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Investigating the Impact of Diverse Carbon Sources on the Growth of *Trichoderma asperellum* Isolates Derived from Pulse Rhizospheres in Odisha

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ABSTRACT: *Trichoderma* has emerged as a valuable biocontrol agent due to the detrimental effects of chemical fertilizers on the environment. These fungal communities play a critical role in combating agricultural diseases and have shown effective elimination of harmful fungi in approximately 90% of cases. The utilization of carbon and nitrogen patterns by heterotrophic organisms is essential for their sustenance, and the wide range of available substrates in nature contributes to biological diversity. This study aimed to investigate the impact of different carbon sources on the growth and sporulation of *Trichoderma asperellum* isolates (TAGJM, TANYG, TABLGR, TAPUR, TAKJR and TACTC) in liquid Richard's medium. Eight carbon sources were tested, and their utilization by the fungus was analyzed by adjusting their quantities to match the carbon content of sucrose in a constant C/N ratio. A control group without any carbon source was also included. The results demonstrated diverse utilization patterns across the tested isolates, with TAKJR exhibiting the highest mean dry biomass weight, followed by TANYG, while TAPUR and TACTC showed the lowest mean dry biomass weights. Mannitol emerged as the most favorable carbon source, recording the highest dry biomass weight, followed by sucrose and glucose. Lactose and starch exhibited the lowest dry biomass weights. Understanding the nutritional requirements of Trichoderma species and their response to growth and sporulation is crucial for supplementing media and enhancing mass production. Overall, this research provides insights into the ecological behavior and nutritional needs of *Trichoderma* spp., contributing to the development of sustainable agricultural practices and the efficient production of *Trichoderma* biomass.

Keywords: *Trichoderma asperellum*, Carbon source, Mannitol, Sucrose, biomass.

INTRODUCTION

Soil-borne plant diseases are a key cause of root rot disease complexes, which can kill plants and have a significant impact on the production of many important field and horticultural crops. Thus, soil-applied pesticides are not only expensive, but also pose environmental risks (Cook and Baker 1983; Saleem *et al.*, 2000; El-Katatny *et al.*, 2000). In a perfect world, diseases of plants would be prevented by cultivating crops with resistance to those that cause them. Instead of using harmful pesticides, we might save the environment by employing microbial antagonists for the biological management of plant diseases (Larena *et al.*, 2002; Harman *et al.*, 2004).

In recent years, *Trichoderma* has gained recognition as a biocontrol agent thanks to the growing awareness of the environmental damage caused by chemical fertilisers. These fungal communities play a crucial role in preventing the spread of diseases that threaten agricultural yields (Patil *et al.*, 2021). It has been observed that using several *Trichoderma* strains effectively eliminates harmful fungus in around 90% of cases. Heterotrophic organisms rely mainly on their carbon and nitrogen utilisation patterns for sustenance. Because of the wide range of substrates available in nature, biological diversity can emerge. Different types of saprophytic bacteria have different levels of degradative capacity, and this is true even among closely related and distantly related species (Danielson and Davey 1973). The importance of carbon and nitrogen to fungal development is supported by the fact that it makes up almost half of the dry weight of fungal cells (Moore- Landecker, 1996; Vikram *et al.*, 2022). While evaluating the effect of different carbon and nitrogen sources on the *Trichoderma viride*, Mehta *et al.* (2012) reported that among Nitrogen sources (Sodium Nitrate, Potassium Nitrate and Ammonium Sulphate) *Trichoderma viride* showed the high biomass product in Ammonium sulphate (25.68 g) and among carbon sources (Fructose, Lactose and Dextrose) it showed high growth of biomass product in Dextrose (25.15 g).

MATERIALS AND METHODS

A study was conducted to examine how different carbon sources affect the growth and sporulation of *Trichoderma asperellum* isolates (TAGJM, TANYG, TABLGR, TAPUR, TAKJR, TACTC) (Table 1). Eight carbon sources were tested, and the fungus's utilization of these sources was analyzed in liquid Richard's medium. The carbon compounds were adjusted to match the amount of carbon found in 50.00 g of sucrose per liter of Richard's medium, while maintaining a constant C/N ratio, as indicated by their molecular weight (Table 1). A control group was also included, which consisted of a basal medium without any carbon source. Each carbon source was placed in a 250 ml conical flask and inoculated with a 10 mm mycelial disc from 10-day-old cultures of *Trichoderma asperellum* isolates and the flasks were then cultured for 7 days at room temperature (Panda *et al.*, 2019; Boblina *et al.*, 2020). The growth of the mycelium was evaluated by measuring the weight of the dried biomass, with three replicate flasks for each combination of isolates and carbon source. The mycelial biomass from each treatment was harvested, filtered, and dried in an oven at 60°C, and the weights of the fungal dry matter were recorded. The average dry weight of the mycelium was calculated and compared to observe the variations in growth among the different isolates.

Table 1: Different carbon sources along with their amount to be used in basal medium.

Carbon Source	Molecular formulae	Molecular weight (g/mol)	% Carbon	Weight(g) per litre of medium
Lactose	C12H22011	342.30	42.11	50.00
Mannitol	C6H14O6	182.17	39.56	52.63
Sucrose	C12H22011	342.30	42.11	50.00
Glucose	C6H1206	180.16	40.00	52.63
Fructose	C6H1206	180.16	40.00	52.63
D-Galactose	C6H1206	180.16	40.00	52.63
Starch	C6H1005	162.16	51.81	47.36
D Sorbitol	C6H1406	182.17	39.56	52.63

RESULTS AND DISCUSSION

Liquid conditions were used during the investigation. All of the carbon sources that were evaluated were used by the fungus, however the degree of use varied depending on the kind of carbon sources. After 7 days of incubation at 25°C, the fungal growth was assessed. Based on how they used various carbon sources, there was a general finding of diversity across the tested isolates. According to the results of the current inquiry, TAKJR had the highest mean dry biomass weight (794.06 mg), followed by TANYG (694.08 mg), while TAPUR and TACTC had the lowest mean dry biomass weights (580.97 mg and 573.15 mg, respectively). This finding was based on the observation that both of these isolates used the sources the most proficiently of the others and produced the best growth and sporulation. Dry weight measurements of mycelium in a liquid environment were made and are shown in Fig. 1. Mannitol was discovered to be the greatest carbon source out of all the ones tested, recording the highest dry biomass weight (906.99 mg), followed by sucrose (875.66 mg) and glucose (857.77 mg). Among the various carbon sources, lactose (355.77 mg) and starch (445.41 mg) had the lowest dry biomass weights. Understanding the nutritional needs of *Trichoderma* species, their response to growth, sporulation, and shelf life, which are all likely connected to their ecological behaviour, is the foundation for the goal of supplementing media with extra carbon and nitrogen sources. In addition, it can act as a base for increasing Trichoderma mass manufacturing. Our findings may be explained by the nature of the substance, which is a blend of peptides and amino acids that also contains water-soluble vitamins (Cochrane, 1958). This was consistent with sources that said the optimal carbon source was glucose or sucrose (Rajput *et al.*, 2014; Abdullah *et al.*, 2005). According to Monga (2001), glucose and sucrose have the best impact on sporulation and biomass production.

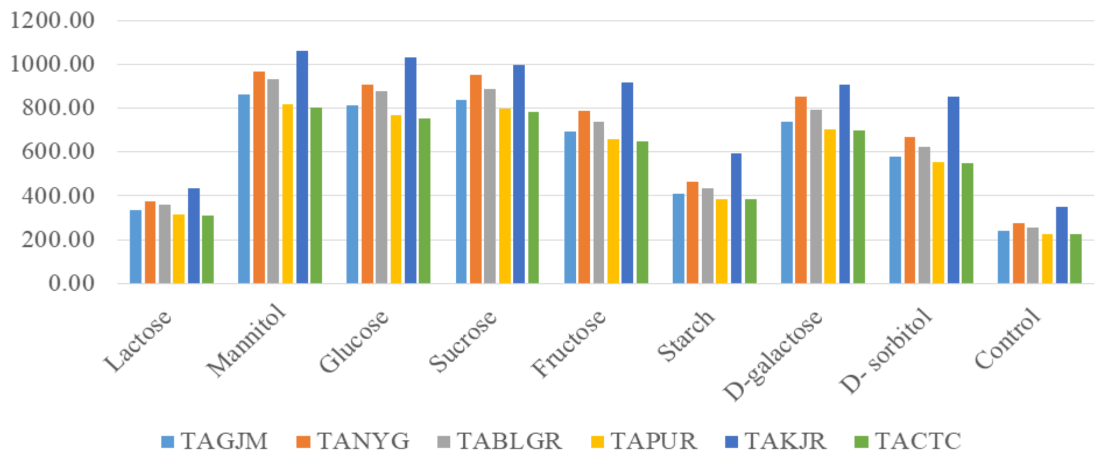

Fig. 1. Differential respose of *Trichoderma asperellum* isolates to carbon source.

CONCLUSIONS

Research into the effects of different carbon sources on the development and sporulation of *Trichoderma asperellum* isolates has shown interesting differences in resource consumption by these fungus. The results showed that growth rates varied significantly amongst isolates, highlighting the need of learning about their dietary preferences. Mannitol, sucrose, and glucose were shown to be ideal substrates for *Trichoderma* growth, and the choice of carbon source was found to have a major impact on biomass output.

FUTURE SCOPE

The elucidation of the precise metabolic pathways implicated in carbon metabolism through molecular and genetic investigations could facilitate the formulation of customized cultivation approaches. Moreover, an examination of the interplay between *Trichoderma* and other microorganisms inhabiting the agricultural ecosystem may reveal mutualistic associations that have the potential to be utilized to improve agricultural productivity or biocontrol. In addition, by conducting further investigations to evaluate the effects of these carbon sources on additional aspects of its functionality, including its capacity to promote plant growth or its antagonistic effects on plant pathogens, the potential applications of *Trichoderma* biocontrol agent in sustainable agriculture could be significantly expanded.

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Conflict of Interest. None.

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