CONVERTING AGRICULTURAL WASTE INTO VALUE ADDED COMPOST AND ITS PROXIMATE ANALYSIS

A Synopsis

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INTRODUCTION

Solid wastes generated by domestic, commercial and industrial activities are often indiscriminately disposed. Piles of garbage and wastes of all kinds littered everywhere have become common site in Indian urban areas. The rural areas have also not been spared from the menace of mounting garbage and associated hazards. With the burgeoning population and indifferent civic services coupled with wasteful consumerism and general apathy from cleanliness, the symptoms of strain on the environment and living conditions are conspicuously evident even in the urban areas in India.

Disposal of municipal solid waste is generally done through open dumping or land filling. Most of the Indian cities have shortage of land as most of the land-filling sites are already over used. So there is an obvious need to reuse or recycle the urban waste, the technologies for recovery of energy and nutrients from such wastes can play a vital role in mitigating the solid waste problems. Various technologies developed to recycle and reuse solid wastes include biomethanation, sanitary land fill gas, pelletisation, pyrolysis/ gasification, composting and vermicomposting.

Waste includes all items that people no longer have any use for, which they either intend to get rid of or have already discarded. Additionally, wastes are such items which people are require to discard, for example by lay because of their hazardous properties. Types of waste include Municipal waste, Industrial waste, Mining waste, Electronic waste, Agricultural waste, etc.

Agricultural waste is composed of organic wastes (animal excreta in the form of slurries and farmyard manures, spent mushroom compost, soiled water and silage effluent) and inorganic waste such as plastic, scrap machinery, fencing, pesticides, waste oils and veterinary medicines. There are a number of methods used to treat agricultural waste, the most common being spreading the waste on land under strict conditions, anaerobic digestion and composting.

There are a number of potential environmental impacts associated with agricultural waste, if it is not properly managed, the most harmful being run-off of nutrients to the surface waters which can cause over enrichment of the water body. Leaking and improper storage of agricultural waste can also pose a serious threat to the environment, should the waste reach surface waters. Various types and sources of organic wastes are utilized in agriculture but most of these materials remain unutilized and become potential sources of air, land and water pollution. Huge amounts of organic materials are in the form of farm waste, city waste, sewage sludge, poultry litter and agro-industrial wastes. (Lal, 2005; Kolay, 2000)

Organic, inorganic fertilizers and microbial biomass are the main resources used for building up soil fertility. There is wide gap between nutrient removal and their proper addition in soil. The recycling of crop residues is essential for supplementing plant nutrients. A proper technology is needed to meet the shortage of plant nutrients through organic resources and their application in a balanced way to provide humified materials for maintaining soil productivity. Composting is a non-polluting and safe method for disposal and recycling of organic waste by its conversion to organic fertilizers.

Composting provides an effective and environment friendly procedure of organic waste disposal (Millner et al., 1998) since it is more economical and environment friendly. It also conserves natural resources and improves cycling of non-renewable resources. Keeping in view the present energy crises it is an excellent option for energy conservation because a lot of energy is utilized in fertilizer sector. This process biologically converts the organic waste material into stable humus like substances, which may be stored and applied without any environmental impacts (Gallardo-Larva and Nogales, 1987). The organic manures and compost are important in sustaining farming by providing plant N-supply (Korsaeth et al., 2002).

Vermicomposting is a process by which biological degradation of organic wastes takes place in controlled conditions, due to earthworm feed on the material. The key to maximum productivity is maintenance of aerobic condition with optimum moisture and temperature (Edward, 1988). The most promising worm for vermicomposting is *Eisenia foetida*, prevalent in India. (Neuhauser et al 1980, Elvira et al, 1997, 1998)

Aristotle called worms the "intestines of the earth" and stated that there may not be any other creature that has played so important a role in the history of life on earth. Earthworms constitute a large part of biomass (living bodies) inhabiting soil. Scientific rearing of earthworm, their reproduction, nutrition and conservation come under Vermiculture. Biotechnology and the earthworms are used in degradation of organic/ agricultural waste and the product after degradation is known as vermicompost.
One kg earthworm can consume one kg organic materials in a day. They secrete castings (vermicompost) which are rich in Ca, Mg, K, N, useful microorganisms, (bacteria, fungi, actinomycetes and protozoa) hormones, enzymes and vitamins and certain micronutrients needed for plant growth. (Lee, 1985; Bansal and Kapoor, 2000).

In recent years efforts have been made to use the potential of earthworms in recycling of nutrients, waste management and development of vermicomposting systems at commercial scale. These are also called as "Ecosystem engineers" as they increase the numbers and types of microbes in the soil by creating conditions under which these creatures can thrive and multiply. In India, the integration of crops and livestock and use of manure as fertilizer were traditionally the basis of farming systems. But development of chemical fertilizer industry during the green revolution period created opportunities for low-cost supply of plant nutrients in inorganic forms which lead to rapid displacement of organic manures derived from livestock excreta. The deterioration of soil fertility through loss of nutrients and organic matter, erosion and salinity, and pollution of environment are the negative consequences of modern agricultural practices.

The potential benefits of vermicomposting of agricultural waste include control of pollution and production of a value added product. Vermicomposting is the method which, recycles the crop residues and significantly increases the amount of N, P and K concentration in compost (Jambhekar, 1992). Vermicomposting of mustard (*Brassica juncea*) residue with pretreatments of submergence in water, nutrients (urea and low grade rock phosphate) supplementation, microbial (Bacillus sp., *Trichoderma viride* and *Cellulomonas fimi*) inoculation and their combined use with fresh cow dung/slurry improves the quality of vermicomposts with respect to C/N ratio, yield, humus fractions and nutrients content.(Prateek Shilpkar , 2011)

Since increasingly large amount of organic wastes are produced throughout the world, creating environmental problems, Vermicomposting through crop residue management among other alternatives has been considered as a way of transforming some of these wastes into useful compost for plants and soil while diminishing their negative environmental impacts. Organic wastes from very different sources have been used in vermicomposting. Apart from this, such practices entail wastage of organic and inorganic nutrients present in the solid wastes which might be put to good use.

My Research project is focused on value addition in the vermicompost produced from crop residues of *Brassica juncea* .

OBJECTIVES

- To assess the potential of the earthworm species (*Eisenia foetida*) to transform agricultural waste into useful compost.
- To evaluate the physicochemical parameters of the crop residue collected.
- To evaluate the physicochemical parameters of the vermicompost produced.
- To manage the crop residues and convert them into a useful product for better growth and quality of crops
- To assess the value addition in vermicompost after its production from crop residue.

REVIEW OF LITERATURE

Vermicomposting is a low cost technology system for the processing or treatment of organic wastes (Hand et.al, 1988). Vermicomposting could be an adequate technology for the transformation of sludges into valuable products (Elvira et al., 1997).

Many comparative studies between vermicomposting and composting systems have shown that earthworms (especially in trials conducted using composting worms) will accelerate the mineralization of organic matter, increase humification, lower the C: N ratio and bioavailability of heavy metals (Elvira et al, 1996, 1998; Dominguez 1997; Edwards and Bohlen, 1996). Gunathilagraj and Ramesh (1996) and Gunathilagaraj and Ravignanam (1996) reported respectively about management of coir and sericultural wastes by earthworms in India. A comparison of the composting of household waste by a traditional Indian composting procedure and vermicomposting was done in order to select a more efficient method of composting. Vermicomposting converted household waste into compost within 30 days, narrowed the C/N ratio and retained more N than traditional methods (Gandhi et al., 1997).

Vermicomposting as a principle originated from the fact that earthworms in the process of feeding fragment the waste substrate thereby increasing its surface area for further microbial colonization (Chan and Griffiths, 1998). During this process, the important plant nutrients, such as a nitrogen, potassium, phosphorous and calcium present in field material are converted into forms that are much more soluble and available to plant than those in the parent compounds (Ndegwa and Thompson, 2001) while the worm themselves provide a protein source in the form of animal feed(Sabine,1978,Hartenstein,1981). Vermicomposting technology is known throughout the world. Normally, vermi-composting is preferred to microbial composting in small towns as it requires less mechanization and it is easy to operate. A few vermi composting plants generally of small size have been set up in some cities and towns in India, the largest plant being in Bangalore of about 100 MT/day capacities (Sinha, 1996). Chennai, Mumbai, Indore, Jaipur and several other Indian cities are also setting up vermiculture farms.

Vermicomposting facilities have already entered domestic and industrial marketing in countries like Canada, USA, Italy and Japan. Vermicomposting was started in Ontario (Canada) in 1970 and is now processing about 75 tonnes of refuse per week (Asnani, 2004).

Temperature and moisture are the most important environmental factors in vermicomposting systems (Edwards, 1995, 1998). The optimum environmental conditions have been well researched and they are fairly similar for all composting species. A balanced vermicomposting system is usually maintained at 15-25^{0}C. The optimum temperature for *Eisenia* sps. is generally regarded as 20^0 C (Edwards,1998b), although ,*E.foetida* has the broadest temperature tolerance (Reinecke et.al,1992).

Edwards (1995) claims that, through the vermicomposting process the important plant nutrients in the organic material particularly nitrogen, phosphorus, potassium and calcium are released and converted through microbial action into forms that are more soluble and available to plants than those in the parent compounds. The magnitude of the transformation of phosphorus forms is considerably higher in the case of earthworm-inoculated organic wastes, showing that vermicomposting may prove to be an efficient technology for providing better phosphorus nutrition from different organic wastes (Reinecke et al., 1992; Ghosh et al., 1999).

Different natural and anthropogenic wastes which have already been converted into useful compost by different species of earthworms include sewage sludges (Diaz-Burgos et al, 1992, Benitez et al., 1999); dairy processing plant sludge (Kavian and Ghatnekar, 1991, Gratelly et al., 1996, Elvira et al, 1998); paper mill industry sludge (Elvira et al, 1998; Butt, 1993) pig waste (Reeh, 1992; Chan and Griffiths, 1988); water hyacinth (Gajalakshmi et al 2001,) ; paper waste (Gajalakshmi et al 2001, Gajalakshmi et al 2002) ; brewery yeast (Butt, 1993) ; crop residues (Bansal and Kapoor,2000) ; sheep manure (Albanell et al, 1988) ; cow slurry (Hand et al 1988) ; cattle Manure (Mitchell, 1997); vine fruit industry sludge (Antharasopoulous, 1993), rice stubbles, mango leaves (Talashilkar et al, 1999).

Hartenstein and Hartenstein (1981) in their lab-scale (10 cm-diameter Petri-dishes) experiments on vermicomposting of activated sludge observed that approximately 1 g worm could convert 4 g of activated sludge in 5 days.

Castings of *Eisenia foetida* from sheep manure alone and mixed with cotton wastes were analyzed for their properties and chemical composition every 2 weeks for 3 months and compared with the same manures in the absence of earthworms. The results showed that earthworms accelerated the mineralization rate and converted the manures into castings with a higher nutritional value and degrees of humification. The castings obtained from manure mixed with cotton wastes exhibited good agronomic quality, suggesting that this kind of industrial residue may be used in vermicomposting (Albanell et al., 1988).

Vermicomposting of vegetable waste was examined in order to identify suitable worm species and efficient levels of temperature and moisture. Laboratory experiments were conducted under controlled conditions using commonly available species namely; Pheretima sp.; *Eisenia* sp. and *P. excavatus*. Worms survived in the moisture range of 20-80 percent and the temperature range of 20 degree -40 degree C. Worm survival in decomposed and undecomposed organic wastes was also studied. Trials indicated that *P.excavatus* is the appropriate species for vegetable waste vermicomposting (Shanthi, et al, 1993).

At the CNR Instituto per la Chimica del Terreno in Pisa, Italy, pilot and field scale tests were conducted on vermicomposting of municipal and paper mill sludges, which evaluated the potential of vermicomposting as an economical/environmental alternative in sludge management. The work dealt with the feasibility of transforming problematic wastes through the action of worms and the agronomic value of the vermicompost. The vermicompost produced was of high quality humic product to be used in the field as a soil organic amendment (Ceccanti, B. and Masciandaro, G. (1999).

Vermicomposting with *Eisenia foetida* of mustard residues and sugarcane trash mixed with cattle dung in a 90 day composting experiment showed the significant reduction in C: N ratio and increase in mineral N (Bansal and Kapoor, 2000).

The benefits of a combined system to process urban green waste could include effective sanitization and pathogen control due to an initial brief period of thermophilic composting, enhanced rates of stabilization, plus the production of earthworms and vermicompost (Jadia and Fulekar, 2008). Stabilization of green waste such as yard waste and vegetable waste through the process of composting and vermicomposting has been carried out earlier (Daniel et al, 1997, Jadia and Fulekar, 2008, and Karthikeyan et al, 2007).

The nutrient status of the different agro industrial waste such as pressmud, bagasse, coir waste, rice husk & ground shell was also assessed and it was found out that vermicompost samples prepared from agro industrial waste recorded fairly higher level of nutrients (Kitturmath, et al., 2007**).**Major nutrient status of vermicompost of vegetable market waste and floral waste processed by three species of earthworms namely, *Eudrilus eugeniae, Eisenia foetida* and *Perionyx excavatus* was assessed and it was found out that nutrient status of the vermicomposts of all the earthworm species produced from both the wastes were more than that of the compost (Pattnaik and Reddy, 2009).

Padmathimma, et.al. (2008) investigated that vermicomposting can be used as a means of reducing organic waste materials. Studies were undertaken to select the most suitable earthworm spp. for vermicomposting, to enrich vermicompost by inoculation with beneficial microbes, to standardize an economically feasible method of vermicomposting, to achieve nutrient economy through vermicompost application in acid soils and to assess the performance of vermicompost as a bioinoculant in cow pea, banana and cassava. Earthworm spp. *Eudrillus eugeniae, Eisenia foetida, Perionnyx sansibaricus, Pontoscolex earthworms* and *Megascolex chinensis* were compared for their efficiencies and *E.eugeniae* found to be a superb agent.

Vermicomposting of food industry sludge mixed with biogas plant slurry employing *Eisenia foetida* shows that *Eisenia foetida* was unable to survive in 100% food industry sludge. So addition of some other organic waste was necessary during vermicomposting. Final vermicompost had higher concentration of important plant nutrients. There is a significant decrease in PH, organic matter & C: N, but increase in N, P, and K was recorded after vermicomposting (Yadav and Garg, 2010).

Jayanthi and Neelanarayanan (2010) conducted a study on the processed mixed leaves litter in which the litter was mixed with cured cow dung in different proportions viz., 50:50 & 60:40 & 70:30 (each concentration in triplicates) and filled in the plastic trays, individually. Hundred *Eudrilus euginiae* adult earthworms were introduced into each of these trays. Simultaneously a control for each of these concentrations was prepared and maintained without earthworms. The conversion ratio of mixed leaves litter into vermicompost was found to be more or less similar in all the concentrations. Further, vermicompost obtained from all the three concentration has desired level of plant nutrients for uptake. The results suggest that the mixed leaves litter with cured cow dung at any of these concentrations can be used for converting into value added vermicompost by utilizing the earthworm *E. eugeniae.*

Vermicomposting results in bioconversion of the waste streams into two useful products: the earthworm biomass and the vermicompost. The former product can further the processed into proteins (earthworm meal) or high-grade horticultural compost (Philips, 1988; Sabine, 1988; Fisher, 1988; Edwards and Niederer, 1988).The later product (vermicompost) is also considered an excellent product since it is homogeneous, has desirable aesthetics, has reduced levels of contaminants and tends to hold more nutrients over a longer period, without impacting the environment.

Vermicompost is natural organic manure produced from the excreta of earthworms fed on scientifically semi-decomposed organic waste. Use of organic amendment, such as traditional thermophilic composts, has long been recognized as an effective means of improving soil structure, enhancing soil fertility (Follet et al., 1981).

In the study on the seven vermicomposts produced by the action of worms on sheep manure, dairy manure, poultry manure, a mixture of wastes (underfelt, lawn clippings etc.), kitchen scraps, another mixture (carboard, wheat, meat etc.) and piggery solids were mixed at a rate of 30% by vol with a potting medium base (ground pine bark + sand, 4:1 by vol). These mixes were treated by acidification and/or the addition of various combinations of N, P, K, S and trace elements as basal fertilizer or in the watering solution. *Matthiola incana* (stocks) were grown in pots of the mixes. The growth of the plants and nutrient concentrations in the mixes and plants indicated that a vermicompost will supply the full requirements for trace elements and P, and will probably supply initial requirements for K and S, but will provide little or no N. There is a danger of toxicity from high levels of trace elements such as Zn, Cu and Mn. (Handreck,K.A., (1986)

Vermicompost is a finely-divided mature peat-like material with high porosity, aeration, drainage, water-holding capacity and microbial activity which are stabilized by interactions between earthworms and microorganisms in a non-thermophilic process (Edwards and Burrows 1988). Stolyarenko et.al. (1992) reported that the application of vermicompost stimulated root and shoot growth in maize plantlets. Vermicompost is rich in microbial populations and diversity, particularly fungi, bacteria and actinomycetes (Edwards 1998; Tomati et al., 1987). Vermicompost has large particulate surface areas that provide many micro sites for microbial activity and for strong retention of nutrients (Shi-wei and Fu-Zhen 1991). Vermicompost increases microbial diversity and populations (Barakan et al., 1995).

Vermicompost contains most of the nutrients such as nitrates, phosphates and exchangeable calcium and soluble potassium in plant available form (Edwards 1998; Orozco et al., 1996).Vermicomposts have a better structure than other media and it is suggested that vermicomposts contain plant growth hormones, soil enzymes, high microbial populations, and that earthworms selectively cull pathogens and harmful microorganisms in the soil (Benitez et al, 1999; Edwards and Bohlen, 1996).

Vermicompost consistently promotes biological activity which can cause plants to germinate, flower, grow and yield better than in commercial container media, independent of nutrient availability (Arancon et al., 2004; Atiyeh et al., 2000 a, b).Decomposition of different types of organic substrates into valuable vermicompost was done to evaluate the efficiency of an exotic earthworm sps. The % of N, P, and K in vemicompost was found to increase while $_{P}$H and total organic carbon declined as a function of the vermicomposting (Garg et al, 2006) .

Vermicomposting requires a specific species of worms that is adapted to living in decomposing organic materials rather than the soil. Two such species are *Eisenia foetida,* more commonly known as the red worm, manure worm or red wiggler and *Lumbricus rubellus* (Thakur, 2006).

Role of earthworms in the breakdown of organic debris on soil surface and soil turn over process was first highlighted by Darwin (1881).Earthworms in general are highly resistant to many pesticides and have been reported to concentrate the pesticides and heavy metals in their tissues. They also inhibit the soil borne pathogens and work as detoxifying agents for polluted soil (Davis 1971, Ireland 1983).Study conducted on feeding rates of worms by Wright (1972) on *Lubricus terrestris* revealed that the feeding rates was dependent on the feed as well as the feed preparation or feed pretreatment. Neuhauser et al. (1980) studied the effect of population density on growth and production of *E foetida* and using linear regressions concluded that growth decline with increase in population density, while production increased with population density.

In 1998, the Government of India announced exemption from tax liability to all those institutions, organizations and individuals in India practicing vermiculture on a commercial scale (Annual Budget 1998**).**

Earthworm farming (vermiculture) is a bio-technique for converting the solid organic waste into compost. Vermiculture (derived from the Latin *vermis* meaning worm) involves the mass production of earthworms for waste degradation, and composting with ‘vermicast’ production (Kale, 1991). Earthworm castings have a higher ammonium concentration and water-holding capacity than bulk soil samples and they constitute sites of high denitrification potential (Elliot et al., 1990).The castings of earthworms may contain two to three times more available potassium than the surrounding soil (Basker et al., 1993).In Bangalore, earthworms successfully decomposed sugar factory residuals and turned them into a soil nutrient that allowed farmers using the material to reduce chemical fertilizers by 50% (Logsdon, 1994).

Riggle and Holmes (1994) noted that worms can consume as much as their own weight in 24 hr.Edwards and Bohlen (1996) demonstrated that the feed rates varied greatly not only with earthworm species but also with the feed type. They further observed that the amount of litter that the earthworms ingest seems to depend more on the total amount of suitable organic matter than on other factors.

Earthworms play a major role in the breakdown of organic matter and in the cycling of nutrients in natural ecosystems. They are a part of a complex chain of chemical, biochemical, biological, and ecological interactions. Earthworm mouthparts are not capable of chewing or biting, so they rely on the decomposition of organic matter by microorganisms such as, bacteria, algae, fungi, nematodes, protozoa, rotifers and actinomycetes, before they can ingest the softened material along with the microorganisms. Earthworms possess a grinding gizzard that fragments the organic residuals. They ingest microorganisms and depend on them as their major source of nutrients (Edwards and Bohlen, 1996), but also, the earthworm gut secretes mucus and enzymes that selectively stimulates beneficial microbial species (Doube and Brown, 1998). Earthworms promote further microbial activity in the residuals so that the faecal material, or casts that they produce, is much more fragmented and microbially active than what the earthworms consumed (Edwards, 1995). Effectively, earthworms inoculate the soil, or organic matter, with finely ground organic residuals and beneficial microorganisms which increase the rate of decomposition and enables further ingestion of microorganisms by earthworms.

Studies by Dominguez and Edwards (1997) on the effect of stocking rate of growth and maturation of *Eisenia andrei* concluded that, whereas individual worms grew more and faster at the lowest population density, the total biomass production was maximum at the highest population density in their test. At higher rates, they noted, the worms sexually matured faster than in the lower stocking rates.

Worms were grown with food residuals at Flying Heart Farm in a mixture of restaurant residuals and composted wood chips, manure, and yard trimmings that have been run through a chipper. It was found that the worms consumed about 800 pounds per week. Every 4 days, 2 inches of food residuals are laid out over the worms and covered with 3 inches of compost which is first screened with a trommel. It took 8 months for a row to get to the proper height for harvesting. An electric, self-propelled harvester that straddles a row to collect and separate worms, worm eggs, and castings were used. In addition to selling worms wholesale, the farm has other ventures including retail sales of worm castings and worms, giving educational and technical tours, and establishing vermiculture programs at elementary schools (Farrell, M. (1997).

Earthworms serve as "nature's plowman" to facilitate these functions. They form nature's gift to produce good humus, which is the most precious material to fulfill the nutritional needs of crops. In short, earthworms, through a type of biological alchemy, are capable of transforming garbage into 'gold' (Vermi Co 2001, Tara Crescent 2003).

Aira et al (2003) reported effect of two species of earth worms *Allolobophora cligmosa* and *A.moller* on soil system including microfaunal and biochemical properties. The two species of earthworm, *Eisenia foetida* and *Eudrilus eugeniae* can be employed to degrade the vegetable waste and agro-residues. Chemical analysis of the vermicomposts derived from vegetable waste showed that the quantity of organic carbon was reduced from 42.1% to 31.19 and 30.19% by *E.foetida E.eugeiniae*,respectively. The level of N,P,K,Ca was higher in vermicompost of vegetable waste processed by *E.eugeniae* than *E.foetida*.An ideal C/N ratio (27:44) was observed in vegetable vermicompost processed by *E.eugeniae*. Similarly, *E.eugeniae* worked vegetable waste vermicompost positively altered the height, number and area of leaves, fruit length and weight of *Abelmoschus esculentus* (Alagesan and Vasuki ,2010).

METHODOLOGY AND EXPERIMENTAL PLAN

This Research project consists of vermicomposting of Agricultural waste (Indian mustard crop residue) and value addition to the produced vermicompost.

To achieve the objectives the work plan is as follows:

Collection of Agricultural Waste (*Brassica juncea* crop residue)

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Physicochemical analysis of waste

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Preparation of Vermicompost (Vermicomposting)

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Physicochemical analysis of the Vermicompost produced

↓

Assessment of the value added in the vermicompost produced through statistical analysis

<u>Collection of the Agricultural waste</u>

Crop residue of *Brassica juncea* will be collected.

<u>Physicochemical characterization of the crop residue collected</u>

The waste will be finely chopped and grinded and the available nutrients of the organic waste will be analyzed for:

- pH (pH meter)
- Electrical Conductivity (Conductivity meter)
- Moisture content (Oven method)
- Organic Carbon (Black and Walkley method)
- Available Phosphorus (Olsen's method)
- Ammonical and Nitrate Nitrogen (Kjeldhal assembly)

- Total Calcium(Versenate method)
- Available Nitrogen (Steam Distillation)

Preparation of Vermicompost from the crop residue

Vermicompost of the residue will be prepared in 5 ratios i.e. 90:10(900gm cow dung and 100 gm waste),80:20 (800gm cow dung and 200 gm waste), 70:30 (700gm cow dung and 300 gm waste),60:40(600gm cow dung and 400 gm waste) and 50:50 (500gm cow dung and 500gm waste) with control (without worms) of them.

Physicochemical analysis of Vermicompost

To evaluate the value addition through Vermicomposting physicochemical analysis of the prepared vermicompost will be done wherein the following parameters will be taken:

- pH (pH meter)
- Electrical Conductivity (Conductivity meter)
- Moisture content (Oven method)
- Organic Carbon (Black and Walkley method)
- Available Phosphorus (Olsen's method)
- Ammonical and Nitrate Nitrogen (Kjeldhal assembly)
- Total Calcium(Versenate method)
- Available Nitrogen (Steam Distillation)

Statistical Analysis-

Two-way analysis of variance (ANOVA) will be computed to test the level of significance of difference between the waste collected; the vermicompost and compost produced with respect to the physico-chemical parameters.

SIGNIFICANCE

The proposed research work would embark on converting organic agricultural waste into a quality vermicompost.

- The Agricultural wastes like crop residues specially from Brassica and pulses contain organic as well as inorganic matter and offer good possibilities for recovery of energy in its organic fraction for gainful utilization through adoption of suitable processing and treatment technologies.
- Vermicomposting of Brassica waste (residues) may offer some additional benefits also such as:
  - the total quantities of the generated waste gets reduced.
  - the known usable waste of Brassica which hither to is mainly used for burning can be converted into value added organic vermicompost.
  - there would be a net reduction in the environmental pollution.
- Considering the significant potential of Brassica waste for vermicomposting and the associated benefits, it is logical that the potential of vermicomposting technology be carefully examined and, where ever feasible be incorporated in the overall scheme of crop residue management.
- This project aims to develop a state-of-art-technology using earthworm composting to manage the crop residues and convert them into a useful product for better growth and quality of crops.
- This research project thus has economic and environment and hence societal relevance.

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