observations of Pinky Raihing and Vijayalakshmi (2020) who found that composted fruit waste significantly increased the shoot length of *Vigna mungo* L (T_4- 56.50, 58.13 and 65.60 cm) on 15, 35 and 55 DAS.

PLATE-III

Effect of biocomposted vegetable and jackfruit peel waste on vegetative parameters of Black gram (*Vigna mungo* L.)



C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

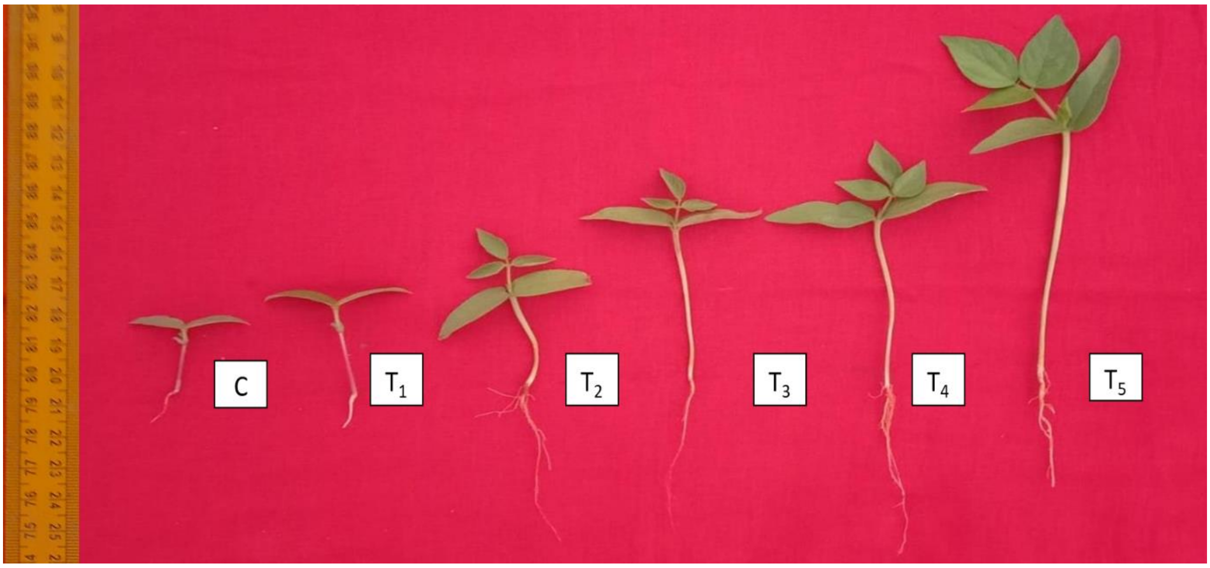
T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

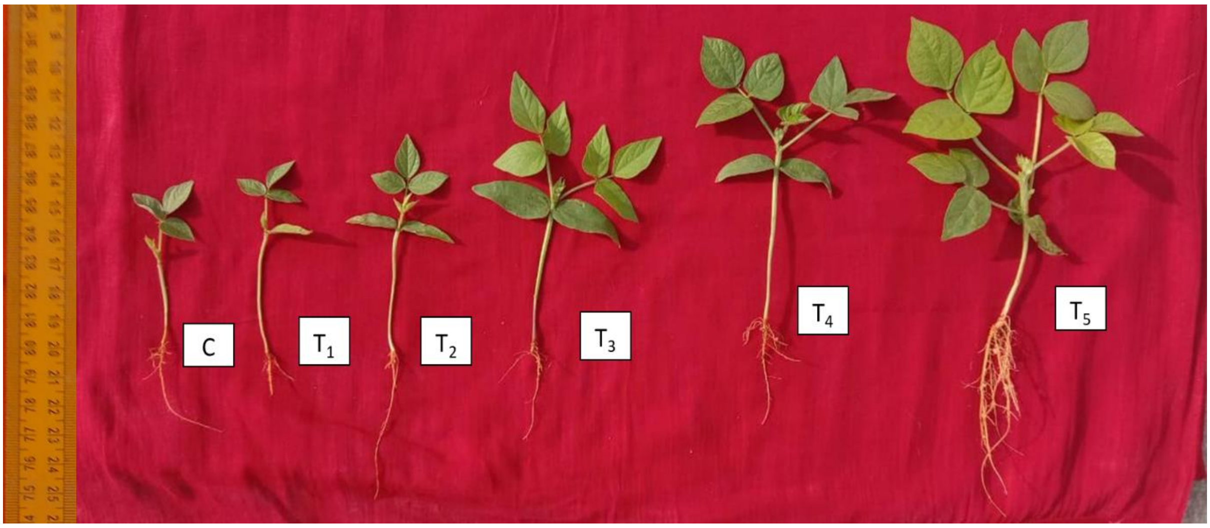
PLATE-IV

Effect of biocomposted vegetable and jackfruit peel waste on vegetative parameters of Black gram (*Vigna mungo* L.) on 15 and 25 DAS

15 DAS



25 DAS



C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

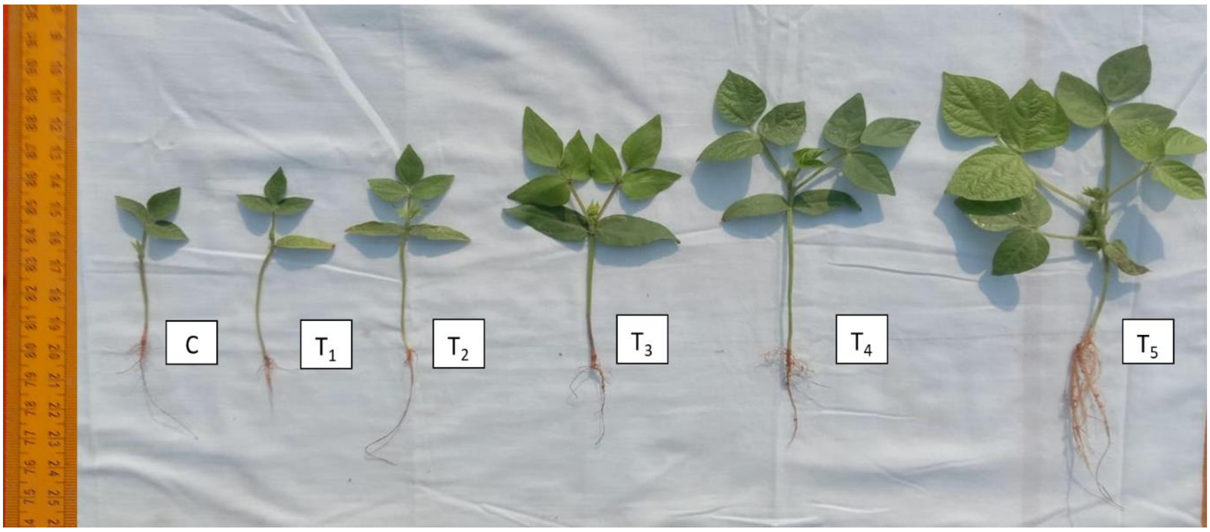
T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

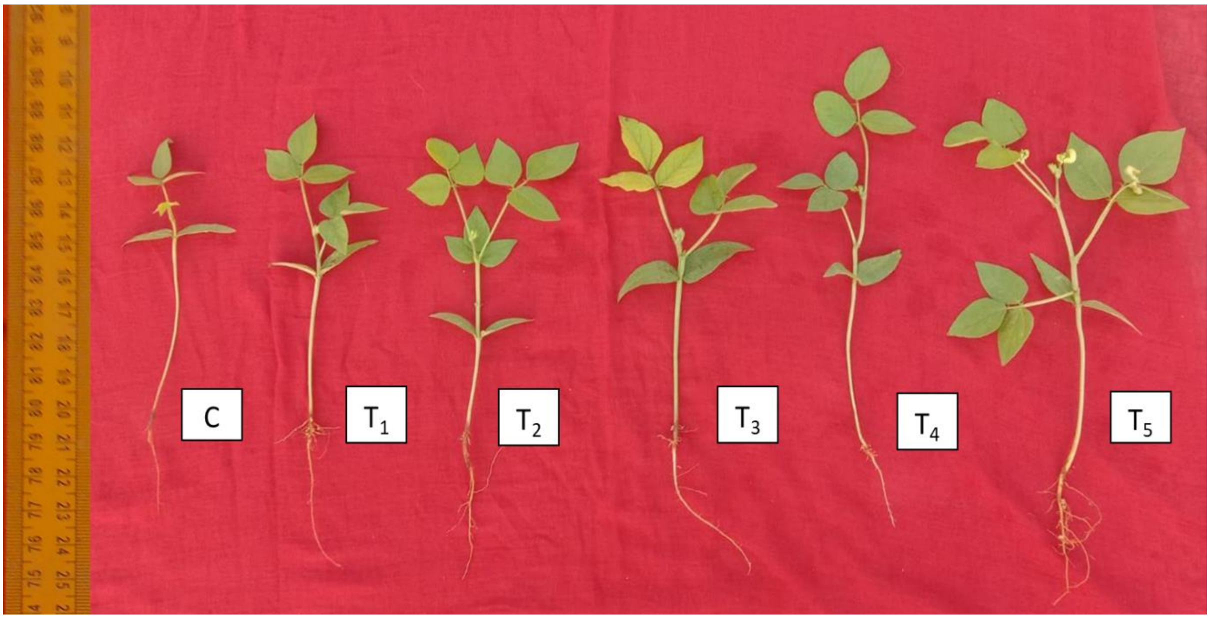
PLATE-V

Effect of biocomposted vegetable and jackfruit peel waste on vegetative parameters of Black gram (*Vigna mungo* L.) on 30 and 35 DAS

30 DAS



35 DAS



C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

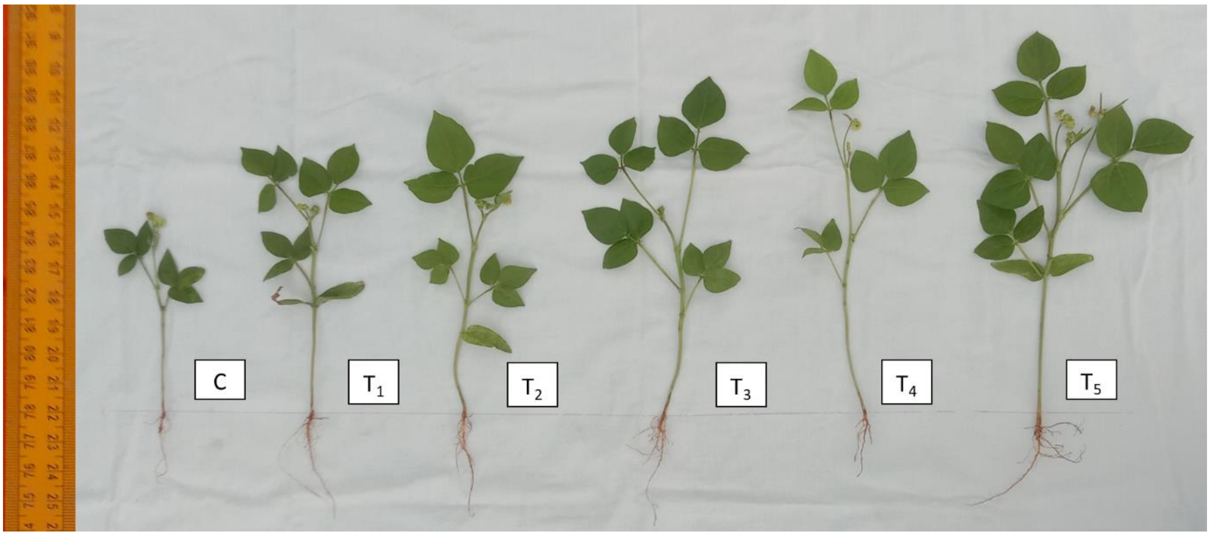
T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

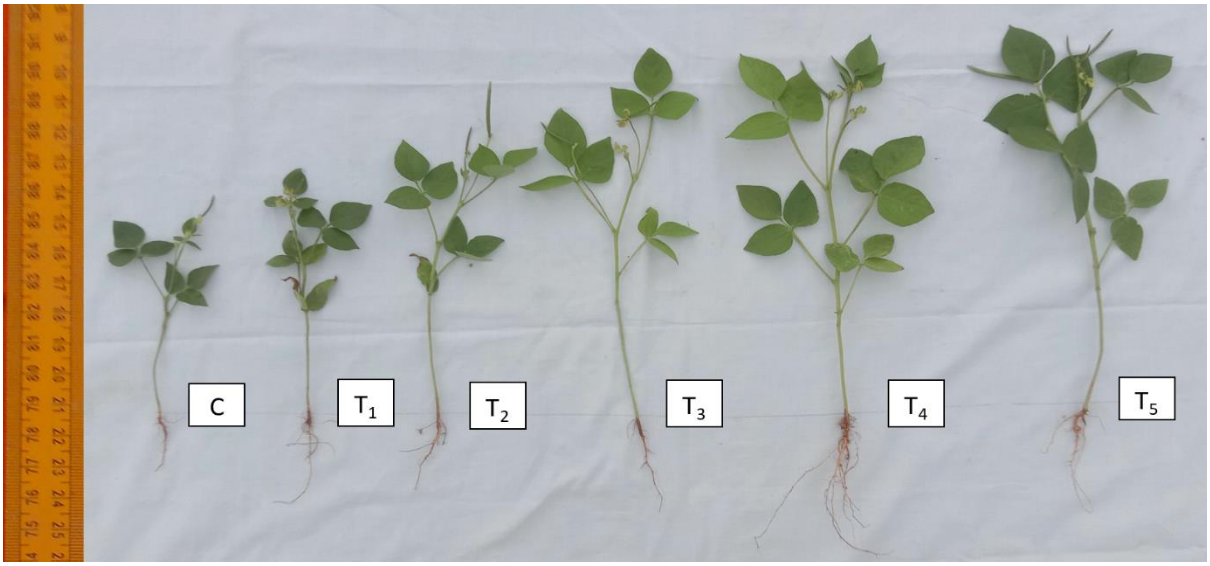
PLATE-VI

Effect of biocomposted vegetable and jackfruit peel waste on vegetative parameters of Black gram (*Vigna mungo* L.) on 40 and 45 DAS

40 DAS



45 DAS



C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

TABLE -II

Effect of biocomposted vegetable and jackfruit peel waste on vegetative parameters of Black gram

Treatments	Root length (cm)						Shoot length (cm)					
	15 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS	15 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS
C	2.8	4	4.2	5.6	7.3	9.1	5	8	13	15.5	18.5	18.9
T_1	3	6	7.5	7.8	9.5	10.5	5.5	11.5	13.2	19.4	21.5	22.1
T_2	4	8	10.2	10.8	11.5	13.2	8.5	12	16.7	20.7	22.5	23.9
T_3	5	9	12	11.9	12.4	12.6	12	17	19	23.2	27.0	24.5
T_4	7	11.5	12	13.2	15.3	18.4	13.8	19.5	23.8	25.5	28.8	31.4
T_5	12.5	14	15.2	15	17	19.5	15	20.6	27.5	28.3	29.1	33.4

TABLE -III

Effect of biocomposted vegetable and jackfruit peel waste on vegetative parameters of Green gram

Treatments	Root length (cm)						Shoot length (cm)					
	15 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS	15 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS
C	3	3.8	4.8	5.7	7	13	4.5	11.8	14.1	14.8	17.3	18.2
T_1	4	5.9	7	7.3	7.5	13.2	6	14	17.8	20	20.8	22.8
T_2	4.5	7.2	7.8	9.4	10.2	13.5	8.5	14.5	21.2	21.5	21.8	22.3
T_3	5.7	8.9	10.5	11.3	14.2	15.4	8.7	16.5	20.6	22	27.3	30.0
T_4	6	10.3	10.9	11.5	15.5	15.9	12.3	17.5	21.8	24.4	29.2	32.3
T_5	9	11.4	12.2	15.5	16.1	16.7	12.5	17.9	27.4	28.6	30.5	33.8

PLATE-VII

Effect of biocomposted vegetable and jackfruit peel waste on vegetative parameters of Green gram (*Vigna radiata* L.)

C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

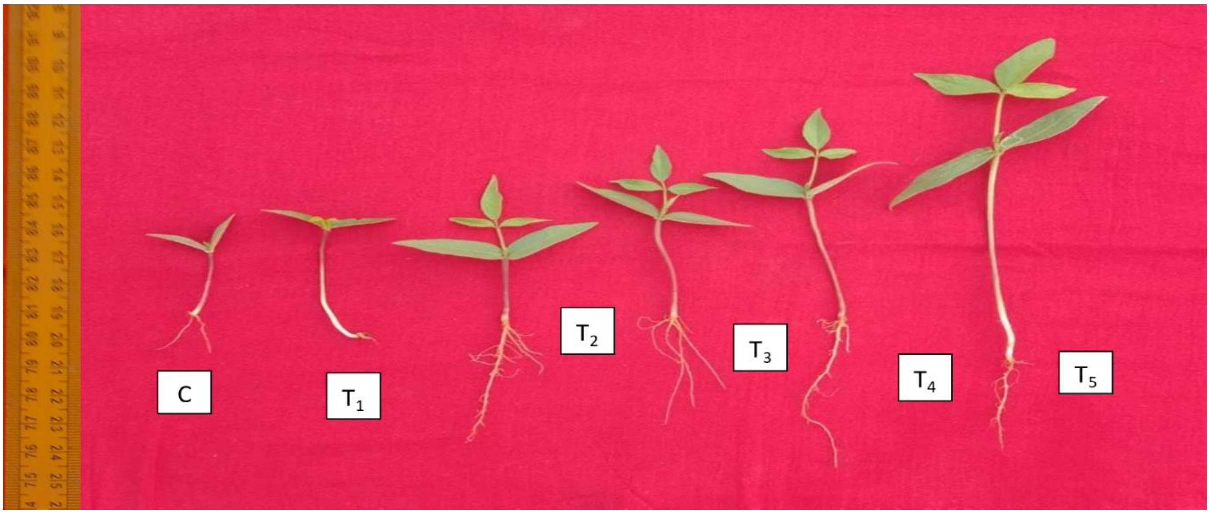
T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

PLATE-VIII

Effect of biocomposted vegetable and jackfruit peel waste on vegetative parameters of Green gram (*Vigna radiata* L.) on 15 and 25 DAS

15 DAS



25 DAS

C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

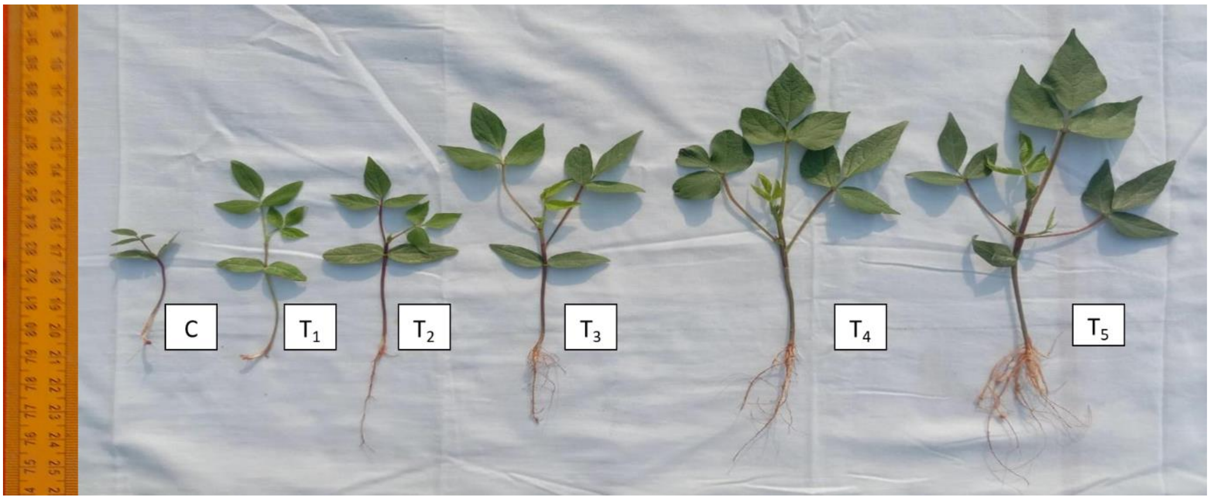
T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

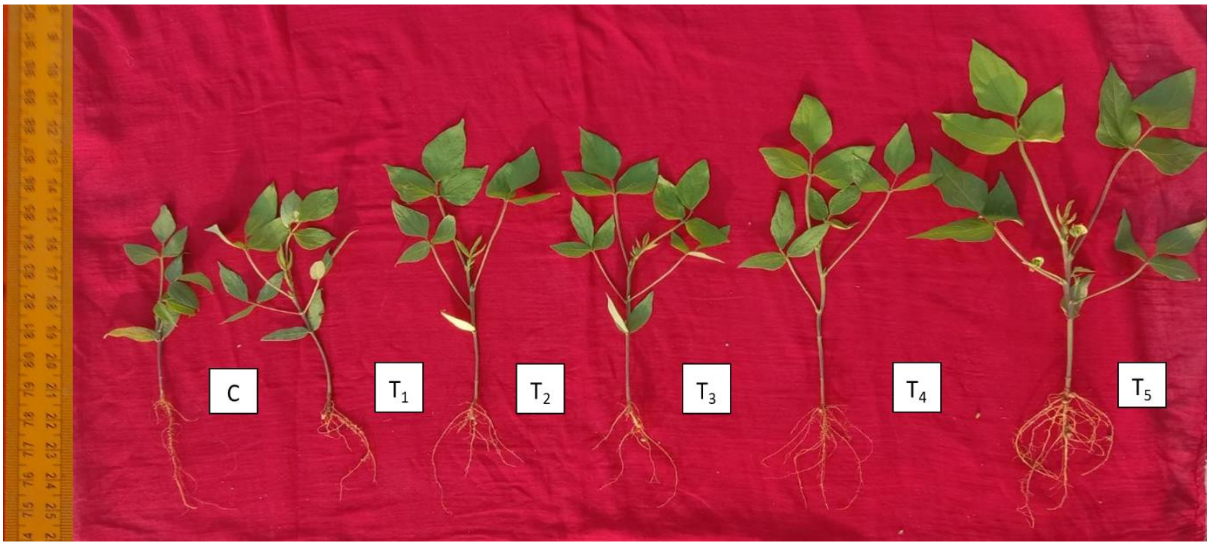
PLATE-IX

Effect of biocomposted vegetable and jackfruit peel waste on vegetative parameters of Green gram (*Vigna radiata* L.) on 30 and 35 DAS

30 DAS



35 DAS



C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

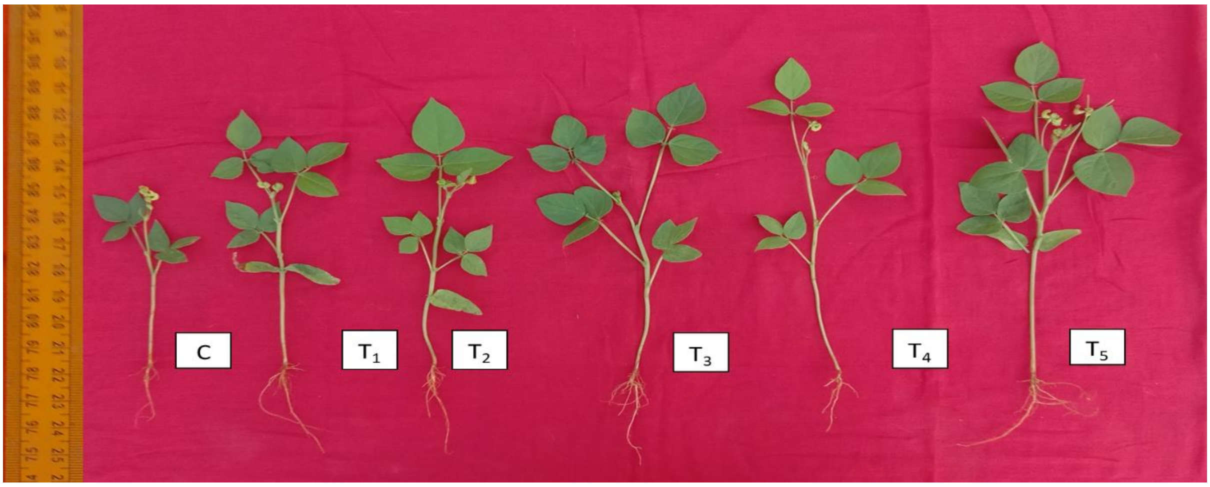
T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

PLATE-X

Effect of biocomposted vegetable and jackfruit peel waste on vegetative parameters of Green gram (*Vigna radiata* L.) on 40 and 45 DAS

40 DAS



45 DAS

C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

NUMBER OF LEAVES

Black gram (*Vigna mungo* L. Var. VBN 8)

Black gram showed significant increase in number of leaves. T_5 treatment (8, 11, 16, 20, 21 and 29) showed maximum and is followed by T_4 treatment (7, 12, 11, 14, 18 and 21) over control (5, 8, 8, 9, 10 and 11) on 15, 25, 30, 35, 40 and 45 DAS.

Green gram (*Vigna radiata* L. Var. Co. (Gg) 7)

An appreciable increase in the number of leaves/plants were recorded in all the treatments (T_1 to T_5) from 15 to 45 DAS. A substantial increase in the number of leaves/plants were recorded in T_5 (10, 15, 16, 18, 22 and 24), T_4 (8, 11, 12,15,16 and 17) followed by T_3 (8, 10,12,12,14 and 16) as compared to the control (4, 6, 7,9,9 and 12) on 15, 25, 30, 35, 40 and 45 DAS respectively.

NUMBER OF NODULES

Black gram (*Vigna mungo* L. Var. VBN 8)

A significant increased in root nodules was observed in T_5 treatment (9, 11, 12, 14 and 15) which is followed by other treatment and control (3, 3, 3, 4 and 5) on 25, 30, 35, 40 and 45 DAS respectively.

Green gram (*Vigna radiata* L. Var. Co. (Gg) 7)

Number of nodules showed a significant increase up to 25 to 45 DAS. Maximum number of nodules were recorded in T_5 treatment (7, 11, 13,15 and 16) closely followed by T_4 (6, 8, 9, 11 and 12) and T_3 (5, 6, 7, 8 and 9) treatment on 25,30,35,40 and 45 DAS as compared to the control (2, 3, 3, 4 and 5).

The present finding is in conformity with Uddin *et al.*, (2014) who found a significant increase in number of leaves per plant of 21.46 over absolute control of 19.40 in wheat with the application of compost at 500 kg ha^{-1}.

The present observation is in accordance with the findings of Rekha *et al.*, (2018) who observed that 50% vermicompost treatment increase number of leaves in chilly plant (8.3,13.0,16.7,17.9 and 25) on I week to V week.

The present finding is in accordance with the result of Al-Sabbagh *et al.*, (2020) who confirmed that maximum number of leaves was recorded in ecodrum compost treatment (13.66) grown plants followed by Coarse compost treatment (11.66 b) and control (8.66) in Chinese Kale.

The present finding was supported by Gupta *et al.*, (2018) who confirmed that the treatment of vermicompost mixed with soil and half recommended dose of NPK (T_3) significantly increased the leaves of Okra plants by comparing treatment T_1 and T_3.

The present findings agreed with the results of Chaudhari *et al*., (2013) who found that combined application of vermicompost and panchagavya (4%) as a soil supplement significantly enhanced the number of nodules in summer green gram on 30 DAS.

The present finding coincides with the result of Badawi *et al*., (2014) who noted an increase in the number of nodules in two lentil varieties Giza 9 (12.49%) and Sinai 1 (12.03%) due to the application of bio-enriched compost tea. The present result was positively correlated with findings of Patane *et al*., (2014) who recorded maximum number of nodules in black gram with the application of vermicompost.

It was supported by Premalatha *et al*., (2017) who confirmed significantly higher number of nodule (12 plant-1) in the treatment 100% leaf litter compost than 75% leaf litter compost.

FRESH WEIGHT AND DRY WEIGHT

Black gram (*Vigna mungo* L. Var. VBN 8)

As shown in table- VI, the fresh weight of lablab was increased significantly in T_5 treatment (1.116 g, 4.263 g, 7.582 g, 8.612 g, 8.593 g and 12.442 g) which is followed by T_4 treatment (0.788 g, 2.976 g, 3.786 g, 6.017 g, 7.345 g and 8.047 g) when compared to control (0.173 g, 0.499 g, 1.023 g, 1.142 g, 1.569 g and 2.567 g) on 15, 25, 30, 35, 40 and 45 DAS. The dry weight of the plant showed maximum in T_5 treatment (0.229 g, 1.321 g, 1.913 g, 2.082 g, 2.125 g and 2.521 g) when compared to control (0.081 g, 0.134 g, 0.227 g, 0.384 g, 0.541 g and 0.592 g) on 15, 25, 30, 35, 40 and 45 DAS.

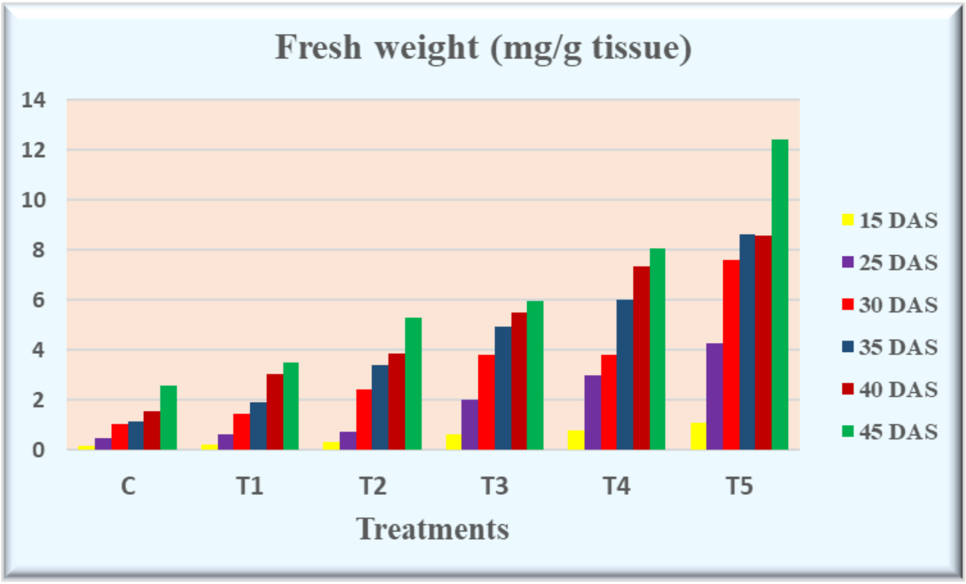
Green gram (*Vigna radiata* L. Var. Co. (Gg) 7)

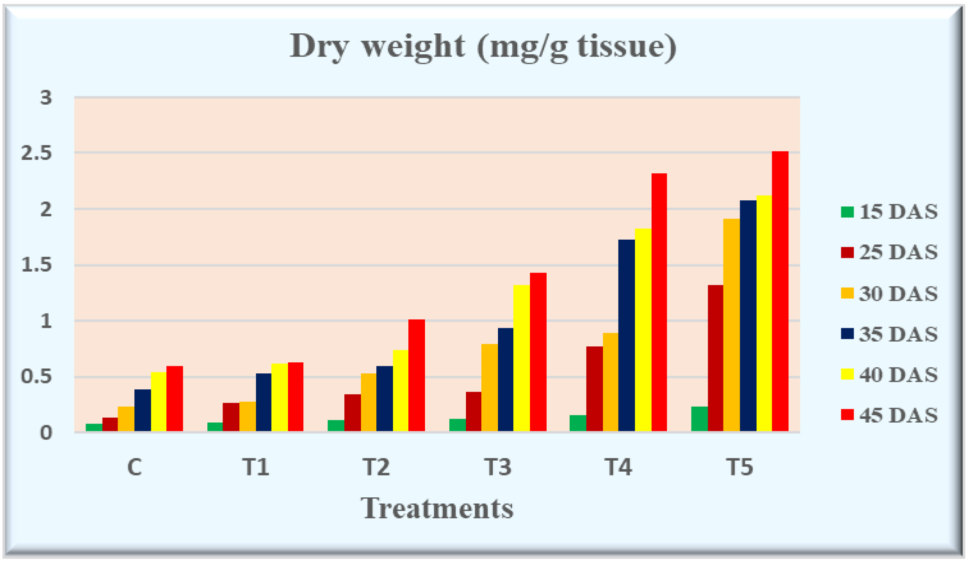
A significant increase in fresh weight was maximum in T_5 (1.152 g, 4.153 g, 5.986 g, 6.336 g, 9.720 g and 10.896 g) followed by T_4 (1.095 g, 2.643 g, 3.867 g, 4.769 g, 7.635 g and 9.639 g) and T_3 (0.921 g, 1.647 g, 2.162 g, 2.759 g, 4.639 g and 6.663 g) on 15 DAS to 45 DAS after sowing as compared to the control (0.175 g, 0.473 g, 0.947 g, 1.316 g, 1.543 g and 2.027 g) respectively.

The highest dry weight content was registered in the treatment in T_5 (0.241 g, 1.075 g, 1.367 g, 1.438 g, 2.379 g and 2.887 g) followed by T_4 (0.223 g, 0.753 g, 0.838g, 1.220 g, 1.692 g, 2.436 g) as compared to the control (0.051g, 0.070 g, 0.282 g, 0.412 g, 0.456 g and 0.576 g) on 15, 25,30, 35,40 and 45 days after sowing.

FIGURE-II

Effect of biocomposted vegetable and jackfruit peel waste on vegetative parameters of black gram (*Vigna mungo* L.)





C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

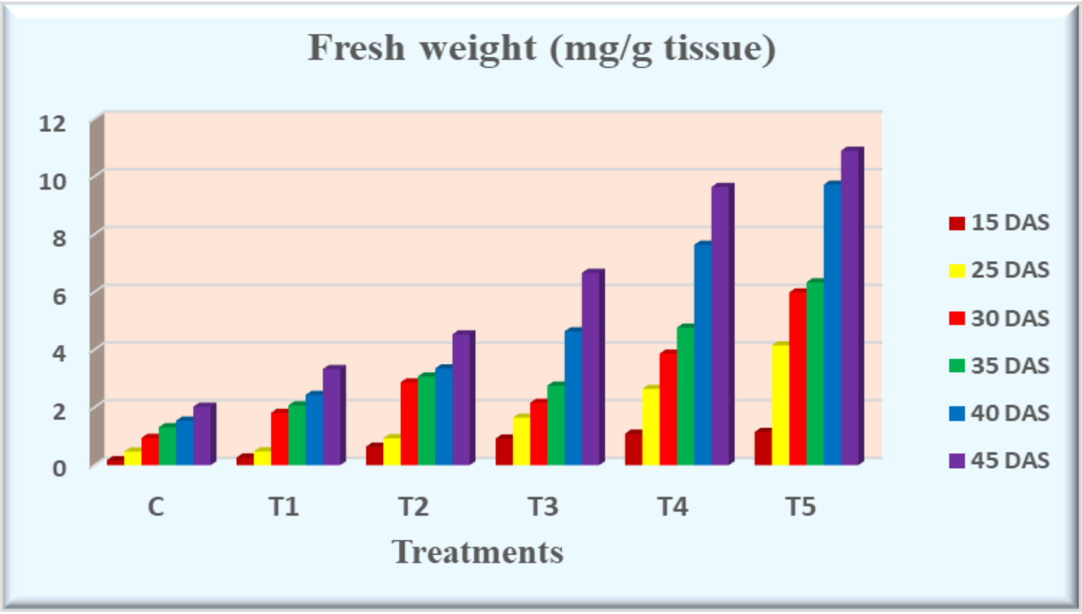
T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

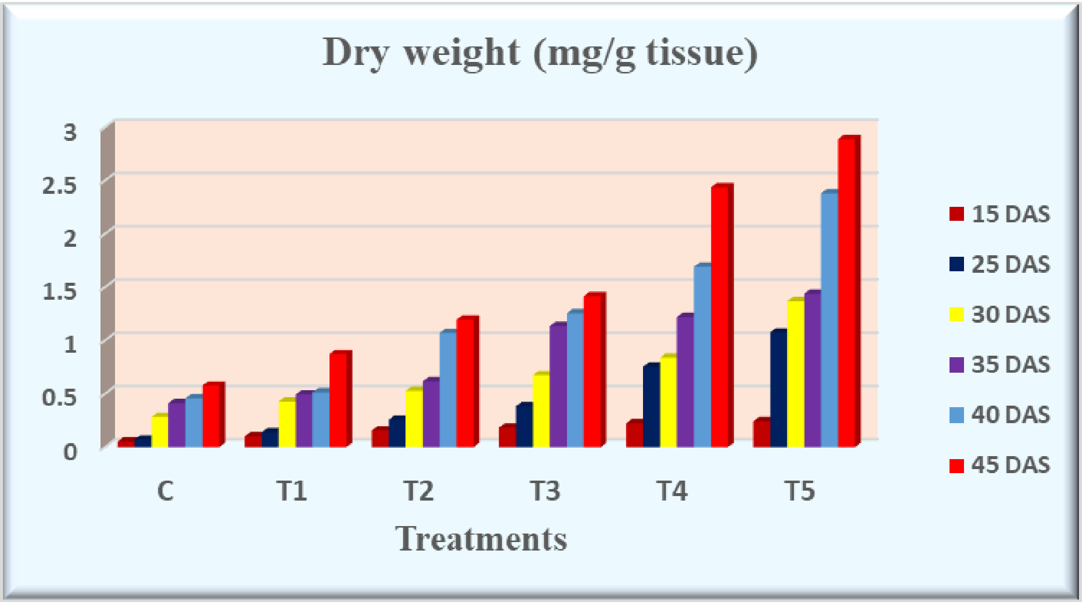
T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

FIGURE-III

Effect of biocomposted vegetable and jackfruit peel waste on vegetative parameters of green gram (*Vigna radiata* L.)





C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

TABLE -IV

Effect of biocomposted vegetable and jackfruit peel waste on vegetative parameters of Black gram

Treatments	Number of leaves						Number of nodules				
	15 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS
C	5	8	8	9	10	11	3	3	3	4	5
T_1	7	7	8	9	12	12	3	4	5	6	6
T_2	7	9	8	11	14	15	4	5	7	7	9
T_3	7	11	9	12	12	16	5	6	7	8	9
T_4	7	12	11	14	18	21	6	8	9	9	11
T_5	8	11	16	20	21	29	9	11	12	14	15

TABLE - V

Effect of biocomposted vegetable and jackfruit peel waste on vegetative parameters of Green gram

Treatments	Number of leaves						Number of nodules				
	15 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS
C	4	6	7	9	9	12	2	3	3	4	5
T_1	5	9	11	11	12	13	3	4	5	6	8
T_2	6	9	11	12	13	14	4	5	5	7	9
T_3	8	10	12	12	14	16	5	6	7	8	9
T_4	8	11	12	15	16	17	6	8	9	11	12
T_5	10	15	16	18	22	24	7	11	13	15	16

TABLE -VI

Effect of biocomposted vegetable and jackfruit peel waste on Fresh weight and Dry weight of Black gram

Treatments	Fresh weight						Dry weight					
	15 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS	15 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS
C	0.173	0.499	1.023	1.142	1.569	2.567	0.081	0.134	0.227	0.384	0.541	0.592
T_1	0.198	0.635	1.434	1.935	3.040	3.492	0.085	0.269	0.273	0.525	0.615	0.627
T_2	0.347	0.726	2.417	3.420	3.888	5.289	0.111	0.344	0.532	0.597	0.738	1.012
T_3	0.616	2.034	3.836	4.937	5.507	5.967	0.126	0.365	0.792	0.936	1.320	1.428
T_4	0.788	2.976	3.786	6.017	7.345	8.047	0.150	0.769	0.889	1.726	1.823	2.320
T_5	1.116	4.263	7.582	8.612	8.593	12.442	0.229	1.321	1.913	2.082	2.125	2.521

TABLE -VII

Effect of biocomposted vegetable and jackfruit peel waste on Fresh weight and Dry weight of Green gram

Treatments	Fresh weight						Dry weight					
	15 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS	15 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS
C	0.175	0.473	0.947	1.316	1.543	2.027	0.051	0.070	0.282	0.412	0.456	0.576
T_1	0.265	0.476	1.815	2.070	2.436	3.329	0.102	0.137	0.427	0.493	0.513	0.872
T_2	0.641	0.936	2.869	3.074	3.353	4.533	0.156	0.255	0.527	0.617	1.069	1.196
T_3	0.921	1.647	2.162	2.759	4.639	6.663	0.182	0.384	0.673	1.135	1.254	1.416
T_4	1.095	2.643	3.867	4.769	7.635	9.639	0.223	0.753	0.838	1.220	1.692	2.436
T_5	1.152	4.153	5.986	6.336	9.720	10.896	0.241	1.075	1.367	1.438	2.379	2.887

The present finding is in conformity with Silpa and Vijayalakshmi (2020) who reported that the application of cocoa shell biocompost enhanced the plant fresh weight and plant dry weight content on 25 DAS to (7.195 g,8.186 and 12.555 g) 45 DAS (1.277g,1.465 g, and 2.254) of *Vigna unguiculata* (l.) walp over the control.

A similar result was reported by Omidi *et al.,* (2017) who confirmed that 75% of composted peanut shells showed the fresh weight (28.22 g), and dry weight of the canopy (6.95 g).

The present finding was supported by Jandaghi *et al.,* (2020) who observed that increasing the amount of chicken manure tea (up to 50%) significantly increases fresh and dry weights in *Cucumis sativus* on 40, 65, and 90 days.

CHLOROPHYLL AND NITROGEN CONTENT OF BLACK GRAM (*Vigna mungo* L. Var. VBN 8) AND GREEN GRAM (*Vigna radiata* L. Var. Co. (Gg) 7) (Table- VIII to XI, Figure-IV & V)

Black gram (*Vigna mungo* L. Var. VBN 8)

The chlorophyll content and nitrogen content were measured on 15, 25, 30, 35, 40, 45 DAS in leaves of different treatments and control using plant nutrient analyser. The chlorophyll content seem to increase as the plant grow. The significant increase in chlorophyll content was observed in T_5 treatment (28, 45.4, 45.8, 52.6, 58 and 68 SPAD), which is followed by other treatment and control 16.7, 24.4, 31.2, 32.8, 35.7 and 51.5 SPAD). Similarly, the nitrogen content also increases significantly in T_5 treatment (16.1, 17.2, 19.1 19.3, 25.6 and 25.8 mg/g) when compared to control (7.9, 10.4, 12.5, 13.0, 13.9 and 19.0 mg/g) on 15, 25, 30, 35, 40 and 45 DAS.

Green gram (*Vigna radiata* L. Var. Co. (Gg) 7)

The Chlorophyll content of green gram leaves increased significantly in all the treatments from T_1 to T_5 when compared with control. The treatment T_5 showed highest chlorophyll content from 15 to 45 DAS which ranged from 33.2 to 67.1 (SPAD) followed by T_4 which ranged from 28.0 to 62.3 (SPAD). The least chlorophyll content was registered in control 22.7 to 56.8 (SPAD). The present study revealed that nitrogen content in leaves of green gram increased from 15 to 45 DAS in all the treatments i.e., T_1 to T_5. A significant increase in nitrogen content was observed in T_5 (13.2 to 23.9 mg/ml) followed by T_4 (11.5 to 21.9 mg/g) when compared with control (9.8 to 20.4 mg/g).

The present investigation is on par with the result of Silpa and Vijayalakshmi (2020) who confirmed that different combination of biocomposted agro-industrial wastes (T_8 & T_4) significantly increased chlorophyll content in the leaves of cowpea from 25 to 35 DAS.

TABLE -VIII

Chlorophyll (SPAD) content of Black gram (*Vigna mungo* L. Var. VBN 8)

Treatments	Chlorophyll (SPAD)					
	15 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS
C	16.7	24.4	31.2	32.8	35.7	51.5
T_1	17.1	32.9	39.0	39.9	46.7	52.0
T_2	19.3	34.2	38.9	40.6	51.2	62.1
T_3	20	40.1	40.6	41.8	55.0	63
T_4	25	43.7	44.7	51.5	54.9	65.1
T_5	28	45.4	45.8	52.6	58	68

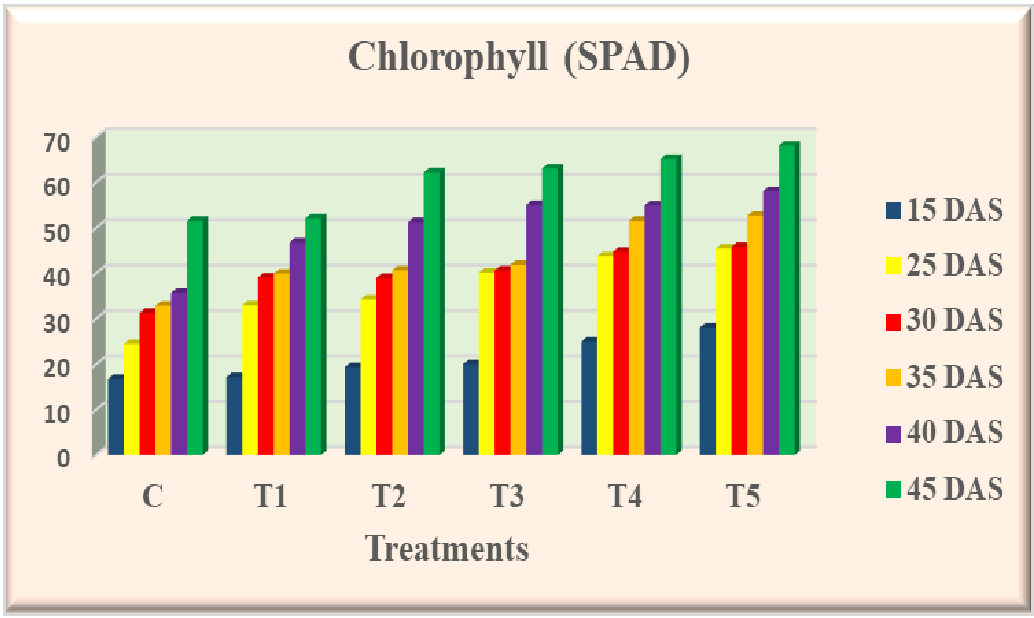
TABLE -IX

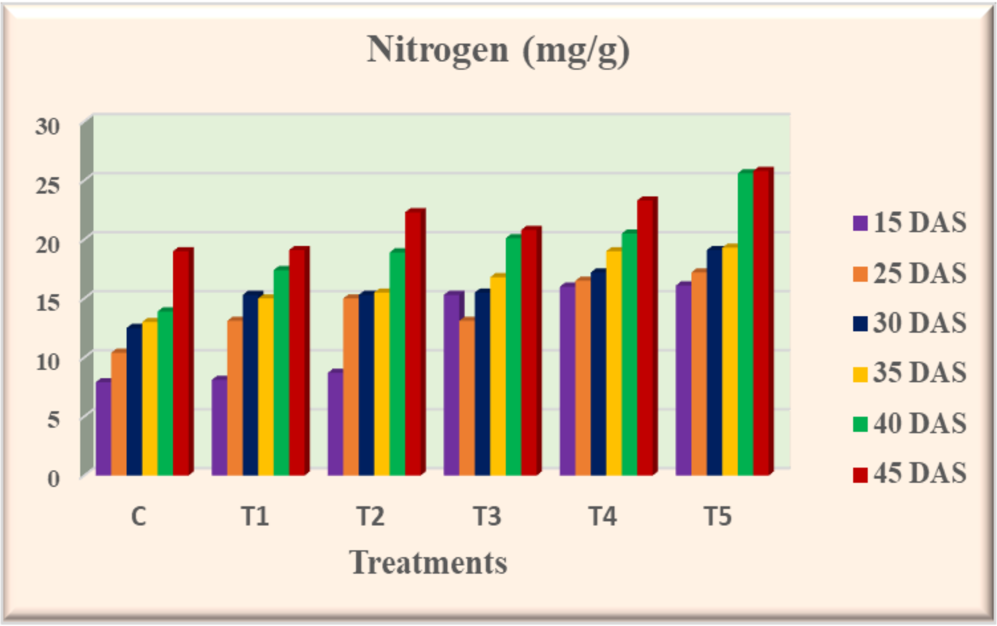
Chlorophyll (SPAD) content of Green gram (*Vigna radiata* L. Var. Co. (Gg) 7)

Treatments	Chlorophyll (SPAD)					
	15 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS
C	22.7	29.4	32.0	36.8	44.7	56.8
T_1	24.8	31.3	35.0	47.6	51.0	58.2
T_2	25.4	32.9	39.2	48.6	57.3	60.8
T_3	26.8	40.0	46.9	48.7	57.9	62.2
T_4	28.0	45.9	47.2	50.2	58.3	62.3
T_5	33.2	46.9	54.8	58.3	66.0	67.1

FIGURE-IV

Chlorophyll (SPAD) and Nitrogen (mg/g) content of black gram (*Vigna mungo* L.)





C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

Similar result was obtained by Gayathri and Aiswariya (2020) who observed an increase in chlorophyll content are more in the plants *Arachis hypogeae* L. (45.53 ± 4.82) and *Sesamum indicum* L (55.90 ± 10.81) treated with mixture of organic fertilizers.

Similar work was carried out by Gayathri and Aiswariya (2020) who confirmed that nitrogen content was more in Sesamum (20.37 ± 3.42 mg/g) treated with VAM + Panchagavya + Azospirillum.

Similar work was carried out by Rajeshri *et al.*, (2021) revealed that treatment T_3 consisting of vermicomposted groundnut shell and vegetables waste (75g) shows significantly increased chlorophyll content in pigeon pea as compared to the control and T_1, T_2 treatments.

TABLE -X

Nitrogen (mg/g) content of Black gram (*Vigna mungo* L. Var. VBN 8)

Treatments	Nitrogen (mg/g)					
	15 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS
C	7.9	10.4	12.5	13.0	13.9	19.0
T_1	8.1	13.1	15.3	15.0	17.4	19.1
T_2	8.7	15.0	15.3	15.5	18.9	22.3
T_3	15.3	13.1	15.5	16.8	20.1	20.8
T_4	16.0	16.5	17.2	19.0	20.5	23.3
T_5	16.1	17.2	19.1	19.3	25.6	25.8

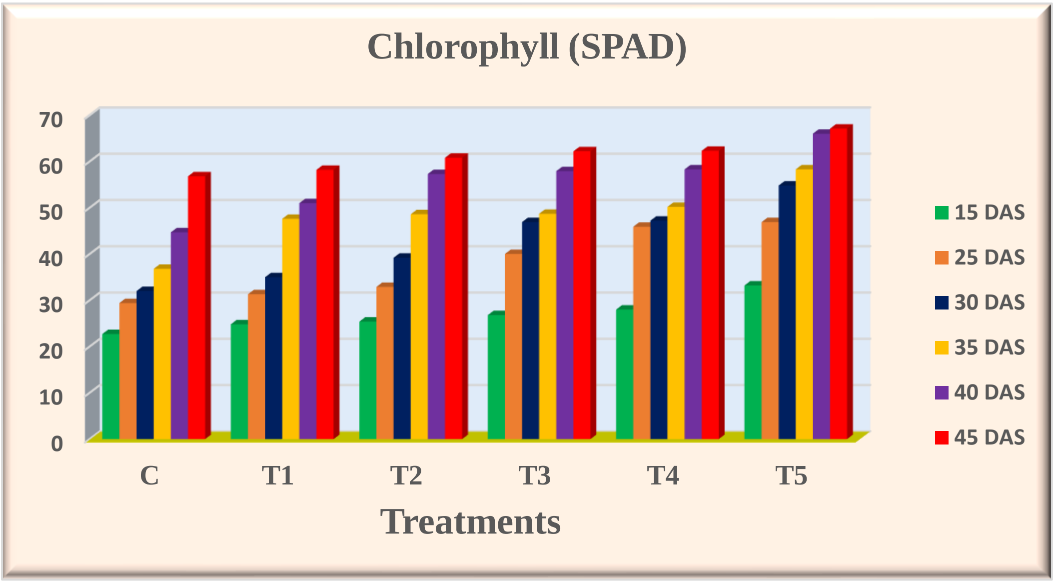
TABLE -XI

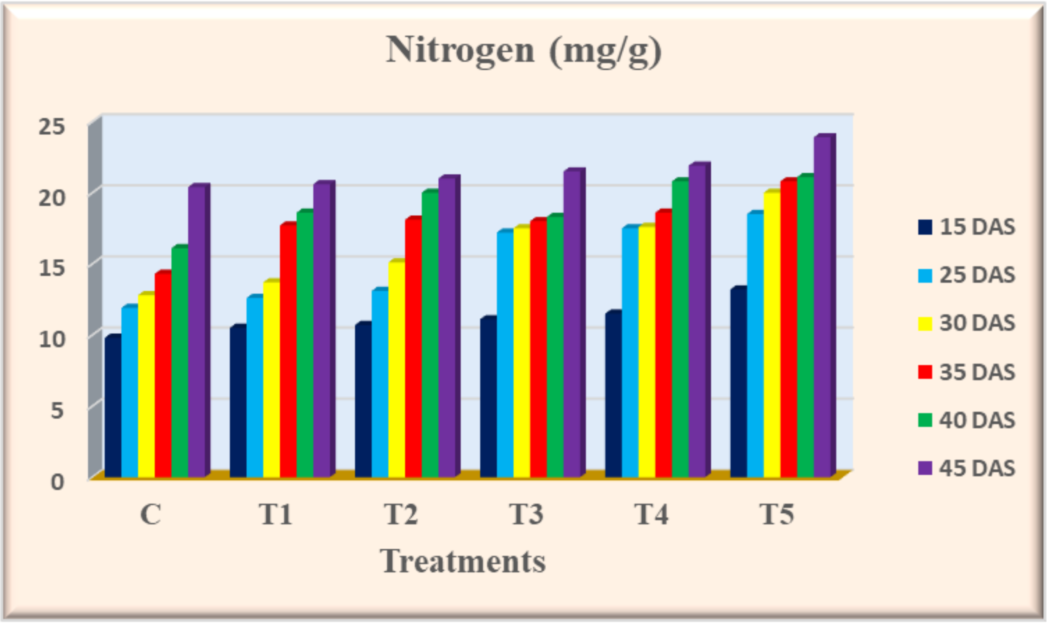
Nitrogen (mg/g) content of Green gram (*Vigna radiata* L. Var. Co. (Gg) 7)

Treatments	Nitrogen (mg/g)					
	15 DAS	25 DAS	30 DAS	35 DAS	40 DAS	45 DAS
C	9.8	11.9	12.8	14.3	16.1	20.4
T_1	10.5	12.6	13.7	17.7	18.6	20.6
T_2	10.7	13.1	15.1	18.1	20.0	21.0
T_3	11.1	17.2	17.5	18.0	18.3	21.5
T_4	11.5	17.5	17.6	18.6	20.8	21.9
T_5	13.2	18.5	20	20.8	21.1	23.9

FIGURE- V

Chlorophyll (SPAD) and Nitrogen (mg/g) content of green gram (*Vigna radiata* L.)





C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

LEGHAEMOGLOBIN CONTENT (Table- XII & XIII, FIGURE- VI & VII)

Black gram (*Vigna mungo* L. Var. VBN 8)

As shown in table- XII, there is significant increase in leghaemoglobin content in all the treatment on 40 and 45 DAS. Among all the treatment, a maximum leghaemoglobin content was found in T_5 treatment (0.057 mg/g and 0.059 mg/g) and followed by T_4 (0.055 mg/g and 0.057 mg/g) when compared to control (0.030 mg/g and 0.035 mg/g) on 40 and 45 DAS.

Green gram (*Vigna radiata* L. Var. Co. (Gg) 7)

The leghaemoglobin content was significantly increased in T_5 treatment (0.058 mg/g and 0.060 mg/g) followed by T_4 treatment (0.051 mg / g and 0.052 mg/g) on 40 and 45 DAS. The minimum amount of leghaemoglobin content was registered in control treatment (0.035 mg/g and 0.040 mg/g).

TABLE -XII

Effect of composted vegetable and jackfruit peel waste on Leghaemoglobin content in nodules of Black gram

Treatments	40 DAS	45 DAS
C	0.030	0.035
T_1	0.039	0.042
T_2	0.046	0.047
T_3	0.047	0.052
T_4	0.055	0.057
T_5	0.057	0.059

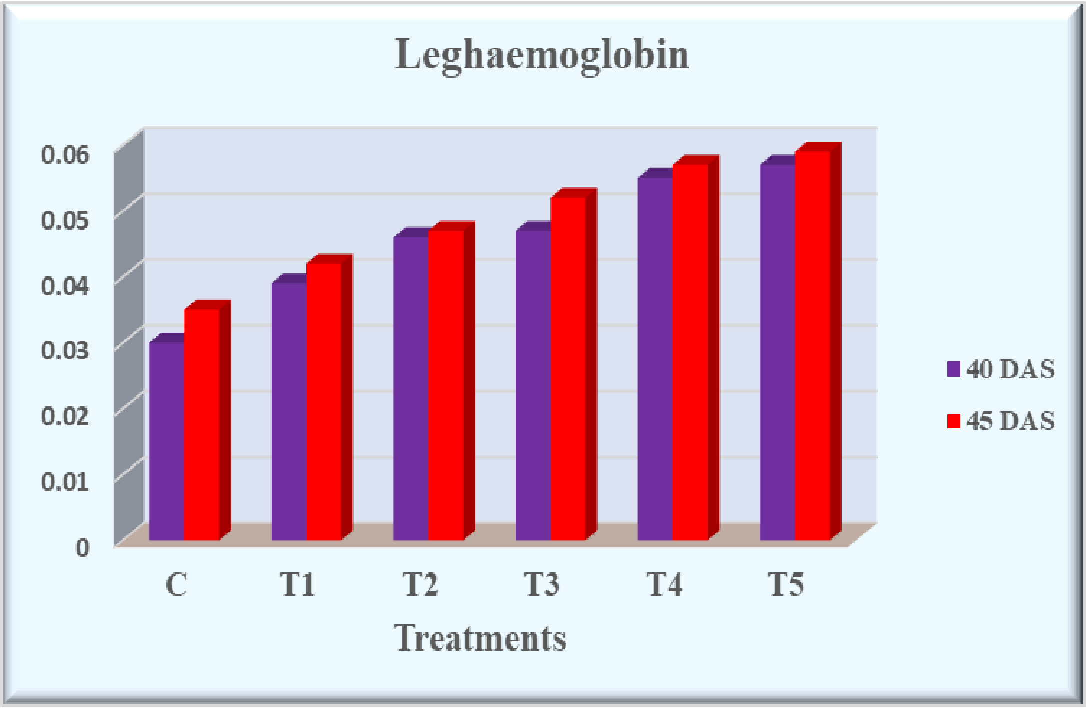
TABLE -XIII

Effect of composted vegetable and jackfruit peel waste on Leghaemoglobin content in nodules of Green gram

Treatments	40 DAS	45 DAS
C	0.035	0.040
T_1	0.042	0.044
T_2	0.043	0..046
T_3	0.045	0.048
T_4	0.051	0.052
T_5	0.058	0.060

FIGURE- VI

Effect of biocomposted vegetable and jackfruit peel waste on leghaemoglobin content in nodules of black gram (*Vigna mungo* L.)



C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

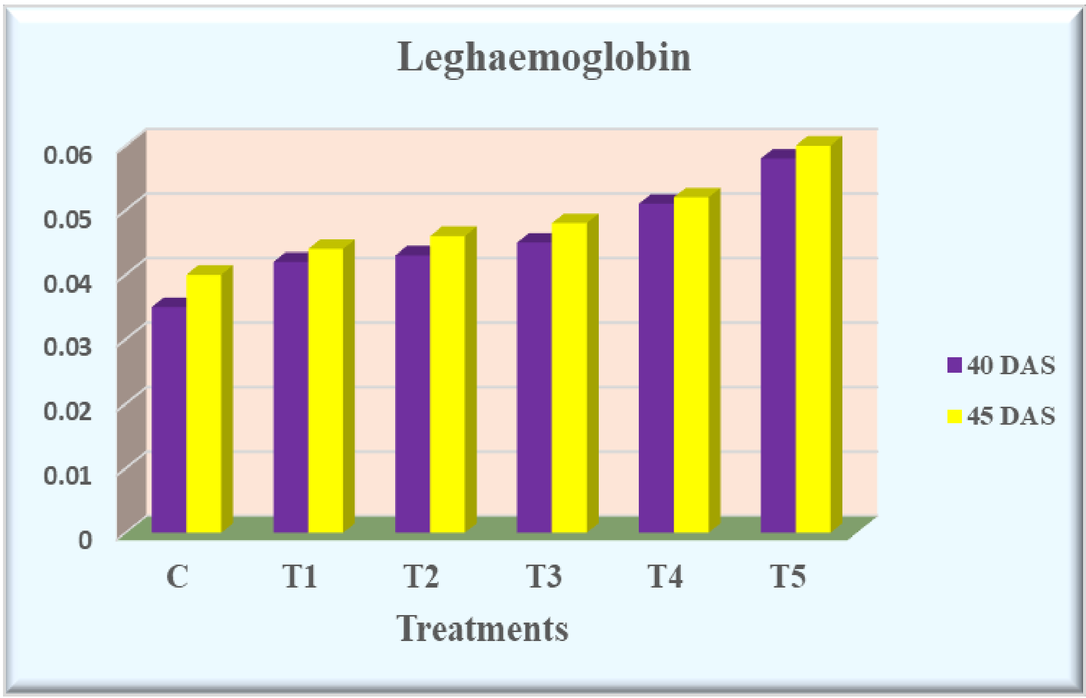
T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

FIGURE- VII

Effect of biocomposted vegetable and jackfruit peel waste on leghaemoglobin content in nodules of green gram (*Vigna radiata* L.)



C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

The similar work was done by Nalini and Kumar (2016) who revealed that 15 per cent concentration of *Mycorrhiza* significantly increased the leghaemoglobin content (4.59 mM (g.f.m)-1 in *Vigna mungo* root nodules.

The result is on par with Verma *et al*., (2014) who observed a maximum leghaemoglobin content of 2.00 mg/g with the application of vermicompost (6t ha-1) in fenugreek.

The result was in agreement with Anju singh and Vijayalakshmi (2013) who reported that increase in leghaemoglobin content (0.0560mg/g) in green gram.

The similar work was done by Moinuddin *et al.*, (2014) who revealed that combined inoculation of phosphorus (60/kg) + biological phosphorus fertilizer (*Pseudomonas striata*) increased the leghaemoglobin content (3.37 mg/g) in chickpea nodules.

YIELD CHARACTERS (Table- XIV & XV, FIGURE- VIII & IX)

Black gram (*Vigna mungo* L. Var. VBN 8)

As shown in table-, number of pods per plant, number of seeds per pod, pod length and weight of seeds per pod, pod fresh weight and dry weight were superior in T_5 treatment on 65 DAS.

The highest number of pods per plant (22), number of seeds per pods (7), pod length (4.7 cm), pod fresh weight (1.223 g) and pod dry weight (0.620 g) was registered in T_5 treatment which is followed by T_4 over control (6, 4, 3.8 cm, 0.576 g and 0.150 g) respectively.

Green gram (*Vigna radiata* L. Var. Co. (Gg) 7)

The maximum number of pods/plant (23), number of seeds per pod (15) was observed in T_5 followed by T_4 (20 and 12) on 60 DAS. A conspicuous increase in the length of pod was counted in T_5 (8.5). The pod fresh weight (1.847g and 1.838 g) and pod dry weight content (0.789 g and 0.712 g) was observed in T_5 treatment followed by T_4 treatment as compared to the control (1.253g and 0.450 g) respectively on 65 DAS.

The present finding is in conformity with Rahman *et al*., (2012) who found that significant number of seeds / fruits 289.78 as compared to the control with the application of biocompost (3 kg / pot) in *Capsicum annum.*

The effect of vermicompost with biofertilizers (T_4) showed significantly high performance in *Lycopersicum esculentum* plant height (cm), number of leaves per plant, number of branches, length of the root, number of fruits per plant (Gopinathan and Prakash 2015).

TABLE -XIV

Yield parameters of Black gram influenced by vegetable and jackfruit peel waste biocompost on 65 DAS

Treatments	No. of pods/plant	Pod length	No. of seeds/pod	Pod fresh weight	Pod dry weight
C	6	3.8	4	0.576	0.150
T_1	10	3.9	5	0.653	0.231
T_2	12	4.4	6	1.102	0.425
T_3	14	4.5	6	1.013	0.420
T_4	18	4.6	7	1.127	0.582
T_5	22	4.7	7	1.223	0.620

TABLE -XV

Yield parameters of Green gram influenced by vegetable and jackfruit peel Waste biocompost on 65 DAS

Treatments	No. of pods/plant	Pod length	No. of seeds/pod	Pod fresh weight	Pod dry weight
C	9	6.9	7	1.253	0.450
T_1	12	7.2	8	1.442	0.552
T_2	14	7.4	9	1.538	0.602
T_3	16	7.6	10	1.807	0.698
T_4	20	8.3	12	1.838	0.712
T_5	23	8.5	15	1.847	0.789

FIGURE-VIII

Yield parameters of black gram (*Vigna mungo* L.) influenced by vegetable and jackfruit peel waste biocompost on 65 DAS

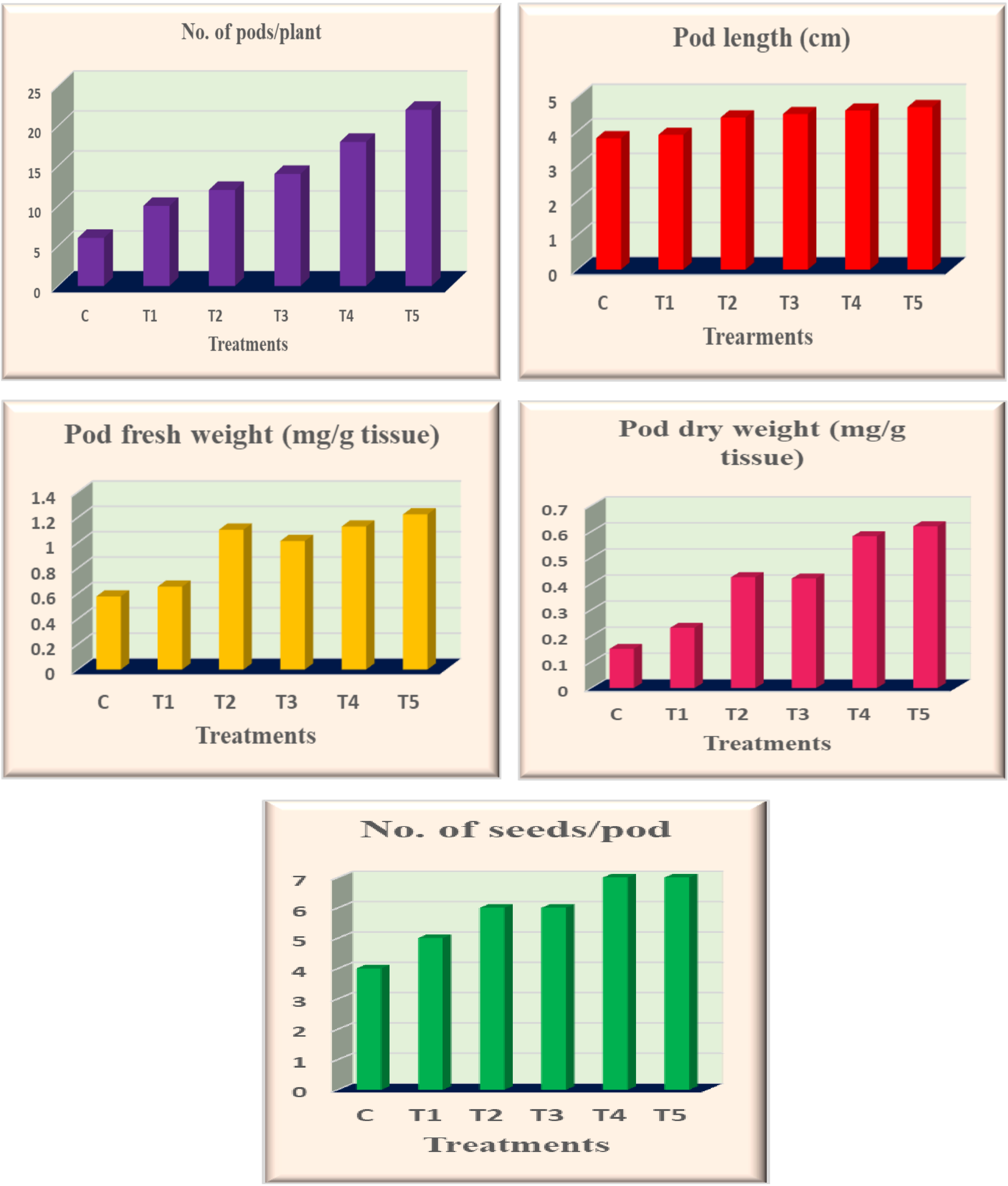
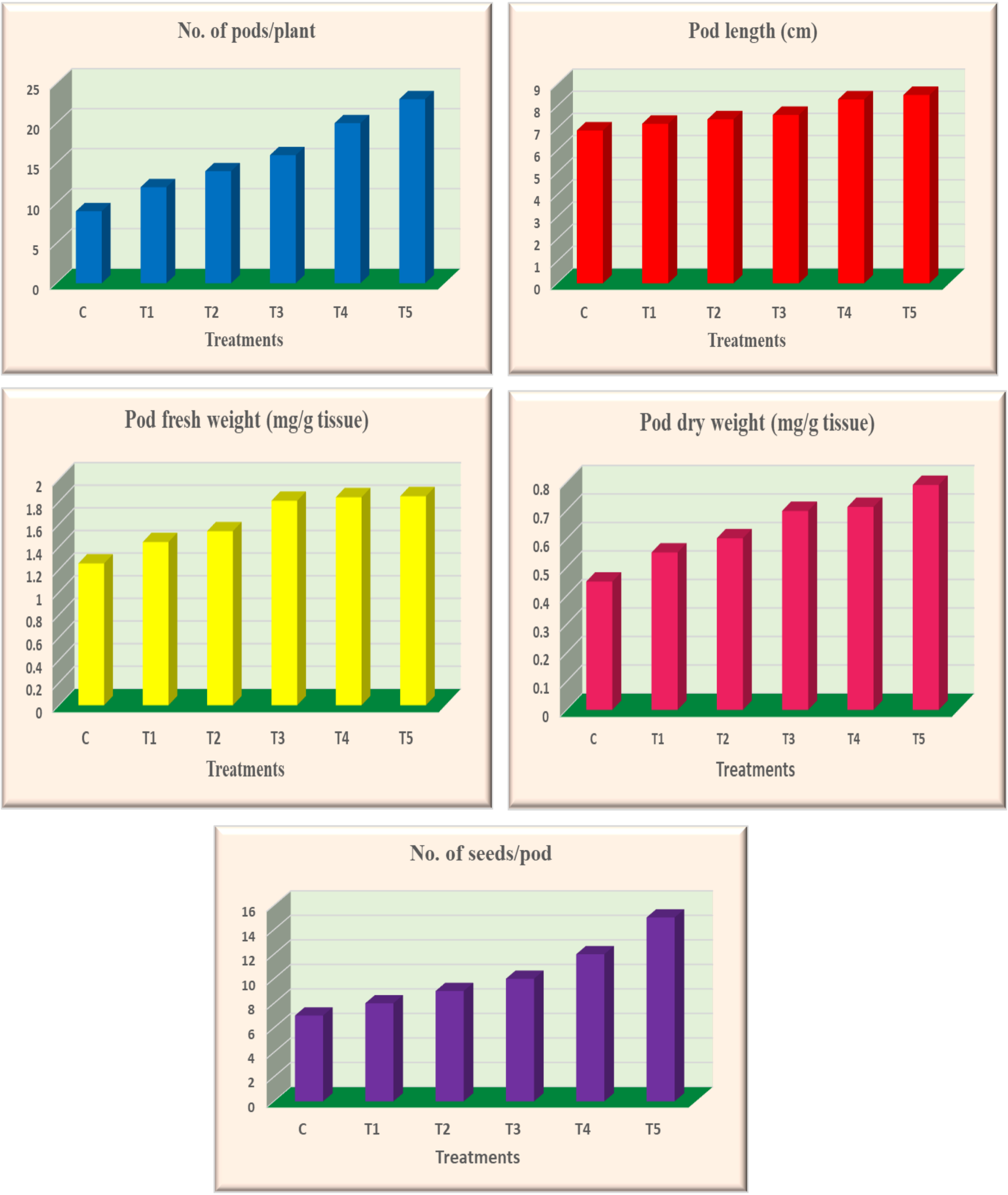


FIGURE-IX

Yield parameters of green gram (*Vigna radiata* L.) influenced by vegetable and jackfruit peel waste biocompost on 65 DAS



Similar result was obtained by Joshi *et. al.,* (2016) who observed that recommended dose of RDF (fertilizer 20-40-0 NPK kg ha^{-1}) was significantly higher the number of green pods per plant (79.60) and number of seeds per pod (13.45) in *Vigna unguiculata* (L.) Walp over different organic sources.

The present result is in accordance with Haghighi *et al*., (2016) who observed that combined application of vermicompost and 25 per cent municipal solid waste compost significantly enhanced the number of fruits at the harvest period over control in *Lycopersicum esculentum*

PROTEIN AND CARBOHYDRATE CONTENT IN SEEDS OF TEST CROPS (Table-XVI & XVII, PLATE- XI)

Black gram (*Vigna mungo* L. Var. VBN 8)

The protein content was found to be more in T_5 treatment (83.90 mg / g tissue) followed by T_4 (83.62 mg / g tissue) as compared to control (79.90 mg / g tissue) on 65 DAS. Among the treatment's carbohydrate content was found to be maximum in T_5 (79.92 mg / g tissue) followed by T_4 (79.37 mg/ g tissue) as compared to control (76.08 mg / g tissue).

Green gram (*Vigna radiata* L. Var. Co. (Gg) 7)

A significant increase in protein content was found to be maximum in T_5 (84.35 mg / g tissue) treatment followed by T_4 (83.62 mg / g tissue) as compared to control (80.17 mg / g tissue). The carbohydrate content was found to be more in T_5 (70.06 mg / g tissue), T_4 (69.19 mg / g tissue) followed by T_3 (68.53 mg / g tissue) as compared to the control (65.46 mg / g tissue).

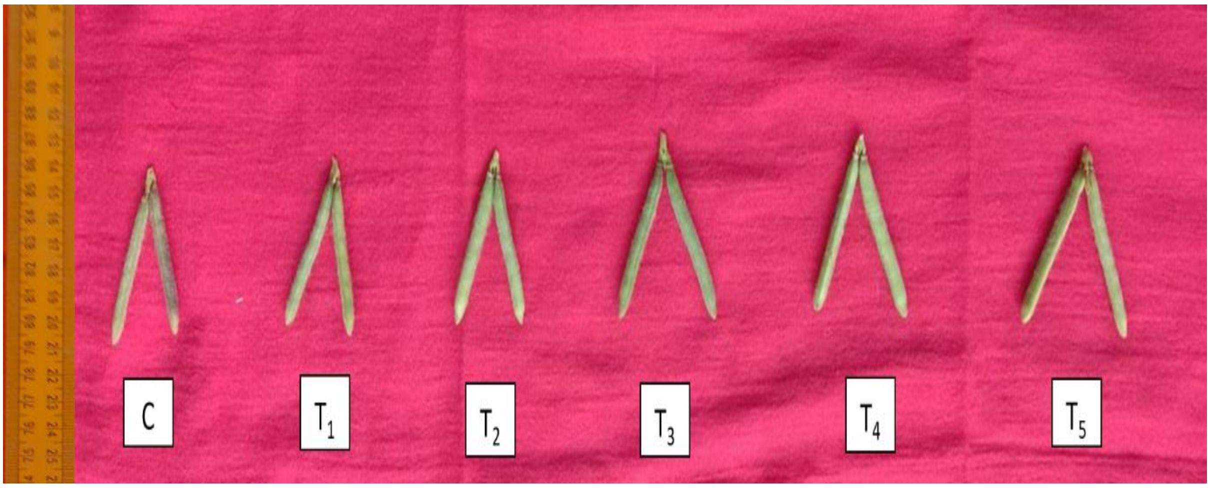
A similar result was observed by Zodape *et al.,* (2010) who reported that the application of 15% seaweed (*Kappaphycus alvarezii*) extract increased the protein (19.43 mg/g tissue) and carbohydrate (61.99 mg/g tissue) in green gram. The present finding was positively correlated with the findings of Ravimycin (2016) who recorded highest protein content in coriander (23.32 mg fresh weight) compared to control (16.48 mg fresh weight) on 90 DAS.

This result was supported by the work of Sakthivigneswari and Vijayalakshmi (2018) who confirmed maximum protein (64.08 mg/g tissue) and carbohydrate (97.55 mg/g tissue) content was found to be maximum in T_6 (Raw coirpith predigested by using *Pleurotus sajor-caju* and *Eudrilus eugeniae* (5 t/ha) followed by T_3 (Raw corncob predigested by using *Pleurotus sajor-caju* and *Eudrilus eugeniae* (5 t/ha) (58.56 and 92.84 mg/g tissue) as compared to control.

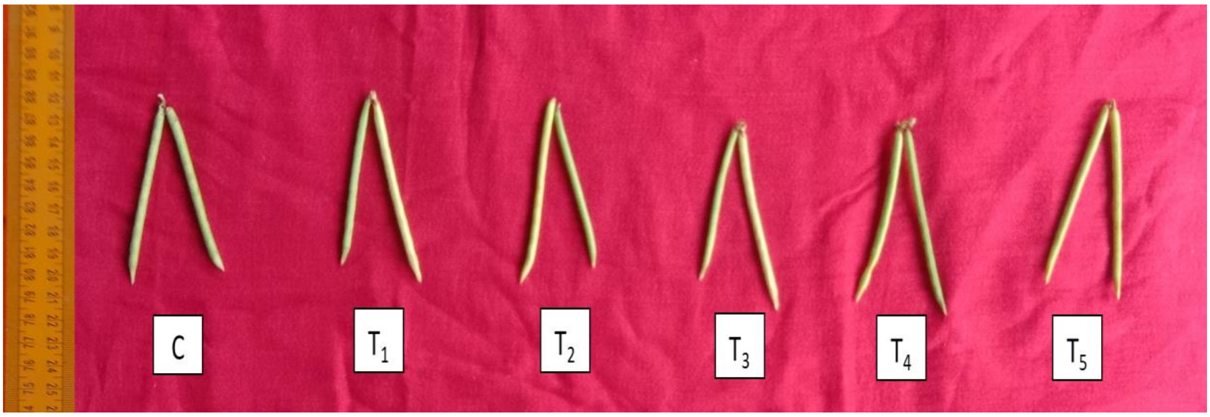
PLATE-XI

Yield Parameters influenced by biocomposted vegetable and jackfruit peel waste on 65 DAS

Black gram (*Vigna mungo* L.)



Green gram (*Vigna radiata* L.)



C - Control

T_1 - 10 g vermicomposted vegetable waste and jackfruit peel waste

T_2 - 20 g vermicomposted vegetable waste and jackfruit peel waste

T_3 - 30 g vermicomposted vegetable waste and jackfruit peel waste

T_4 - 40 g vermicomposted vegetable waste and jackfruit peel waste

T_5 - 50 g vermicomposted vegetable waste and jackfruit peel waste

TABLE -XVI

Effect of composted vegetable and jackfruit peel waste on Protein and carbohydrate content in seeds of Black gram

Treatments	Protein	Carbohydrate
C	79.90	76.08
T_1	81.08	77.18
T_2	82.53	77.94
T_3	83.26	78.60
T_4	83.62	79.37
T_5	83.90	79.92

TABLE -XVII

Effect of composted vegetable and jackfruit peel waste on Protein and carbohydrate content in seeds of Green gram

Treatments	Protein	Carbohydrate
C	80.17	65.46
T_1	80.81	67.65
T_2	81.71	67.87
T_3	82.90	68.53
T_4	83.62	69.19
T_5	84.35	70.06

Present study was in agreement with the results of Ashwini *et al.,* (2018) who found that significantly higher seed protein content and protein yield (24.38 % and 480.00 kg ha-1) was recorded in T_6 as compared to T_8 (21.71 % and 307.62 kg ha-1, respectively) and T_9 (22.19% and 278.61 kg ha^{-1}, respectively.

CHAPTER-V

SUMMARY AND CONCLUSION

The present investigation entitled **"Bioconversion of vegetable and jackfruit peel waste and Its effect on the growth of Black gram and Green gram"** was undertaken to study the effect of biocomposted vegetable and jackfruit peel waste as a growth promoter for Black gram and Green gram. It is to find out means and solution for the profitable utilization and to reduce its environmental problem.

COMPOSTING

Physico-chemical composition of raw and composted vegetable and jackfruit peel waste

The physico-chemical parameters pH, Electrical Conductivity (millimhos cm-^{1}), Total nitrogen (%), Total phosphorus (%), Total potassium (%), C : N ratio, Organic carbon Ligni and cellulose were analyzed in raw and composted banana peels waste to assess the compost maturity. A significant difference was noted in raw and biocomposted sample. There was significant increase in pH, EC, nitrogen, phosphorus and potassium content in the compost. Decrease in lignin, cellulose, organic carbon and C : N ratio was also observed in compost.

POT EXPERIMENTS

Plant nutrition analyser, also known as crop nutrition diagnostic instrument was used to measure three parameters namely chlorophyll, nitrogen content and temperature in leaf. In the present study, Chlorophyll (SPAD) and Nitrogen (mg/ml) was observed using the instrument.

Black gram (*Vigna mungo* L. Var. VBN 8)

Maximum shoot and root length was observed in T_5 treatment followed by other treatment and control on 15, 25, 30, 35, 40 and 45 DAS. Number of leaves per plant was increased in T_5 treatment from 15 to 45 DAS. Fresh weight and dry weight increased in T_5 treatment followed by T_4 when compared to the control from 15 to 45 DAS.

A significant increase in chlorophyll (SPAD) and nitrogen (mg/ml) content was observed in T_5 treatment from 15 to 45 DAS followed by T_4 and control.

Green gram (*Vigna radiata* L. Var. Co. (Gg) 7)

Maximum root length, shoot length and number of leaves per plant were observed in T_5 treatment followed by T_4 compared to the control on 15, 25, 30, 35, 40 and 45 DAS. Fresh weight and dry weight increased significantly in T_5 treatment followed by T_4 compared to the control from 15 to 45 DAS. Chlorophyll (SPAD) and nitrogen (mg/ml) content was significantly increase in T_5 treatment from 15 to 45 DAS when compared to control.

LEGHAEMOGLOBIN CONTENT

Black gram (*Vigna mungo* L. Var. VBN 8)

Maximum leghaemoglobin content was observed in T_5 treatment which is followed by other treatment and control on 40 and 45 DAS.

Green gram (*Vigna radiata* L. Var. Co. (Gg) 7)

Leghaemoglobin content in root nodules on 40 and 45 DAS were maximum in T_5 which is followed by T_5 when compared to the control.

YIELD PARAMETERS

In the selected test crop, Black gram (*Vigna mungo* L) and Green gram (*Vigna radiata* L.), the yield parameters (number of pods / plants, number of seeds / pods, pod length, pod fresh weight and dry weight) significantly increased in T_5 followed by T_4 when compared to the control on 65 DAS. The protein and carbohydrate content in seeds on selected test crops was increased significantly in T_5 treatment which is followed by other treatment and control on 65 DAS.

CONCLUSION

The present study is to provide the possibilities of using vegetable and jackfruit peel waste to enhance the crop productivity. Degradation of the vegetable and jackfruit peel waste was done with the help of lignolytic fungi *Trichoderma asperelloides* and *Pleurotus florida* for 90 days. It was good and efficient as organic manure for plant growth. From the present results, it can be concluded that combined application of vegetable and jackfruit peel waste biocompost increased the biometric characters, leghaemoglobin content, yield in Black gram (*Vigna mungo* L) and Green gram (*Vigna radiata* L.) in T_5 treatment which is followed by T_4 treatment over the control.

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