Bio Bulletin 4(1): 43-47(2018)
(Published by Research Trend, Website: www.biobulletin.com)

ISSN NO. (Print): 2454-7913
ISSN NO. (Online): 2454-7921

Microfungi isolated from Water hyacinth (*Eichhornia crassipes*) compost

SK Jha and LB Thapa
Central Department of Botany,
Tribhuvan University, Kirtipur, Kathmandu, Nepal

(Corresponding author: SK Jha)
(Published by Research Trend, Website: www.biobulletin.com)
(Received 15 March 2018; Accepted 29 May 2018)

ABSTRACT: Water hyacinth is considered as the worst invasive alien plant. One of the methods to control and manage this species is utilization in the form of compost. The aim of this study was to isolate microfungi involved in decomposition of Water hyacinth. Compost was prepared using mixture of Water hyacinth and garden soil. Fungi in the compost were cultured, isolated and identified. A total of 10 species of fungi were identified from the genera *Aspergillus*, *Fusarium*, *Trichoderma*, *Mucor*, *Penicillium* and *Verticillum. Trichoderma* was the most frequent genus among the fungi species identified. It indicates that these fungi are the important decomposers involved in the Water hyacinth composting activity. Application of these fungi could enhance the compost quality and the utilization of Water hyacinth as compost would be one of the economically feasible method of controlling and management further infestation of this invasive weed.

Key words: Invasive weed, soil fungi, organic compost, nutrient quality

How to cite this article: Jha S.K. and Thapa L.B. (2018). Microfungi isolated from Water hyacinth (*Eichhornia crassipes*) compost. *Bio Bulletin,* **4**(1): 43-47.

INTRODUCTION

Fungi play very important role in ecosystem processes by regulating nutrient cycling and energy flows. The fungi as saprophytes convert organic matters into inorganic nutrients and as the mutualists they make a close association to plants and provide various nutrients (Morris and Robertson, 2005). Many of the soil fungi grow successfully on various types of substrates and help to decompose organic matters to beneficial inorganic nutrients (Fuchs, 2010).

Ligninolytic and Cellulolytic enzymes produced by fungi help in hydrolysis of cellulose (Novotný *et al.,* 2004; Gao *et al.,* 2008). Fungal activities and lignocellulosic materials of plants to be decomposed are the factors required for good quality composting (Hubbe *et al.,* 2010). It has been suggested that the fungal enhanced compost increase water holding capacity and balance the C:N ratios (Hart *et al.,* 2002; Sivaramanan, 2014). Addition of materials containing microorganisms such as fungi, bacteria and other microbes shortens the composting period (Mishra and Nain, 2013).

Infestation of invasive alien plants and their impacts to biodiversity has becoming a serious issue worldwide. As the invasive alien plants are impacting ecosystem functioning, soil characteristics and native species negatively (Tiwari *et al.,* 2005; Thapa *et al.,* 2015), various alternative ways of their control and management has become the matters of discussions. Use of invasive plants for bio-fertilizers can be one of the controlling measures. In additions, application of appropriate microbes should be given importance to enhance composting process and increase compost quality.

The Water hyacinth, *Eichhornia crassipes* (Mart.) Solms, a fast growing, native to South America, is an invasive plant species in many countries and it is included in 100 of the world's worst invasive species (Lowe *et al.,* 2000). It has become highly problematic in its invaded ranges as it block water ways, affect swimming; fishing and other aquatic life by preventing sunlight or oxygen from reaching the water column (Lowe *et al.,* 2000; Tiwari *et al.,* 2005; Patel, 2012). Controlling and management of this weed has become difficult because it has high capability of fast growing and spreading in aquatic ecosystems (Akter and Zuberi, 2009; Jafari 2010).

Previous studies show that compost of Water hyacinth is good for high yield and growth for many plants (Jarafi, 2010; Osoro, *et al.* 2014; Calvert, 2002). In additions, application of fungi such as *Trichoderma* in Water hyacinth compost has been proved useful for shortening the duration of composting and nutrition quality (Ghosh, 2010). We aimed to list out the fungi involved in composting process of Water hyacinth so that they can be characterized for their ability to enhance composting process.

MATERIALS AND METHODS

A. Compost preparation

Watery hyacinth was collected from Phewa Lake, Pokhara, Nepal in October 2016. The plant was washed thoroughly to remove dirt and dust on them. It was dried for 3 days at room temperature and chopped into 2-4 cm pieces. The chopped plant materials were mixed with sieved garden soil in a ratio 3:1. The mixture was left for composting for 30 days. There were three replications, each having 800 g mixtures.

B. Fungi isolation

Soil plate method was used for fungal colony observation and isolation (Warcup, 1950). About 0.005 to 0.015 gm. of compost was transferred to a sterile Petri dish and 10 ml. of cooled Czapek-Dox medium was added. From each replication of the compost a total nine plates were prepared. The criteria used for identification process was the colony characters and microscopic morphological details of the fungi (Watanabe, 2002). The experiment was conducted at Central Department of Botany, Tribhuvan Unviersity, Kirtipur, Nepal.

C. Data analysis

Relative frequency of fungi occurring on the plates was calculated by dividing frequency of each fungus by total frequency and was multiplied by 100. The frequencies of isolated species were compared using Kruskal-Wallis Test as the data were not normal.

RESULTS AND DISCUSSION

The fungi isolated from the control treatment were *Aspergillus*, *Fusarium*, *Trichoderma*, *Mucor*, *Penicillium* and *Verticillum*. *Aspergillus* was the largest genus with representation of 4 species (*A. niger, A. nidulans, A. tereus* and *A. flavus*) (Table 1). The most occurring fungus was *Trichoderma* (relative frequency 20%) followed by *A. flavus, A. nidulans* and *F. oxysporum* species (relative frequency 16%) (Table 1). Relative frequency of *A. niger* and *Mucor* sp. was lower than *Trichoderma, A. flavus, A. nidulans* and *A. oxysporum* but the frequency was 50% higher than the frequency of other four species *A. tereus, Penicillium sp., Helminthosporium sp.* and *Verticillium* sp. (Table 1).

Table 1: List of fungi isolated and their relative frequency.

S.No.	Name of species	Relative Frequency ±SE*
1	*Trichoderma sp.*	20±1.32
2	*Aspergillus flavus*	16±0.37
3	*Aspergillus nidulans*	16±0.79
4	*Fusarium oxysporum*	16±0.82
5	*Aspergillus niger*	8±0.62
6	*Mucor sp.*	8±0.44
7	*Aspergillus tereus*	4±0.60
8	*Penicillium sp.*	4±0.49
9	*Helminthosporium sp.*	4±0.50
10	*Verticillium sp.*	4±0.64
**SE; Standard Error*		

The frequency of isolated species was significantly different (Kruskal Wallis Test, P<0.001).

The fungi *Aspergillus* and *Trichoderma* are considered as potentially cellulose degrading micro-fungi (Sharma and Ramendra, 2015). Presences of other species like *Fusarium, Penicillium* and *Verticillium* may also contribute in the degrading activity and mineralization of plant biomass into inorganic nutrients. Decomposition of cell wall polysaccharides in the plant materials is carried out by fungal innate properties of secreting enzymes such as cellulases, hemicellulases, polysaccharide lysases and carbohydrate esterases (Perez *et al.,* 2002; Himmel *et al.,* 2010). Fungi isolated from the mixture of Water hyacinth and soil may contribute for enhancement of composting process and compost quality.

Aspergillus, *Trichoderma*, *Mucor* and *Penicillium* species were also isolated from various types of composts using potato peel, sugarcane waste and tree bark by Ashraf *et al.* (2007). Three species of *Aspergillus* i.e. *Aspergillus flavus*, *Aspergillus nidulans* and *Aspergillus terreus* were also contributing species in steamed mushroom compost (Kleyn and Wetzler, 1981). These species are described as the capable species of degrading starch, fat, oil and proteins and hence they can play a significant role in nutrient cycling in ecosystem (Bennett, 2010). The genus *Aspergillus, Trichoderma* and *Penecillium* are the cellulytic fungi which accelerate composting by reducing the composting period (Neklyudov *et al.* 2008).

Another species *Trichoderma* is free-living fungi commonly found in soil and is popular in organic farming. This fungus is found *effective to* increase N, P, K, S content in the composting (Sharma *et al.,* 2012). In addition to role of *Trichoderma* in composting its ability to produce metabolites that inhibit the growth of pathogenic fungi such as *Sclerotium rolfsii* have been highlighted by number of studies (e.g. Lopez *et al.,* 2015). In addition to *Trichoderma, Penicillium* and *Fusarium* species are included in degrader fungi of cellulose, lignin and chitin of litters (Kjøller and Struwe, 2002). Compost prepared from kitchen wastes using *Trichoderma* has been proposed as bio-fertilizer for improvement in yield and quality of tomato (Molla *et al.,* 2012). Therefore, this species can be used as a candidate to promote composting of Water hyacinth.

Mucor is one of the abundantly present species in different kind of substrates including soil. *Mucor* with *Trichoderma* and *Penicillium* was found effective in composting for high nutrient content in relation to NPK (Mubyana and Korentajer, 2002). Presence of *Muror* in this study with *Aspergillus* and *Penecillium* in the composting materials supports findings of Lee *et al.* (1994).

Water hyacinth has been creating great environmental and economic problems in wetlands of the world. It has been colonized throughout Nepal and becoming as one of the noxious weed in the country. Its control and management is a challenging issue to the environmental managers. As an alternative way of management preparation of compost of Water hyacinth has become popular activities (Kafle *et al.,* 2009). *T*he compost prepared from *Water hyacinth* is considered as good quality compost and therefore it is suggested that recycling of this species by this method is an ecofriendly management strategy (Balasubramanian *et al.,* 2013).

CONCLUSIONS

Aspergillus, *Fusarium*, *Trichoderma*, *Mucor*, *Penicillium* and *Verticillum* are the species responsible for decomposition of Water hyacinth. Application of these fungi for composting would enhance compost quality and shorten the duration of composting from Water hyacinth. Further studies on compost quality of Water hyacinth are recommended. Use of Water hyacinth as fertilizer would be economically feasible method of its controlling and management in aquatic ecosystems.

ACKNOWLEDGEMENT

Authors would like to acknowledge Professor emeritus Dr. Pramod Kumar Jha, former head of Central Department of Botany, Tribhuvan University (CDB-TU), Kirtipur, Kathmandu, Nepal; Prof. Dr. Mohan Siwakoti, Head of CDB-TU and Dr. Jayakant Raut for their support.

REFERENCES

Akter, A. and Zuberi, M. I., 2009. Invasive alien species in Northern Bangladesh: identification, inventory and impacts. *International journal of biodiversity and conservation*, **1**(5): 129-134.

Ashraf, R., Shahid, F. and Ali, T. A. 2007. Association of fungi, bacteria and actinomycetes with different composts. *Pakistan Journal of Botany*, **39**(6): 2141-2151.

Balasubramanian, D., Arunachalam, K., Arunachalam, A. and Das, A. K. 2013. Water hyacinth [*Eichhornia crassipes* (Mart.) Solms.] engineered soil nutrient availability in a low-land rain-fed rice farming system of north-east India. *Ecological engineering*, **58**: 3-12.

Bennett, J. W. 2010. An overview of the genus *Aspergillus*. In: *Aspergillus:* molecular biology and genomics (Eds. Machida, M and Gomi, K). Caister Academic Press, Norfolk, UK. p 1-17.

Calvert, P. 2002. Water Hyacinth Control and Possible Uses. Technical Brief. International Technology Development Center, United Kingdom.

Neklyudov, A. D., Fedotov, G. N. and Ivankin, A. N. 2008. Intensification of composting processes by aerobic microorganisms: A review. *Applied biochemistry and microbiology,* **44**(1): 6-18.

Fuchs, J. G. 2010. Interactions between beneficial and harmful micro-organisms: from the composting process to compost application. In: Microbes at work. From wastes to resources (Eds. Insam H, Franke-Whittle IH, Goberna M). Springer, Heidelberg, pp 213–230

Gao, J., Weng, H., Zhu, D., Yuan, M., Guan, F. and Xi, Y. 2008. Production and characterization of cellulolytic enzymes from the thermoacidophilic fungal *Aspergillus terreus* M11 under solid-state cultivation of corn stover. *Bioresource Technology*, **99**(16): 7623-7629.

Ghosh, D. 2010. Water hyacinth, befriending the noxious weed. *Science Reporter*, **47**(12): 46–48.

Hart, T. D., De Leij, F. A. A. M., Kinsey, G., Kelley, J. and Lynch, J. M. 2002. Strategies for the isolation of cellulolytic fungi for composting of wheat straw. *World Journal of Microbiology and Biotechnology,* **18**(5): 471–480.

Himmel, M. E., Xu, Q., Luo, Y., Ding, S. Y., Lamed, R. and Bayer, E. A. 2010. Microbial enzyme systems for biomass conversion: Emerging paradigms. *Biofuels*, **1**(2): 323–341.

Hubbe, M. A., Nazhad, M. and Sánchez, C. 2010. Composting as a way to convert cellulosic biomass and organic waste into high-value soil amendments: A review. *BioResources*, **5**(4): 2808-2854.

Jafari, N. 2010. Ecological and socio-economic utilization of water hyacinth (*Eichhornia crassipes* Mart Solms). *Journal of Applied Sciences and Environmental Management*, **90***:* 43–49.

Kafle, M. R., Kafle, G., Balla, M. K. and Dhakal, L. 2009. Results of an experiment of preparing compost from invasive water hyacinth (*Eichhornia cras*sipes) in Rupa lake area, Nepal. *Journal of Wetlands Ecology*, **2**(1): 17-19.

Kjøller, A. H. and Struwe, S. 2002. Fungal communities, succession, enzymes, and decomposition. In: Enzymes in the Environment: activity, ecology and applications, (Eds. Richard GB and Richard PD). CRC Press, Vol. **1**: 267-284

Kleyn, J. G. and Wetzler, T. F. 1981. The microbiology of spent mushroom compost and its dust. *Canadian journal of microbiology,* **27**(8): 748-753.

Lee, Y., Joo, W. H. and Seo, J. Y. 1994. Decentralized composting of garbage in a small composter for dwelling house II. Changes in microbial flora in laboratory composting of household garbage in a small Bin. *Korean Journal of Environmental Agriculture,* **13**(3): 338-345.

Lopez, L. L. M. A., Reyes, R. G. and Alvindia, D. G. 2015. Evaluation of two species of Trichoderma as compost activator and bio-control agents. *Journal of Agricultural Technology.* **11**(2): 525-537

Lowe, S., Browne, M., Boudjelas, S. and De Poorter, M. 2000. 100 of the world's worst invasive alien species: a selection from the global invasive species database. Auckland: The Invasive Species Specialist Group (ISSG) a specialist group of the Species Survival Commission (SSC) of the World Conservation Union (IUCN), p 12.

Mishra, B. K. and Nain, L. 2013. Microbial activity during rice straw composting under co-inoculation of cellulomonas cellulans and *Phanerochaete chrysosporium*. *International Journal of ChemTech Research*, **5**(2): 795–801.

Molla, A. H., Haque, M. M., Haque, M. A. and Ilias, G. N. M. 2012. Trichoderma-enriched biofertilizer enhances production and nutritional quality of tomato (*Lycopersicon esculentum* Mill.) and minimizes NPK fertilizer use. *Agricultural Research*, **1**(3): 265-272.

Morris, S. J. and Robertson, G. P. 2005. Linking function between scales of resolution. In: The Fungal community: its organization and role in the ecosystem (Eds. Dighton J, White JF, Oudemans P). Taylor and Francis, Boca Raton, USA, pp 13-26.

Mubyana, T. and Korentajer, L. 2002. A comparative study of the nutrient status of household waste composted using different starters. *Journal of Tropical Microbiology Biotechnology*, **1**(1): 54-63.

Novotný, Č., Svobodová, K., Erbanová, P., Cajthaml, T., Kasinath, A., Lang, E. and Šašek, V. 2004. Ligninolytic fungi in bioremediation: extracellular enzyme production and degradation rate. *Soil Biology and Biochemistry*, **36**(10): 1545-1551.

Osoro, N. O., Kawaka, F., Naluyange, V., Ombori, O., Muoma, J. O., Amoding, A. and Maingi, J. M. 2014. Effects of water hyacinth (*Eichhornia crassipes* [Mart.] Solms.) compost on growth and yield of common beans (*Phaseolus vulgaris*) in Lake Victoria Basin. *European International Journal of Science and Technology*, **3**(7): 173–186.

Patel, S. 2012. Threats, management and envisaged utilizations of aquatic weed Eichhornia crassipes: an overview. *Reviews in Environmental Science and Bio/Technology*, **11**(3): 249-259.

Perez, J., Munoz-Dorado, J., de la Rubia, T. D. L. R. and Martinez, J. 2002. Biodegradation and biological treatments of cellulose, hemicellulose and lignin: An overview. *International Microbiology*, **5**(2): 53-63.

Sharma, B. L., Singh, S. P. and Sharma, M. L. 2012. Bio-degradation of crop residues by *Trichoderma* species vis-a vis nutrient quality of the prepared compost. *Sugar Tech*, **14**(2): 174-180.

Sharma, T. K. and Ramendra, S. 2015. Isolation, identification and screening of cellulose degrading microfungi from decomposed *Eichhornia crassipes*. *International Journal of Innovation Sciences and Research*, **4**(10): 509–512.

Sivaramanan, S. 2014. Isolation of cellulolytic fungi and their degradation on cellulosic agricultural wastes. *Journal of Academia and Industrial Research*, **2**(8): 458–463.

Tiwari, S., Adhikari, B., Siwakoti, M. and Subedi, K. 2005. An inventory and assessment of invasive alien plant species of Nepal. IUCN Nepal, Kathmandu, Nepal**.**

Thapa, L. B., Thapa, H. and Magar, B. G. 2015. Perception, trends and impacts of climate change in Kailali District, Far West Nepal. *International Journal of Environment*, **4**(4): 62-76.

Warcup, J. H. 1950. The soil-plate method for isolation of fungi from soil. *Nature,* **166**(4211): 117-118.

Watanabe, T. 2002. Pictorial Atlas of Soil and Seed Fungi: Morphologies of Cultured Fungi and Key to Species, Second edition, CRC Press, Florida.