Fungal Diversity of Vermicompost Produced from Municipal Solid Waste in National Thermal Power Corporation (NTPC) Barh, Bihar (India)

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Abstract

The present study has been carried out to investigate the fungal diversity from vermicompost generated from the major municipal biodegradable solid waste (fruits & vegetables) by using two common species of earthworm viz., Eisenia foetida and Eudrilus eugeniain National Thermal Power Corporation (NTPC), Barh, Bihar (India). Altogether 25 fungal species have been identifiedfrom the vermicompost among which rare (20%), occasional (21-40%), frequent (41-60%), common (61-80%) and dominant (81-100%) fungal species have been reported throughout the investigation.

Keywords: Vermicompost, Fungal diversity, NTPC, Barh, India

I. INTRODUCTION

The organic pollution is a challenging task for the growing cities with rich agricultural backgrounds. To resolve this problem an eco-friendly method of beedi leaf waste management was recommended to convert the waste biomass into bio-fertilizers using vermi - biotechnology [1]. Land pollution is the result of not only man's misuse but more due to solid waste disposal from the developed and developing countries. Generally solid wastes are dumped in oceans or open grounds. The industrial refuses contaminate the streams and lakes [2].

Vermiculture is a profitable technology with immense potential of application in many fields. Different species of earthworms can be used for recycling the biodegradable organic waste to produce a rich bio-fertilizer useful for agriculture, horticulture etc. It has been noted that the earthworms can also be used for pharmaceutical products [3], weed management [4], production of cheap animal protein [5], poultry waste [6], decomposition and production of organic fertilizers from plant litter [7,1,8], agro industrial waste [9], municipal solid waste [10].

Vermicomposting is an aerobic bioxidation process in which the waste organic matter is decomposed and fed to the earthworms which in turn produce the vermicasts rich in nutrients and microbial population [11].Studying fungal population observed that as many as 66 species found in compost including Aspergillus, Penicillium, Chladosporium etc. and considered them the most common composting materials because of their capacity to sustain higher temperature and degrade broad spectrum organic waste material[12].Earthworms are the important drivers of the process, conditioning the substrate and altering the biological activity although microbes responsible for biochemical degradation of the organic matter [13, 14]. Mychorizal fungi make phosphorus available to the plants easily. Certain microbes even detoxify pesticides too [15, 16].Therefore, in assessing the quality of vermicompost, it is most essential to view the microbial spectrum which survive in vermicompost or quit to play their role in the field. The fungal flora were isolated from different composition of cow dung and degradable materials i.e. vermicompost.

II. MATERIALS AND METHODS

Site description

The study area falls under the National Thermal Power Corporation (NTPC) is located in Barh in the Indian state of Bihar. NTPC Barh is located barely four kilometers east of the Barh sub-division on National Highway-31 in Patna district situated at 25^0 9'11.4" N,85^0 44'42'.6" E[17]. The project has been named a mega power project, and is owned by Indian energy company National Thermal Power Corporation.This power plant serves as a beneficiary for Bihar, UP and Uttrakhand states.

Figure 1: Location map of study area

III. METHODOLOGY

The biologically degradable and decomposable organic wastage such as animal dung, agricultural wastes, forestry wastes, city leaf litter, wastage paper and cotton cloth, city refuge etc have been used in vermiculture and vermicomposting. The collected solid waste was then classified based on its size (above and below 100 mm) by trammel. The materials which are above 100 mm materials are used for reuse / recycling purposes. Larger inert objects (plastic, metal and glass) in the sorted organic fraction municipal solid waste were removed by hand. Inorganic matter was below 100 mm was used for composting purposes as it contains most of the organic materials. Two most commonspecies of earthworm viz., Eisenia foetida and Eudrilus eugenia have been used for vermicomposting.

Fungal Analysis

Vermicompost samples were examined for fungal analysis. This was done by serial dilution plate technique in which possibly all the living propagules/spores grow and develop individual colony. For fungal growth Potato Dextrose Agar (PDA) medium along with 0.1 ml Streptomycin were used. The medium was poured in sterilized Petri-plates (1/4 of its volume) under aseptic condition in laminar air flow chamber. To get serial dilution about 1gm of soil was suspended in 9ml of sterilized distilled water (DW) to make the volume of suspension to 10ml. 1ml of suspension was transferred to additional flask containing 9ml DW, in this way suspension of 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6},10^{-7},10^{-8},10^{-9} and 10^{-10} were prepared separately[18]. Aliquots of 0.3ml (300µl) suspension were poured on the surface of PDA-medium. The plates were gently shaken to spread sample suspension uniformly and incubated in BOD - incubator at 25^0C±1 for 7 days. The fungi were isolated and identified on the basis of morphological characteristics and their identification was confirmed by following the "A Manual of Soil Fungi" [19].Details are given in the Table 7. The overall processes are carried outin Plant Pathology Laboratory, University Department of Botany, TMBU Bhagalpur Bihar (India).

IV. RESULTAND DISCUSSION

Microbial inhabitation in vermicompost is a natural phenomenon related with several beneficial effects on plant growth. The compatibility among all the micro flora is established in such a way that they develop an ecological niche. Perusal of results observed under the present investigations clearly indicates that the different vermicompost samples which are converted by earthworms into different casts have slight variation in microbial composition. Altogether 25 species of fungi were identified in different cast samples produced by Eisenia foetida (exogenous sp) and Perionyxex cavatus (indigenous sp.) which are depicted in the table-1and figure-2. Percentage occurrence has been calculated using the following formula.

% of occurrence = No. of individual species x 100 / Total no. of species

Different species of Aspergillus, Penicillium, Fusarium etc. were commonly recorded in different samples, however their % of occurrence was found to. Some of the fungi are of economic importance such as the species of Penicillium for Penicillin production, Trichoderma and Verticillium as bio-control agents, Cheatomiun as cellulose degrading agent, and Aspergillus and Penicillium acting as phosphate solubilizers.

The potentiality of vermicompost which has undisputed role in increasing soil humus, water holding capacity, nutrient composition and microbial flora, has been established in agriculture, horticulture and floriculture. In the recent years, the trend to switch over to eco- friendly organic farming and improvement in the soil fertility status are being widely adopted in developing countries as a replacement of chemical fertilizers. In the coming years it may an alternative of chemical fertilizer for sustainable agriculture.

Table: 1.Fungal diversity analysis of produced vermicompost during 2017-18

Sl. No.	Name of fungal species	Vermicompost samples									Percentage of occurrence (%)
		V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	
1	*Aspergillus fumigates*	−	+	+	+	-	-	+	+	+	D
2	*Aspergillus niger*	+	+	+	+	+	+	+	+	+	D
3	*Aspergillus sulphureus*	+	+	+	−	+	-	+	+	-	F
4	*Aspergillus terreus*	+	−	+	+	+	+	-	-	+	C
5	*Actinomycetes sp.*	−	+	+	−	+	+	+	-	+	C
6	*Aspergillus flavus*	+	+	+	+	+	+	+	+	+	D
7	*Chaetomium sp.*	−	+	+	−	+	-	+	+	-	F
8	*Choanophora sp.*	-	-	-	+	+	-	-	-	-	R
9	*Cladosporium sp*	-	-	-	-	+	+	-	-	-	O
10	*Fusarium oxysporum*	+	+	−	+	+	-	+	+	-	F
11	*Fusarium moniliforme*	–	+	+	+	+	+	+	+	+	C
12	*Gliocladium fimbriatum*	+	−	+	+	-	+	+	+	-	F
13	*Mucor mucedo*	−	−	−	+	+	+	-	+	+	F
14	*Penicillium notatum*	+	−	+	+	+	+	+	+	+	D
15	*Penicillium restrictum*	+	+	−	+	+	+	+	+	+	D
16	*Penicillium citrinum*	+	+	+	+	+	+	+	+	+	D
17	*Rhizopus stolonifer*	+	+	+	+	+	-	+	+	+	D
18	*Trichoderma viride*	−	−	+	−	-	-	+	+	+	O
19	*Verticillium cellulosae*	+	-	+	+	+	+	+	-	+	F
20	*Verticillium lateritium*	+	−	+	+	+	+	-	-	-	F
21	*Penicillium fuscum*	+	+	-	+	+	-	+	+	+	C
22	*Penicillium purpurascens*	+	+	+	+	-	+	+	+	-	F
23	*Penicillium spinulosum*	-	+	+	-	+	+	-	+	+	C
24	*Penicillium nigricans*	+	+	+	+	+	-	+	+	-	C
25	*Penicillium rugulosum*	+	+	+	-	+	+	+	+	+	C
Diversity of fungi		16	16	19	18	21	16	19	19	16	

+ = present, − = absent, R = rare (20%), O = occasional (21-40%), F = frequent, (41-60%), C = common (61-80%), D = dominant (81-100%)

Aspergillus and Penicillium spp were dominant (81-100%), and Choanophora sp were rare. Aspergillus fumigates, Aspergillus niger, Aspergillus flavus, Penicillium notatum

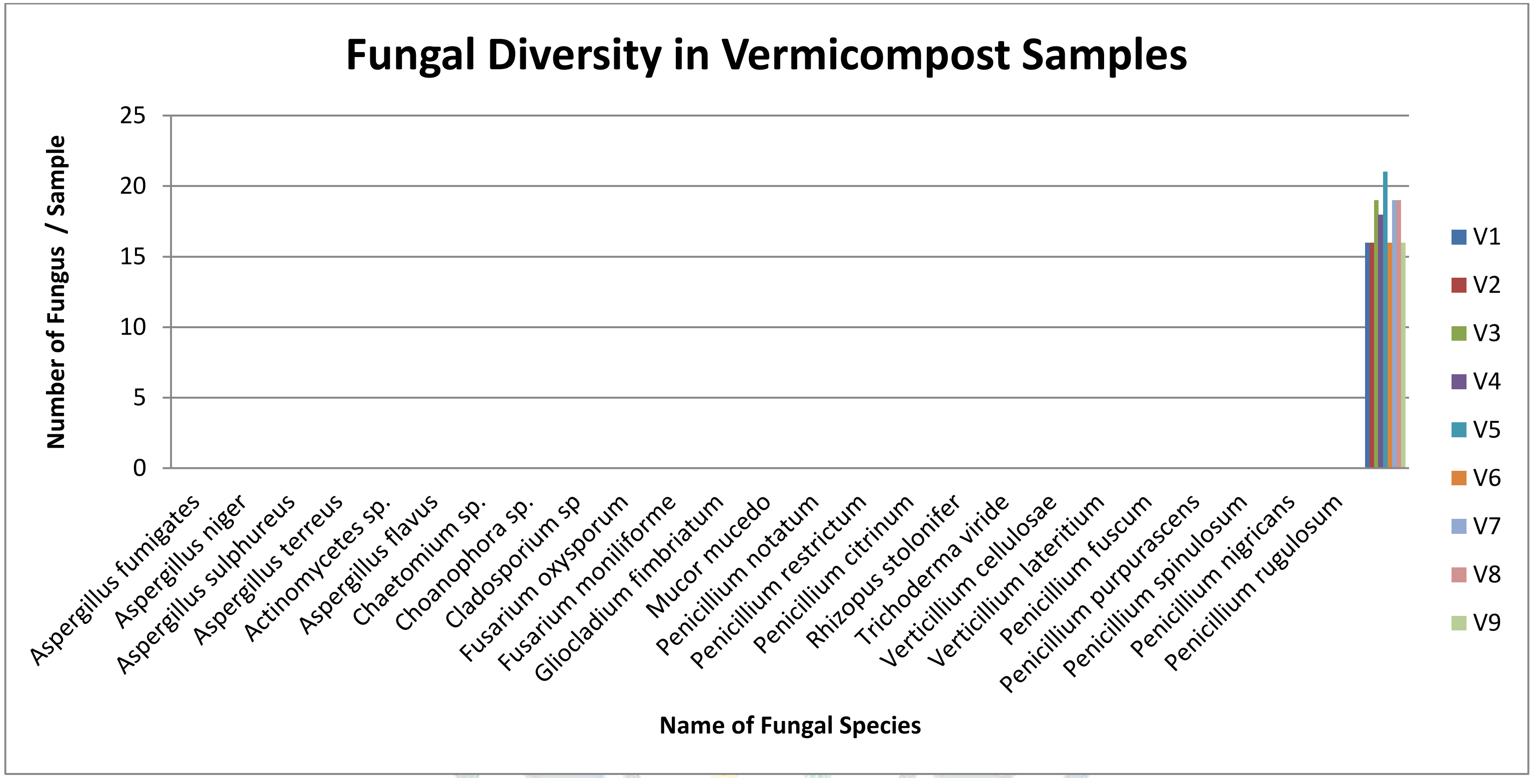

Figure-2: Fungal species reported from the vermicompost

V. CONCLUSION

The increase in the fungal population count from the vermicompost produced from municipal solid waste using both the common species of earthworm viz., Eisenia foetida and Eudrilus eugenia might have enhanced the biological activities of the cast. It is also stated that the fungal community in the vermicompost will promote the vermicomposting process and the metabolic potential would be dealt with the degree of organic matter degradation and stabilization.

VI. ACKNOWLEDEMENT

The authors are thankful to the University Department of Botany T. M. Bhagalpur University, Bhagalpur, Bihar (India) for providing laboratory facilities. We are also thankful to National Thermal Power Corporation (NTPC), Barh, Bihar (India) for the cooperation during the research.

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