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Can Production of Biocontrol Agent from Waste Biomass Maximize Waste Utilization?

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In the recent times, eco-friendly pest management for sustainable crop production has gained tremendous importance as a potential alternative to agrochemicals for controlling plant pathogens. This has eliminated the hazards of conventional chemical pesticides on the environment and non-target organisms and also slashed the production cost. This approach is being adapted world over and found to be highly compatible with sustainable agriculture and effective against array of soil borne plant pathogens. Biocontrol agents (BCAs), such as *Trichoderma* sp., *Pseudomonas* sp., *Bacillus thuringiensis* (Bt) and others play a major role in achieving the targets of Integrated Pest Management Programme (IPMP). However, for large scale production of BCAs, cost effective formulations is the major goal of IPMP. The issue has been well addressed by the use of different wastes (e.g. household waste, vegetable waste, sugarcane baggase, fruit juice wastes, winery wastes and waste from wastewater treatment plants) as substrates for the mass production of the BCAs. These wastes are otherwise a major concern of pollution and disposal as well.

Waste biomass conversion methodologies are most commonly designed either for the production of energy products, such as cordage, textiles, paper products, upholstery and packaging materials, animal feed, insulators and panel boards. However, these biomass conversion strategies always end with a huge amount of unwanted by-products (e.g. bio-solids) and disposal of it is a big deal in terms of the inputs of time, money and labor. In addition, spreading of the bio-solids into the open field area affects the soil fertility and biota as they might contain heavy metals and metallic nanoparticles. Thus, to gain a 'biomass to product (BM : P) ratio' value closer to one, it is highly desirable that the employed methodology sufficiently converts all the biomass into the targeted product. In this regard, production of BCAs from wastes of different origin has proven better efficiency in terms of biomass conversion ratio.

Many BCAs grown on the wastes as substrate fairly supported mass multiplication (mycelium or cells) and high spore yield (viable) as achieved with commercial media. Evaluation of in vitro potential of the BCAs metabolites against different plant pathogens has exhibited a high level of antagonistic activity towards a broad spectrum of phytopathogens as compared to chemical pesticides. Wastes rich in carbon and nitrogen sources are easily metabolized into body mass of BCAs and manipulation in the total carbon to nitrogen ratio (C : N) of the waste substrate can enhance the entomotocity as well. Microbial culture medium with a low C : N ratio generally favors high biomass yield and less metabolic pathways. However, with a high biomass yield obtained from a waste as substrate the total extractable metabolic product will still be higher due to the tendency of reaching the biomass to product conversion ratio closer to one. This also results in no or negligible amount of substrate residue not metabolized into BCAs biomass. Thus, for large scale production of BCAs, any waste biomass with a carbon source can be exploited instead of processing them into different energy or non-energy products that always ends with huge amount of unwanted hazardous/non-hazardous by-products. For both IPMP and waste management domains, waste biomass conversion into BCAs strongly supports economic and environmental aspects.

The underexplored scope of mass production of BCAs from waste biomass should be technically improvised further to develop it as the most cost effective methodology among the other contemporary waste biomass to value added product conversion strategies being adopted world over. Thus, the biocontrol agents certainly hold a high power when it comes to utilization of the complete biomass, for example, Trichoderma production using wastewater sludge can enhance utilization of three times concentrated wastewater sludge (at 1-2% solids concentration) from municipal wastewater treatment plants with all the produced biomass going to agricultural land. Biocontrol agents production maximize utilization of wastes with enhanced application and minimal sidestreams during production process.

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