Organic initiative-Vermicomposting A departmental endeavour for sustainable waste management- A Case Study

A.M.Chalkoo, Zahoor A Wani, Peerzada Yasir, Bilal A Wani, Azad H Khan, Yaseen Maqbool, Ubaid Yaqoob, M Sulaiman Dar, Mir Khusrau, Bahar Ahmad Meer

Abstract

The present work is aimed towards developing a sustainable waste management practice and to impart skill-based training to Bonafide students at the institute to achieve Sustainable Development Goals (UN-SDG). Keeping in view rampant use of spurious pesticides and chemical fertilizers prevalent in market, an initiative was taken by the department to sensitize the student community and progressive farmers about already existing tradition of converting farmyard manure (FYM) like cow dung and plant litter into organic manure-Vermicompost. The aim was also to reduce the period of decomposition and to apply established scientific procedure like augmentation with red wiggler worms, layering of plant litter and FYM in Vermibeds and maintenance of optimum moisture and temperature to facilitate rapid conversion of organic waste into ecofriendly biofertilizer-vermicompost. The vermicompost produced was analysed for its quality and the organic carbon content, N, P, and K content was found to be in the desirable range. Further the students were given hands-on training sessions and demonstrations about the vermicompost production process and successful students were awarded certificates as well.

Keywords

Vermicompost, Nutrient, Sustainable development, Plant litter, Red Wiggler.

Introduction

Often one would feel what our role is towards the sustainable development initiative of our government at the ground level. What do we owe to our society for being students of plant sciences. Small initiatives, interventions and outreach activities could make a huge difference. Having said that we need to think globally but act at a local level.

The rampant use of chemical fertilizers and chemical pesticides are posing a threat to our biosphere including hydrosphere, lithosphere and atmosphere. The water resources along with soil are getting extremely polluted due to the excessive use of spurious chemicals. It is in the backdrop of this concern that the Department of Botany thought it prudent to undertake a sustainable waste management initiative at the institutional level.

Further it was also observed that almost all students enrolled in the college hail from agricultural background and remain associated with agricultural activities. The waste matter like cow-dung (FYM) and agricultural straw is dumped on to the roadside and in open fields which give a shabby look and poses a threat of infection to the local community.

To address this open environmental challenge, a need was felt to develop a sustainable waste management practice. The Department of Botany initiated vermicompost production based on scientific procedures to convert waste like cow dung and farmyard litter into organic manure Vermicompost. Apart from converting waste to resources, Bonafide students at the college were given demonstrations, hands-on training sessions, and certificates in vermicomposting. This integrated approach of the *Waste to Resource (Garbage to Gold)* and *Earn while Learn* concept was adapted for sustainable waste management within the college premises.

Methodology

The Vermiculture (Cultivation of worms) unit was constructed for Vermicompost production and multiplication of worms in the Botanical Garden of the college. The size of the Vermiculture unit was 15×30 feet in which two worm bins (Vermibed) with dimensions of 3×3×12 feet with proper provision of ventilation and drainage system were set up. GI sheets were used to cover the top of the house, and the sides of the house were covered by light weighed tin sheets to protect from direct sunlight and rain, and to avoid the entrance of flying predators and rodents.

The semi decomposed cow dung (around 30 days old) was procured from neighbouring villages and kept in an open area to eliminate the gas before shifting to Vemibeds. A layer of chopped lawn grass was placed at the bottom (Bedding material) followed by a layer of semi decomposed cow dung. This was again followed by a layer of dry grass and the process continued. The layered pattern of cow-dung and straw was followed in other beds also. Around 3 kgs of red wiggler (*Eisenia fetida*) worms were placed in each Vermibed. The moisture content of Vermibeds was maintained by keeping gunny bags on the top and sprinkling of water was ensured in a regulated manner. The whole set up was monitored daily. The final product was properly sun dried and sieved to obtain dark black coloured granular and nutritionally rich Vermicompost, which was packed in bags for sale.

Quality Analysis and Chemical composition

Around 1 kg of semi dried vermicompost was subjected to quality analysis through Mountain Research Centre for Field Crops (SKUAST-K) Khudwani, Kulgam. The chemical analysis report along with the reference standard is detailed below in a tabulated form.

S.No.	*Analyte*	*Vermicompost produced in experimental set up in college*	*Reference Range (Desirable)*
1.	Colour	Dark brown	Dark brown
2.	Odor	Foul Odour absent	Absent
3.	Solids	78%	
4.	Moisture	22%	22.6%
5.	pH	8.4	5-8.5
6.	EC	1.7dSm¹	3.42
7.	Organic Matter	46.4%	50-60%
8.	Carbon	27.3%	28.15%
9.	Total Nitrogen	2.1%	1.42%

10.	C:N Ratio	13	12
11.	Phosphorus (P)	0.82%	0.81%
12.	Potassium (K)	1.96%	1.1%
13.	Man Made Foreign Matter (Glass,Plastic,Metal) <2mm fraction	<1%	
14.	Stones %dry weight	<5%	

Results and Discussion

Vermicompost is a well stabilized, finely divided peat-like material produced through a non-thermophilic process involving the biodegradation and stabilization of organic materials by interactions between earthworms and microorganisms. Vermicompost, which is obtained by decomposition of organic wastes by red wiggler earthworms, is an eco-friendly organic product with high economic and nutritive value (Garg and Gupta, 2009). Many organic wastes (plant litter, animal waste, food wastes, urban solid waste, wastepaper, sawdust, etc.) can be used as raw material in vermicompost production (Karmakar *et al*., 2012).

Earthworms are regarded as friends of farmers, soil managers and nature's ploughmen. They utilize organic matter, promote soil porosity and aeration, bring about fragmentation and mixing of mineral particles. Some species of earthworms have the capability of consuming different organic wastes including animal manure, green manure, industrial waste, sewage sludge and crop residues. Red worms (*Eisenia fetida*) are the most widely used species used in vermicomposting.

The decomposition rate of vermicompost is comparatively faster than traditional compost because in vermicomposting the conversion of organic materials takes place through the gut of earth worm where the end materials contain high microbial activities and rich in nutrient contents.

The analysed result showed that the organic carbon content to be 27.3%, which is in the range of optimum value of organic carbon in most of the already reported studies. This is in conformity with the findings that the worm castings (vermicompost) contain a higher percentage of organic carbon as compared to conventional compost and garden soil. The C:N ratio in the sample was recorded to be 13 and low C:N ratio indicates higher rate of mineralization and thus the vermicompost prepared from the substrates contains a high percentage of total nitrogen (2.1%). Several other studies have also confirmed the low C: N ratio from vermicompost with different substrate composition. Frankenberger and Abdelmagid (1985) state that organic matter with a C/N ratio lower than 20 includes high quality of organic matter and will undergo mineralization in the soil. Majlessi *et al* (2012) stated that the vermicompost with low C/N ratio (14-30) indicates a mature and stable Vermicompost. During the decomposition process, soil microorganisms burn carbon as a source of energy, but not all the carbon remains in its body; a certain amount is lost as carbon dioxide during respiration. Therefore, the low C/N ratio of vermicompost indicates good quality vermicompost.

Total Nitrogen, Available Phosphorus and Potassium (NPK)

The analysed result showed that relatively the highest (0.82%) available phosphorous was recorded from the vermicompost. The enhanced P level in vermicomposting suggests phosphorous mineralization during the process. The worms during vermicomposting converted the insoluble P into soluble forms with the help of P-solubilizing microorganisms through phosphatases present in the gut, making it more available to plants. The study is in conformity with the result of Nagavallemma *et al* (2004) who found that the worm casting contains the highest available phosphorus contents with the values ranging from 1900 to 10,200mg/kg.

Conclusion

Vermicompost is nutritionally rich natural organic manure, which releases nutrients in the soil and improves the quality of the plants with renewed physical and biological properties of soil. The Vermicompost prepared from locally available materials such as cow dung and mixture of all straws were analysed for their nutrient evaluation. According to the results of this study, the nutrient content of Vermicompost prepared from all substrates showed the highest values for all macro and micro plant nutrients. Thus, the vermicompost made from all materials could correct the plant nutrient imbalance if applied to the nutrient deficient soil and could be used for Vermicompost preparation based on the accessibility of materials.

If the practice of converting waste to resource (Garbage to Gold) is followed in the institution or in the countryside or in other institutions, the dependency on chemical fertilizers could be largely minimized and physical, biological, and chemical composition would increase. Further the damage to different components of the environment would be reduced. This way we could make our students ambassadors and messengers of the vermicomposting method.

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References are available upon request.

Affiliations –

A.M.Chalkoo[1], Zahoor A Wani[1*], Peerzada Yasir[1], Bilal A Wani[2], Azad H Khan[2], Yaseen Maqbool[1], Ubaid Yaqoob[1], M Sulaiman Dar[3], Mir Khusrau[4], Bahar Ahmad Meer[5]

[1]Department of Botany, Govt. Degree College Anantnag

[2]Department of Seed Technology, Govt. Degree College Anantnag

[3]Department of Botany, Govt. Degree College Kokernag, Anantnag

[4]Department of Botany, SP College Srinagar

[5]Department of Botany, Govt. Degree College Banihal

*[*]**Corresponding author:** Zahoor Ahmed Wani*

E mail: zawani1986@gmail.com