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NUTRIENT PROFILE OF VERMICOMPOST PREPARED FROM NEEM LEAVES

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Abstract–The study creates awareness among farmers and common man towards clean environment in their 9 surroundings through decomposition of organic waste in to valuable manure using *Eisenia fetida*. The investigation was destined to produce vermicompost from neem leaves litter and cow dung in plastic tubs kept in screen house. The nutrient status of vermicompost was evaluated on initial, 45th and 90th day. Total organic carbon (3.76%), carbon/nitrogen ratio (2.73%) decreased whereas nitrogen (1.38%), phosphorus (0.27%) and potassium (0.21%) content increased on 90th days. The organic waste like neem leaves litter can be used for sustainable agriculture by converting them in to vermicompost.

INTRODUCTION

Vermicompost is environment-friendly manure for sustainable agriculture which can be used as an organic fertilizer; it contains water soluble nutrients that are relatively easy for plants to absorb. Whereas vermicomposting is a bio-oxidative process in which earthworms interact with microorganisms (mainly bacteria, fungi and actinomycetes) and other soil fauna and increases the rate of decomposition through modification of physical, chemical and biological properties within the drilosdrilosphere (Yadav *et al.*, 2013; Kumar *et al.*, 2020). Vermicomposting is socially acceptable and economically viable odourless process in which organic waste materials are converted in to nutrient rich manure in using earthworms. This process is more popular than conventional composting in both industrial and domestic sectors because it is a quick way to treat organic wastes without use of energy. The earthworm species, most often used are *E. fetida*, also known as red wrigglers. They are highly recommended because of their appetites, higher and quick rate of breeding (Ismail, 2005; Edwards *et al.*, 2011; Kumar *et al.*, 2020). Vermicompost is rich in NPK, micronutrients and useful soil microbes, which includes nitrozen fixing, phosphate solublizing bacteria and actinomycetes. Vermicompost is an excellent plant growth promoter and also augment plant immunity so it is sustainable alternative to chemical fertilizers (Sinha *et al.*, 2011; Chauhan and Singh, 2015). Vermiculture provides cheaper solutions for the management of farm and animal wastes, garden, municipal and industrial wastes through biodegradation and converting them into nutritive organic fertilizer. It is creation of 'wealth from waste' or 'gold from garbage' (Bansal and Kapoor, 2000; Domínguez 2004; Sinha *et al.*, 2009). The new idea of farm production against the destructive 'Chemical Agriculture' has been described as 'Sustainable Agriculture'. This is about the production of 'healthy and immunity booster foods' using biological 'organic fertilizers' without the use of lethal agro-chemicals. Sustainable agriculture is considered to be synonymous with 'Cleaner Agriculture' to reduce the use of dangerous agro-chemicals from food production, another objective is to minimise other farm inputs like water and energy, as their indiscriminate use for food production has led to extensive environmental destruction (Pretty, 1996). Sustainable agriculture mainly focuses on production of long term crops and livestock while minimizing harmful effects on environment and 'economic prosperity' for the farmers and 'food security' for the people. This will require beginning of a 'Second Green Revolution'- and this time through 'Vermiculture Revolution' using earthworms (Singh, 1993; Bhatia *et al.*, 2000). The importance of earthworms was recognised long ago by Aristotle and he called them as 'intestine of earth'. The earthworms secrete enzymes such as proteases, lipases, amylases, cellulases and chitinases in their gut for rapid biochemical conversion of the cellulose and proteinaceous materials in organic waste like Cattle dung, pig excreta, chicken excreta and paunched waste materials. Animal excreta which contains excessive nitrogen component may require mixing of saw dust, straw, dried leaves, grasses and finely chopped paper waste to maintain proper C/N ratio (Sinha *et al*., 2009). The above facts made us curious to study the nutrient profile of vermicompost prepared from neem leaves mixed with cow dung.

MATERIALS AND METHODS

Collection of test animal

The culture of earthworm species *E. fetida* was perpetuated to use the third generation of earthworms to avoid the pre-exposure or residual effects of agrochemicals at vermicomposting unit of Department of Zoology and Aquaculture, CCSHAU, Hisar. Mature and completely clitellated earthworms from third generation were used for experimentation.

Collection of Substrate

The cow dung used as substrate was obtained from Biogas Plant of Department of Microbiology, CCS HAU, Hisar. To avoid the harmful effects of gases and increased temperature during vermicomposting, cow dung was pre decomposed for 15 days prior to experimentation.

Experimental set up: The collected cow dung and neem leaves were kept separately for 15-20 days. Thereafter dung and dried neem leaves were mixed in the ratio of 3:1 for vermicomposting in 90 L plastic tubs.

The tubs were kept in screen house under the shed to protect earthworms from rainfall and direct sunlight. Thirty earthworms were properly washed and then released in each plastic tubs. Further, earthworms were checked to ensure that all the worms burrowed into the substrate contained in tubs thereafter all the tubs were covered with gunny bags to avoid water loss. The process of vermicomposting was carried out for 90 days. The temperature and moisture content were maintained by sprinkling water as and when required.

Chemical analysis

The samples of vermicompost for nutrient profile were collected and analysed for total carbon, nitrogen, phosphorus, and potassium by using standard methods on initial (0 day), 45th and 90th day. Zero day refers to the day of transfer of earthworms in to plastic tubs. Total organic carbon (TOC) was determined by using dry combustion method (Nelson and Sommers, 1982). Total nitrogen content was determined by Colorimetric method (Nessler's reagent) (Lindner, 1944) after digesting the sample with diacid mixture of H_2SO_4 and $HClO_4$ (9:1, v/v). Total phosphorus was analysed by vanadomolybdo-phosphoric yellow color method (Koenig and Johnson, 1942). Flame photometer was used for the determination of total potassium after digesting the sample with concentrated HNO_3 and $HClO_4$ in the ratio of 9:1 (Tandon, 1993). The carbon/nitrogen ratio (C/N) ratio was calculated from the measured value of total organic carbon and total nitrogen. The reported results are the mean of three replicates with standard deviation (mean ± SD). Statistical analysis was carried out by using OPSTAT software program.

RESULTS

Organic carbon

Organic carbon contents decreases gradually with time and it was maximum (3.76%) on 90th day (Fig 1A).

Organic nitrogen

No significant change was observed on 45th days but nitrogen content increased up to 1.38 % on 90th days in comparison to control (Fig 1B).

C/N ratio

The carbon and nitrogen ratio of vermicompost decreased (as shown in Fig 1C) up to 45% in all treatment when compared with control.

Organic phosphorus

Organic phosphorus increased from 0.19% on initial day to 0.27% on 90th day in experimental tubs (Fig 1D)

Organic Potassium

Organic potassium increased from 0.18% to 0.21% on 90th day in treated tubs whereas in control it was stable (Fig 1E).

DISCUSSION

The findings of the present study showed that Nitrogen, phosphorus, and potassium content elevated at the rate of 28.76%, 47.57%, and 16.20%, respectively. N (1.38%), P (0.27%) and K (0.21%) increased successively up to termination of experimental protocol (90th days), the aforesaid nutrients plays an important role in soil fertility. The ratio of C: N indicates the concentration of total nitrogen to total carbon, and it is an indicator of the progressive stabilization of biowaste. Reduced C:N ratio (2.73%) of the substrate indicates the organic waste mineralization and stabilization during the process of vermicomposting (Nogales *et al.*, 1999; Kumar *et al.* 2020). It was assumed that vermicomposting had been completed once the C: N ratio had dropped below an intended level (Abbasi *et al.*, 2015). The results obtained in the study are similar to those by Nathiya *et al.* (2015) who observed highly significant decrease in carbon-nitrogen ratio in the experimental set up using earthworms. Earthworm modifies the conditions of the substrate, which promotes the loss of carbon from the substrate through microbial respiration in the form of CO_2 and even through mineralization of organic matter (Bansal and Kapoor, 2000). The reduction in organic carbon may be due to the respiratory activity of earthworms and microorganisms and a result of symbiotic action of microorganisms with earthworms, a significant fraction of organic matter in the initial substrates was lost as CO_2 by the end of vermicomposting period, therefore the percentage of carbon decreases significantly (Nogales *et al.* 1999). The part of the carbon is released as CO_2 by the process of respiration and production of nitrogen lowers the carbon-nitrogen ratio of the pre decomposed substrate. The reduction in organic carbon may be due to the respiratory activity of earthworms and microorganisms and a result of symbiotic action of microorganisms with earthworms, a significant

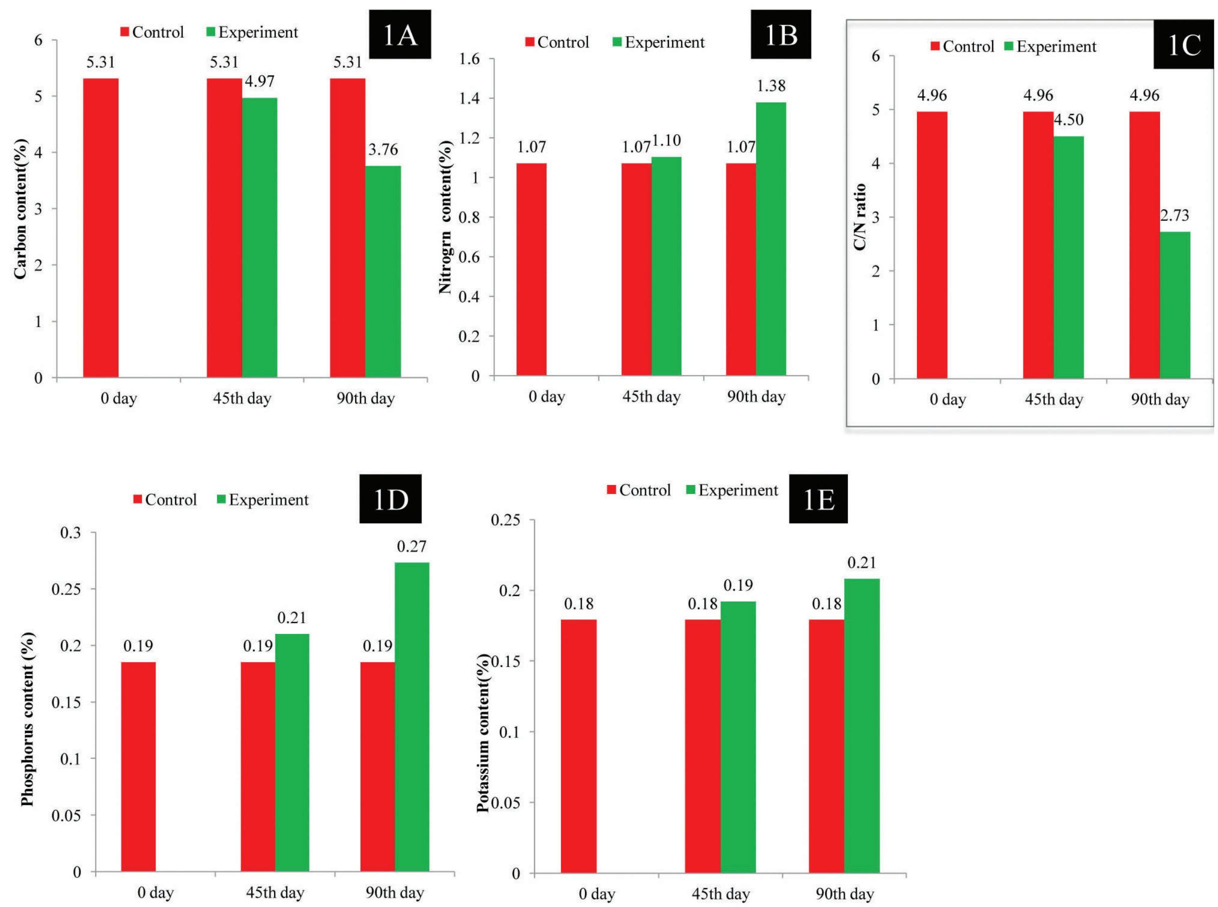

Fig. 1. Vermicompost prepared from Neem leaves using *E. fetida* **(A)** Changes in Organic Carbon content (%) **(B)** Changes in Organic Nitrogen content (%) **(C)** Changes in C/N ratio **(D)** Changes 95 in Organic Phosphorus content (%) **(E)** Changes in Organic Potassium content (%) 96

fraction of organic matter in the initial substrates was lost as CO_2 by the end of vermicomposting period, therefore the percentage of carbon decreases significantly (Nogales *et al*. 1999).

Earthworm activity increases the nitrogen profile of vermicompost through microbial mediated transformation of nitrogen and by addition of mucus and nitrogenous wastes secreted by earthworms. Enhancement in nitrogen content in vermicompost of sugarcane trash and cow dung substrate as compared to control was reported by Ramalingam and Thilagar (2003). Increase in the amount of phosphorus in vermicompost with passage of time has been reported and release of phosphorus in available form is made available partly by phosphatases of earthworm gut (Lee, 1992). Solubilization of potassium in organic wastes through activity of microorganisms by acid production was claimed by Premuzic *et al*. (1998). Suthar (2007) reported that waste material processed by earthworms contains a high concentration of exchangeable K, due to increased microbial activity during the vermicomposting process, which consequently increases the rate of mineralization (Pandit, 2012).

CONCLUSION

The study concludes that vermicomposting could be an efficient method to convert neem leaf litter into a valuable by-product which can be useful for building the model of sustainable agriculture and *E. fetida* plays crucial in the sustainable development.

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Conflict of interest

The authors declare no conflict of interests associated with this paper.

REFERENCES

Abbasi, S. A., Nayeem-Shah, M. and Abbasi, T. 2015. Vermicomposting of phytomass: limitations of the past approaches and the emerging directions. *Journal of Cleaner Production*. 93 : 103-114.

Bansal, S. and Kapoor, K. K. 2000. Vermicomposting of crop residues and cattle dung with *Eiseniafoetida*. *Bioresource Technology*. 73(2) : 95-98.

Bhatia, S., Sinha, R. K. and Sharma, R. 2000. Seeking alternatives to chemical fertilizers for sustainable agriculture: A study of the impact of vermiculture on the growth and yield of potted wheat crops (*Triticum aestivum* Linn.). *Environmental Education and information*. 19(4) : 295-304.

Chattopadhyay, G.N. 2012. Use of vermicomposting biotechnology for recycling organic wastes in agriculture. *International Journal of Recycling of Organic Waste in Agriculture*. 1(1) : 8.

Chauhan, H. K. and Singh, K. 2015. Potancy of Vermiwash with Neem plant parts on the Infestation of Eariasvittella (*Fabricius*) and Productivity of Okra (*Abelmoschus esculentus*)(L.) Moench. *Asian Journal of Research in Pharmaceutical Science*. 5(1) : 36-40. 169

Domínguez, J., Edwards, C. A. and Webster, M. 2000. Vermicomposting of sewage sludge: effect of bulking materials on the growth and reproduction of the earthworm *Eiseniaandrei*. *Pedobiologia*. 44(1) : 24-32.

Domínguez, J. 2004. 20 State-of-the-Art and New Perspectives on Vermicomposting Research. In *Earthworm Ecology*. 401-424. CRC Press Boca Raton, FL, USA.

Edwards, C. A., Subler, S. and Arancon, N. Q. 2011. Quality criteria for vermicomposts. *Vermiculture Technology. Earthworms, organic wastes and environmental management*, 287-301.

Ismail, S.A. 2005. *The Earthworm Book.* Other India Press, Mapusa,pp 101.

Kumar, R., Sharma, P., Gupta, R.K., Kumar, S., Sharma, M.M.M., Singh, S. and Pradhan, G. 2020. Earthworms for Eco-friendly Resource Efficient Agriculture. In: *Resources Use Efficiency in Agriculture* (pp. 47-84). Springer, Singapore. 181

Lee, K. E. 1992. Some trends and opportunities in earthworm research or: Darwin's children—the future of our discipline. *Soil Biology and Biochemistry*. 24(12): 1765-1771.

Lindner, R. C. 1944. Rapid analytical methods for some of the more common inorganic constituents of plant tissues. *Plant Physiology*. 19(1): 76.

Nathiya, S., Scinduja, M., Suganya, K., Vidhyanandhini, J. and Jayapradeep, S. 2015. Experimental study on biodegradation of garden waste, market Waste Using *Eiseniafetida* & *Eudrilus Eugenia* and checking the quality of manure on tomato. *International Journal of Engineering Sciences & Research Technology.* 4(3): 2277-9655.

Nelson, D. W. and Sommers, L. 1982. Total Carbon, organic carbon, and organic matter 1. *Methods of Soil Analysis. Part 2. Chemical and Microbiological Properties*, (methodsofsoilan2), 539-191.

Nogales, R., Melgar, R., Guerrero, A., Lozada, G., Benítez, E., Thompson, R. and Gomez, M. 1999. V Earthworms and Waste Management-Growth and reproduction of *Eiseniaandrei* in dry olive cake mixed with other organic wastes. *Pedobiologia*. 43(6) : 744-195 752.

Pandit, N. P. and Sanjiv Kumar Maheshwari, S. K. 2012. Optimization of vermicomposting technique for sugarcane waste management by using *Eiseniafetida*. *International Journal of Biosciences*. 2(10) : 143-155.

Premuzic, Z., Bargiela, M., Garcia, A., Rendina, A. and Iorio, A. 1998. Calcium, iron, potassium, 200 phosphorus, and vitamin C content of organic and hydroponic tomatoes. *Horticultural Science*. 33(2) : 255-257.

Pretty, J. N. 1995. *Regenerating agriculture: policies and practice for sustainability and self-reliance*. Earthscan Publications.

Pretty, J. N., Thompson, J. and Hinchcliffe, F. 1996. Sustainable agriculture: impacts on food production and challenges for food security. *Gatekeeper Series-Sustainable Agriculture Programme, International Institute for Environment and Development (United Kingdom)*.

Ramalingam, R. and Thilagar, M. 2003. Bio-conversion of agro-waste sugarcane trash using an Indian epigeic earthworm, *Perionyxexcavatus* (Perrier). *Dimensions of Environmental Threats*, 203-208.

Ramnarain, Y. I., Ansari, A. A. and Ori, L. 2019. Vermicomposting of different organic materials using the epigeic earthworm *Eiseniafoetida*. *International Journal of Recycling of Organic Waste in Agriculture*. 8(1) : 23-36.

Singh, R. D. 1993. Harnessing the earthworms for sustainable agriculture. *Institute of National Organic Agriculture, Pune, India*, 1-16.

Sinha, R. K. 2011. *Earthworm Vermicompost*. Nova Science Publishers.

Sinha, R. K., Herat, S., Chauhan, K. and Valani, D. 2009. Vermiculture and sustainable agriculture. *American-Eurasian Journal of Agricultural and Environmental Science*. 5(S).

Sinha, R. K., Herat, S., Bharambe, G. and Brahambhatt, A. 2010. Vermistabilization of sewage sludge (biosolids) by earthworms: converting a potential biohazard destined for landfill disposal into a pathogen-free, nutritive and safe biofertilizer for farms. *Waste Management & Research*. 28(10) : 872-881.

Suthar, S. 2007. Vermicomposting potential of *Perionyxsansibaricus* (Perrier) in different waste materials. *Bioresource Technology*. 98(6) : 1231-1237.

Tahir, T. A. and Hamid, F. S. 2012. Vermicomposting of two types of coconut wastes employing *Eudriluseugeniae*: a comparative study. *International Journal of Recycling of Organic Waste in Agriculture*. 1(1) : 7.

Tandon, H. L. S. 1993. *Methods of Analysis of Soils, Plants, Waters, and Fertilisers* (pp. 23-228 116). H. L. S. Tandon (Ed.). New Delhi: Fertiliser Development and Consultation Organisation.

UNSW, R. 2002. Best practice guidelines to managing on-site vermiculture technologies. *University of New South Wales Recycling Organics Unit, Sydney, NSW, Australia*.

UNSW, R. 2002. Vermiculture in Organics Management-The Truth Revealed. In *Seminar in March*.

Yadav, A., Gupta, R. and Garg, V. K. 2013. Organic manure production from cow dung and biogas plant slurry by vermicomposting under field conditions. *International Journal of Recycling of Organic Waste in Agriculture*. 2(1) : 21.