



Mini Review

Vermicomposting of aquatic weeds: A quick review

Ishtiyag Ahmed Najar

Department of Environmental Sciences, G.D. College, Ganderbal 191201, Kashmir (J&K), India

Article history

Received: 18 May 2017
Accepted: 16 August 2017
Published: 04 September 2017

© Ishtiyag (2017)

Editor

K K Sabu

Publisher

Horizon e-Publishing Group

Correspondence

Ishtiyag Ahmed Najar
✉ ishtiyag.env@gmail.com

Abstract

Aquatic plants play an important role in ecosystem functioning and services but they can also be deleterious if present in excess. The different anthropogenic activities result in accumulation of nutrients in aquatic ecosystems leads to eutrophication with massive weed growth and associated diverse adverse effects. Effective control/management of weeds in different aquatic systems is not only difficult but of short duration. The commonly used methods to manage/control the aquatic weeds are biological, chemical and mechanical, in addition to habitat manipulation. However, these methods can be highly disruptive causing adverse environmental effects and are relatively inefficient. On the other hand different species of earthworms can feed on wide range of weeds and convert them into stable product called vermicompost, rich in plant nutrients. Among different aquatic weeds the most extensively vermicomposted weed is water hyacinth (*Eichhornia crassipes* (Mart.) Solms), using different earthworm species. Among different earthworm species used for vermicomposting of aquatic weeds, *Eisenia fetida* (Savigny) is the most commonly used species. Vermicomposting is an efficient ecobiotechnological process that converts the aquatic weeds into nutrient rich material that can acts as suitable plant growth media for sustainable agroecosystems. Further large scale utilization of aquatic weed based vermicompost in horticulture can solve their management and disposal issues along with restoration of organic matter and nutrient depletion at low input basis.

Keywords: Aquatic plants; Earthworms; Weeds; Vermicomposting

Ishtiyag A N. Vermicomposting of aquatic weeds: A quick review. Plant Science Today 2017;4(3):133-136. doi: 10.14719/pst.2017.4.3.311

Introduction

Aquatic plant community comprise a diverse group of flora that occur seasonally or permanently in different wet environments. These plants are capable of colonizing wide range of aquatic environments (reservoirs, lakes, lagoons, wetlands, rivers and waterfalls) with varied limnological characteristics,

presenting high plasticity and adaptation ability. They are vital in maintenance of food chains and various biogeochemical processes, but are deleterious when present in excess (1). However, anthropogenic activities results in accumulation of nutrients in aquatic ecosystems leads to eutrophication with massive plant growth which impairs recreational activities and ecosystem services (2,3,4,5,6).

Earthworms are among important invertebrate communities in soils in terms of their below ground biomass (7,8,9) and play a major role in their functioning (10) along with essential ecosystem services (11). In different pedoecosystems they enhanced mineralisation and nutrient availability in soil (12,6,13). They contribute to soil aeration, drainage and transformation of plant vitals (minerals and nutrients) to accessible forms, thus making the soil favorable for enhanced crop yield (14,15,16).

Many studies have been documented on the use of vermicomposting in processing of different organic materials/wastes, but studies on its use in the processing of aquatic weeds have been few. Chauduri *et al.* (17) on vermicomposing of *Trapa bispinosa* with *Perionyx excavatus* reported increase in concentration of total nitrogen, available phosphorous, potassium and calcium. Sannigrahi *et al.* (18) vermicomposted fresh and dry form of water hyacinth (*Eichhornia crassipes*) using *P. excavatus* and recorded faster recycling in fresh form as compared to dry form. Gajalakshmi *et al.* (19) screened the potential of epigeic species (*Eudrilus eugeniae* and *P. excavatus*) and anecic species (*Lampito mauritii* and *Drawida willsi*) in vermicomposting of water hyacinth and reported *E. eugeniae* as relatively efficient in the recycling of water hyacinth and further concluded that precomposted weed forms were the mostly favored as feed by *E. eugeniae* (20). Deka *et al.* (21) vermicomposted water hyacinth by using *Eisenia fetida* and reported increase in macro and micro nutrients of the final product besides reduction in time taken for maturation of the compost. Kaniuczak *et al.* (22) reported increase in nitrogen, calcium, magnesium and sodium with good granular structure of vermicompost in pots with *Lemna minor* and *E. fetida* as compared to control without earthworms. Girijia *et al.* (23) on vermicomposting of *Salvinia molesta* and *E. crassipes* with *E. fetida* state that the vermicompost becomes ready for use within 40-45 days.

Gupta *et al.* (24) vermicomposed water hyacinth using *E. fetida*, reported its effective conversion when water hyacinth was mixed with 25% of cow dung (dry weight). Kostecka and Kaniuczak (25) vermicomposted *Lemna minor* (Duck weed) in small containers using *E. fetida* and recorded increase in earthworm number and biomass in containers with duckweed and manure dung than in containers with pure duckweed. According to Sannigrahi (26) noxious aquatic weeds- water lettuce (*Pistia stratiotes*), water hyacinth (*E. crassipes*) and cattail (*Typha angustata*) could be managed beneficially by converting them into good quality vermicompost within 2 to 3 months using *P. excavates*. Chauhan and Joshi (27) vermicomposted noxious weed-water hyacinth (*E. crassipes*) by using *E. fetida* and results showed an increase in NPK and decrease in carbon and carbon:nitrogen ratio in the

vermicompost as compared to control. Najar and Khan (28) recorded increased growth and reproduction in *E. fetida* while feeding on of *Azolla* sp. and confirmed that vermi based technology could be an effective to convert the menace of *Azolla* sp. into a value-added product-vermicompost. Zirbes *et al.* (29) conducted experiment on the feasibility of water hyacinth (*E. crassipes*) mixed with pig manure in varied proportions using *P. excavates* and concluded that *E. crassipes* could be potential raw material in earthworm based composting and biofertilizing if blended with 75% pig manure. Patil *et al.* (30) vermicomposted water hyacinth into vermicompost with poultry litter as supplement in a rotary drum reactor, using *E. fetida* and reported that conversion process completed in 45 days which is almost half the time taken by conventional methods (wedge method, bed and bin method) for management/conversion of water hyacinth. Najar and Khan (4) evaluated the potential of three earthworm species (*Aporrectodea rosea rosea*, *A. caliginosa trapezoides* and *E. fetida*) in management of fresh water weeds and recorded higher recycling potential in *E. fetida* among the three species based on the percent recycling of weed and physiochemical characteristics of final product. Gandhi and Sundari (31) vermicomposted *Azolla* sp. and *Eichhornia* sp. by using earthworms (*E. eugeniae*) and studied the effect of vermicompost on growth and yield of egg plant.

Kannadasan *et al.* (32) confirmed sustainable worm based conversion of *E. crassipes*, using *E. eugeniae* and *E. fetida* and concluded that the compost was rich in prime plant nutrients. Najar and Khan (14) studied the potential of *E. fetida* to manage/recycle the different macrophytes in different combinations during two months experimentation and concluded that nature of weed affect *E. fetida* in terms of growth and reproduction, which in turn determines its recycling rate as ascertained by principal component analysis (PCA). Umavathi *et al.* (33) studied the vermicompost from the aquatic weed *E. crassipes* by employing the earthworm *E. eugeniae* and concluded that nutrients content of *E. crassipes* digested vermicompost were enhanced by the earthworm's digestive enzymes and gut microbes. Mishra *et al.* (34) confirmed the conversion of aquatic weeds- *Azolla microphylla*, *Pistia stratiotes*, *Salvinia cucullata* and *Salvinia molesta* with cow dung, using *P. excavatus* into vermicompost, thus considered vermitechnology as effective and ecofriendly technology for sustainable agriculture. Bernal *et al.* (35) worked on the conversion of water hyacinth using *E. fetida* and concluded that vermicomposting is suitable for managing water hyacinth as it produced a stable and mature product (vermicompost), rich in plant nutrients and thus can be used as organic fertilizer or soil improver.

Nutrient status of vermicompost

Vermicompost is made of C, H, O and contains nutrients such as NO₃, PO₄, Ca, K, Mg, S and other micro-nutrients which exhibit similar effects on plant growth and yield as inorganic fertilizers applied to soil (36). Similarly, vermicompost contains a high proportion of humic substances (humic acids, fulvic acids and humin) which provide numerous sites for chemical reaction known to enhance plant growth and disease suppression (37). Munroe (38) reported presence of chitinase enzyme in vermicast which breaks down the chitin in the exoskeleton of insects and thus repels different insect pests.

Application of vermicompost

There is accumulating scientific evidence that vermicompost can influence the growth and productivity of crops significantly. Different studies have confirmed the positive effects of vermicompost on a wide variety of crops including cereal and legumes (39), vegetables (40,41), ornamental and flowering plants (42,43) and field crops (15,16,44,45,46,47,48).

Conclusion

Vermicomposting is non-thermophilic degradation of organic wastes by the action of earthworms. Vermicomposting of aquatic weeds not only helps in controlling the menace of aquatic weeds but at the same time it helps in control of eutrophication of aquatic systems as well, as they removes large quantities of nitrogen and phosphorous from water. Large scale utilization of aquatic weeds for vermicomposting helps in keeping water bodies free from excess weeds, which in turn improves their aesthetics. Thus vermicomposting is efficient method to convert aquatic weeds into vermicompost- a valuable eco-product for sustainable agriculture.

Acknowledgements

I sincerely thank Dr. Anisa B. Khan and Abdul Hai for their guidance.

Competing interests

The author declare that he has no competing interests.

References

- Bianchini J I, Cunha-Santino M B, Milan J A M, Rodrigues C J, Dias J H P. Growth of *Hydrilla verticillata* (L.f.) Royle under controlled conditions. *Hydrobiologia*. 2010;644:301-312.
- Ishtiyag A N, Anisa B K, Abdul H. Evaluation of seasonal variability in surface water quality of Shallow Valley Lake, Kashmir, India, using multivariate statistical techniques. *Pollut*. 2017; 3(3): 349-362. doi:10.7508/pj.2017.03. 001.
- Najar I A, Khan A B. Earthworm communities of Kashmir Valley, J&K, India. *Trop Ecol*. 2011a; 52(2):151-162.
- Najar I A, Khan A B. Vermicomposting of fresh water weeds (macrophytes by *Eisenia fetida* (Savigny, 1826), *Aporrectodea caliginosa trapezoides* (Duges, 1828) and *Aporrectodea rosea rosea* (Savigny. *Dyn Soil Dyn Plant*. 2012a; 6(S1):73-77.
- Najar I A, Khan A B. Assessment of water quality and identification of pollution sources of three lakes in Kashmir, India, using multivariate analysis. *Environ Earth Sci*. 2012b;66(8): 2367-2378. doi: 10.1007/s12665-011-1458-1.
- Najar I A. Studies on earthworm communities of Kashmir Valley, their application in management of fresh water weeds (macrophytes) and use of vermicompost in horticulture. *Ph.D thesis, Pondicherry University*. 2012.
- Smith R G, McSwiney C P, Grandy A S, Suwanwaree P, Snider R M, Robertson G P. Diversity and abundance of earthworms across an agricultural land-use intensity gradient. *Soil and Tillage Res*. 2008; 100: 83-88.
- Najar I A, Khan A B. Assessment of pollution status of Khushalsar Lake, Kashmir, India using multivariate statistical techniques. *Pollut Res*. 2011b; 30(2):131-136.
- Najar I A, Khan A B. Factors affecting distribution of earthworms in Kashmir Valley: a multivariate statistical approach. *Proc Zool Soc*. 2014; 67(2):126-135. doi:10.1007/s12595-013- 0081-4.
- Ernst G, Emmerling C. Impact of five different tillage systems on soil organic carbon content and the density, biomass, and community composition of earthworms after a ten year period. *Eur J Soil Biol*. 2009; 45: 247-251.
- Jouquet P, Plumere T, Thu T D, Rumpel C, Duc T T, Orange D. The rehabilitation of tropical soils using compost and vermicompost is affected by the presence of endogeic earthworms. *Appl Soil Ecol*. 2010; 46: 125-133.
- Dominguez J, Aira M, Gomez-Brandon M. The role of earthworms on the decomposition of organic matter and nutrient cycling. *Ecosistemas*. 2009; 18(2): 20-31.
- Najar I A, Khan A B. Management of fresh water weeds (macrophytes) by vermicomposting using *Eisenia fetida*. *Environ Sci Pollut Res*. 2013a; 20:6406-6417. doi: 10.1007/s11356-013-1687-9
- Kizilkaya R, Karaca A, Turgay OC, Cetin S C. Earthworm interactions with soil enzymes. In *Biology of earthworms*, ed. A. Karaca. Berlin: Springer; 2011.
- Najar IA, Khan A B. Effect of vermicompost on growth and productivity of tomato (*Lycopersicon esculentum*) under field conditions. *Acta Biol Malaysiana*. 2013b; 2(1):12-21.
- Najar I A, Khan A B, Abdul H. Effect of macrophyte vermicompost on growth and productivity of brinjal (*Solanum melongena*) under field conditions. *Int J Recycl Org Waste Agricult*. 2015; 4(2):73-83. doi: 10.1007/s40093-015-0087-1.
- Chauduri P, Pal T K, Bhattacharjee G, Dey S K. Nutrients changes during vermicomposting by *Perionyx excavatus* of the aquatic weed *Trapa bispinosa*. *Philipp J Sci*. 2001; 130(2):127-133.

18. Sannigrahi A k, Chakraborty S, Borah B C. Large scale Utilization of Water Hyacinth (*Eichhornia crassipes*) as raw material for vermicomposting and surface mulching in vegetable cultivation. *Ecol Environ Conserv*. 2002; 8(3): 269-271.
19. Gajalakshmi S A, Ramasamy E V, Abbasi S A. Potential of two epigeic and two anecic earthworm species in vermicomposting of water hyacinth. *Biores Technol*. 2001; 76:177-181.
20. Gajalakshmi S A, Ramasamy E V, Abbasi S A. Vermicomposting of different forms of water hyacinth by the earthworm *Eudrilus eugeniae*, Kinberg. *Biores Technol*. 2002; 82:165-169.
21. Deka P K, Paul S K, Bora H A. Vermitechnology for economic use and control of water hyacinth. *Pollut Res*. 2003; 22(3): 385-387.
22. Kaniuczak J, Kostecka J, Nowak M, Paczka G. Changes in chosen characteristics and macronutrient contents of the substrate with duckweed subjected to vermicomposting. *Zeszyty Problemowe Postepow Nauk Rolniczych*. 2004; 49(8):95-102.
23. Girijia T, Shama P K, Abraham C T. Vermicomposting of aquatic weeds. *Indian. J Aquatic Weed Sci*. 2005; 37(1/2):155-156.
24. Gupta R, Mutiyar P K, Rawat N K, Saini M S, Garg V K. Development of a water hyacinth based vermireactor using an epigeic earthworm *Eisenia fetida*. *Biores Technol*. 2007; 98(13):2605-2610.
25. Kostecka J, Kaniuczak J. Vermicomposting of duckweed (*Lemna minor* L.) biomass by *Eisenia fetida*. *J Elementol*. 2008; 13(4):571-579.
26. Sannigrahi A K. Management of some aquatic weeds through vermicomposting. *Indian J Environ Prot*. 2009; 29(9): 809-811.
27. Chauhan A, Joshi P C. Composting of Some Dangerous and Toxic Weeds Using *Eisenia fetida*. *J Am Sci*. 2010; 6(3).
28. Najar I A, Khan A B. Vermicomposting of *Azolla pinnata* by using earthworm *Eisenia fetida*. *The Bioscan*. 2010; 5(2):239-241.
29. Zirbes L, Renard Q, Dufey J, Tu P K, Duyet H N, Lebailly P, Francis F, Haubruge E. Valorisation of a water hyacinth in vermicomposting using an epigeic earthworm *Perionyx excavatus* in Central Vietnam. *Biotechnol Agron Soc Environ*. 2011; 15(1): 85-93.
30. Patil J H, Sanil P H, Malini B M, Manoj V, Deepika D, Chaitra D. *J Chem Pharm Res*. 2012; 4(5):2585-2589.
31. Gandhi A, Sundari U S. Effect of vermicompost prepared from aquatic weeds on growth and yield of eggplant (*Solanum melongena* L.). *J Biofertil Biopestici*. 2012; 3(5):128. doi:10.4172/2155-6202.1000128.
32. Kannadasan N, Natarajan N, Anbusaravanan N, Sekar P, Krishnamoorthy R. Assessment of sustainable vermicomposting of water hyacinth by *Eudrilus eugeniae* and *Eisenia fetida*. *J Appl Nat Sci*. 2013; 5(2):451-454.
33. Umavathi S, Mathivanan R, Thangam Y, Revathi S. Effect of *Eudrilus eugeniae* in vermibioconversion of *Eichhornia crassipes* (Martius) Solms-Laubach. *Environ Res Int*. 2015; 1:10-17.
34. Mishra M, Mohapatra A, Satapathy K B. A comparative study of vermicompost prepared from phytoremediated and naturally grown aquatic weeds on growth and yield of green gram [*Vigna radiata* (L.) Wilczek]. *Int J Curr Res Biosci Plant Biol*. 2016; 3(7):104-109.
35. Bernal DA, Hernandez M A L, Osben H R B, Ramos S M C, Mora M. Vermicompost as an alternative of management for water hyacinth. *Rev Int Contam Ambie*. 2016; 32 (4): 425-433. doi: 10.20937/RICA.2016.32.04.06.
36. Singh R, Sarma R, Satyendra K, Gupta R, Patil R. Vermicompost substitution influences growth, physiological disorders, fruit yield and quality of strawberry (*Fragaria xananassa* (Duch.). *Bioresour. Technol*. 2008; 99: 8502-8511.
37. Theunissen J, Ndakidemi P A and Laubscher C P. Potential of vermicompost produced from plant waste on the growth and nutrient status in vegetable production. *Int. J. Phy. Sci*. 2010; 5(13):1964-1973.
38. Munroe G. Manual of On-farm Vermicomposting and Vermiculture. *Publication of Organic Agriculture Centre of Canada, Nova Scotia*. 2007; 39p.
39. Souzaa M E P, Carvalho A M X, Deliberali D C, Juckscha I, Brown G G, Mendonc E S, Cardoso I M. Vermicomposting with rock powder increases plant growth. *Appl. Soil. Ecol*. 2013; 69:56-60.
40. Doan T T, Ngo P T, Rumpe C, Nguyen B N, Jouquet P. Interactions between compost, vermicompost and earthworms influence plant growth and yield: a one-year greenhouse experiment. *Sci Horti*. 2013; 160:148-154.
41. Atiyeh R M, Arancon N Q, Edwards C A, Metzger J D. Influence of earthworm-processed pig manure on the growth and yield of greenhouse tomatoes. *Bioresour. Technol*. 2000a; 75:175-180.
42. Edwards CA, Burrows I. The potential of earthworm compost as plant growth media. In: Edwards CA, Neuhauser (eds) *Earthworms in environmental and waste management*. *SPB Academic Publishers. The Netherlands*. 1988; 211-220.
43. Atiyeh RM, Dominguez J, Subler S, Edwards CA. Changes in biochemical properties of cow manure during processing by earthworms (*Eisenia andrei*, Bouche) and the effects on seedling growth. *Pedobiologia*. 2000b; 44:709-724.
44. Wu Y, Zhang N, Wang J, Sun Z. An integrated crop vermiculture system for treating organic waste on fields. *Eur. J. Soil Biol*. 2012; 51:8-14.
45. Rajeev S, Dwivedi H S, Dwivedi P. Utilization of three obnoxious weeds (*Parthenium hysterophorus*, *Lantana camara* and *Eichhornia crassipes*) through vermicomposting and their response on vegetative growth of Soybean crop. *Int. J. Adv. Res. Biol. Sci*. 2016; 3(9):13-20.
46. Khan V M, Ahamad A, Yadav BL, Irfan M. Effect of Vermicompost and Biofertilizers on Yield Attributes and Nutrient Content and it's their Uptake of Cowpea [*Vigna unguiculata* (L.)Walp.]. *Int. J.Curr.Microbiol. App. Sci*. 2017; 6(6): 1045-1050.
47. Sahoo H R, Gupta N. Of Vermicompost In Enhancing Growth And Development Of Piper Longum- A Ret Medicinal Plant. *Sci. Agri*. 2017; 17 (3): 77-81.
48. Roychowdhury D, Mondal S, Banerjee S K. The Effect of Biofertilizers and the Effect of Vermicompost on the Cultivation and Productivity of Maize - A Review. *Adv. Crop. Sci. Tech*. 2017;5:261. doi: 10.4172/2329-8863.1000261.

