Feasibility of Fungus Bioaugmentation in Sawdust Composting

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ABSTRACT

Interest in composting wood sawdust as a waste management technique has increase enormously in forest industry. In fact, decomposed wood sawdust constitutes a reliable growing media for nursery uses. However, due to its high lignin content, composting process of sawdust is rather slow as compared to other organic wastes. Therefore, in this study, the ability of selected ligninolytic fungus in accelerating composting rate was evaluated. From two-stage screening of lignin degrading ability, *Cerrena unicolor* was selected as inoculum for this sawdust composting trial. Comparative effects on physiochemical changes of inoculated sawdust and non-inoculated sawdust were evaluated within 3 months. The study showed that application of *C. unicolor* as inoculum gave a significant effect on composting rate. It was observed that the compost was ready to be used within 3 months. Maturity of compost was determined by germination test, nursery trial and physiochemical analysis.

Keywords: fungus, sawdust, compost.

INTRODUCTION

Sawdust is a source of organic matter that has been widely used in horticulture and soil amendments. There is an increasing interest of using sawdust for containerized seedlings by forest plantation industry in Sarawak, as this material is readily and easily obtained. Sawdust is known not only to improve the stability of soils, but also improves the water holding capacity of the media and allows for easier root penetration. However, the benefits of sawdust are only attained if sawdust is well-decomposed and the lignin has been converted to humus (Starbuck, 1994). Sawdust that is not well-decomposed will not only promoting nitrogen immobilization, but also contain other organic compounds that may be toxic to plants.

Naturally, sawdust decomposes at a very slow rate due to its lignin content. Lignin is a natural polymer of the cell wall that gives strength to wood. It is particularly recalcitrant to degradation and thus reduce the bioavailability of other cell wall constitute (cellulose and hemicelluloses). Therefore, lignin degradation represents an important step in total biological degradation of wood materials (Hernandez *et al.*, 1998).

Though there are natural microorganisms present in composting process, they may not be able to execute the desired degradation rate due to lack of specific enzymes for lignin degradation to optimum level (Kumar *et al.*, 2008). Nevertheless, white-rot basidiomycetes

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have been reported to develop the unique enzymes system for lignin biodegradation namely Lignin Peroxidase (LiP), Manganese Peroxidase (MnP) and Laccase (Kirk and Farrell, 1987). Therefore, extensive studies of white-rot basidiomycetes have demonstrated their ability to degrade a wide variety of contaminants as well as their potential application in bioremediation.

An experiment involved screening of potential ligninolytic white-rot Basidiomycete for bioaugmentation in sawdust composting was carried out previously (data not shown), which lead to selection of *C. unicolor* as inoculants in this study. The strain has showed remarkable results in decolorization of numbers of dyes used as well as sawdust lignin degradation study. With laccase is the major enzymes, it also expressed simultaneous production of the other two important ligninolytic enzymes in the basal media as described by D'Souza *et al.,* (1999) and also in sawdust lignin degradation test.

Looking at the high ligninolytic capabilities of *C. unicolor* in that previous works, the present study was undertaken to evaluate the feasibility of this fungus in accelerating composting rate. The experiment was carried out in pilot scale and the results are reported in this paper.

MATERIALS AND METHODS

Fungi

A ligninolytic white-rot fungus, *Cerrena unicolor* was used in this study. The strain was selected among 17 ligninolytic white-rot basidiomycetes in early two stages screening which involved dye decolorization test and sawdust lignin degradation experiment (data not shown). The strain is maintained on malt-extract agar (MEA) slant at 4^{o}C until further used.

Inoculum preparation

The strain was pre-grown on MEA plates at 25^{o}C for 10 days before four mycelium plugs were transferred into each of 200 ml malt extract broth. The cultures were incubated on rotary shaker (120 rpm) at room temperature for 10 days.

Composting of sawdust

A lab scale composting trial using *Neolamarckia cadamba* (Kelampayan) sawdust was carried out in Sarawak Forest Tree Seed Bank nursery. 7 L of fresh sawdust was filled in plastic tray and inoculated with *Cerrena unicolor* that previously grown in malt extract broth. 200 ml culture broth was first added at early experiment and second addition was done after 2 weeks.

The containers were covered with transparent plastic to maintain the heat of the decomposition as well as to minimize water evaporation. The experiment were done triplicates and placed in the nursery under uncontrolled environment with non-inoculated fungi served as control. 2 g kg^{-1} urea was added as nitrogen amendment in both inoculated and non-inoculated sawdust. Watering was done at regular interval to maintain the moisture content at about 60%. In the first two weeks, the samples were turned twice a week and subsequently once a week. After 3 months, the samples were collected from various part and depth for further maturity analysis.