



HARNESSING BIOCONTROL POTENTIAL OF *CHAETOMIUM GLOBOSUM* FOR SUSTAINABLE FOREST HEALTH: A COMPREHENSIVE REVIEW

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ABSTRACT: The widespread use of chemical pesticides has significant negative consequences on soil and water quality, disrupting ecological balance and posing serious threat to the environment. To overcome this, one of the less explored biocontrol agents *Chaetomium globosum*, an endophytic fungus, emerges as a alternative strategy for management of tree diseases in forest ecosystem. The present review compiles the evidences of *C. globosum* as an efficient biocontrol agent, showcasing its diverse actions, from inhibiting fungal and bacterial pathogens to promote plant growth. The antagonistic mechanisms, including mycoparasitism, antibiosis, and competition for resources, employed by *C. globosum* against plant pathogens. The study of biodiversity of *Chaetomium* contributes to a deeper understanding of its ecological significance. The morphological features of *C. globosum*, utilizing light and electron microscopy, contributing to species identification and understanding its adaptability to different environments. The use of molecular techniques to differentiate strains, establish genetic relatedness, and refine the phylogenetics of *C. globosum*, shedding light on the cosmopolitan distribution and evolutionary patterns of this fungus. The fungus induces defense responses in plants, contributing to resistance against fungal pathogens. This chapter highlights the importance of *C. globosum* research as a biocontrol agent in forestry, showcasing its efficacy against plant pathogens and emphasizing its taxonomy and biodiversity worldwide. It emphasizes ongoing research to understand the better interactions between *C. globosum*, pathogenic fungi, and the overall ecosystem dynamics, with future prospects focusing on biocontrol strategies for sustainable forest disease management.

Keywords: Biocontrol agent, bioformulation, biopesticides, *Chaetomium globosum*, forest disease

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INTRODUCTION

The emergence of pesticide resistance compounds, demanding urgent attention in 21st century. In response to these environmental concerns, the adoption of biological methods for disease control emerges as a pivotal strategy for sustainable agriculture. Biocontrol, as an eco-friendly and effective alternative to chemical pesticides, presents a promising solution to manage plant diseases. Among the myriads of biological agents, *Chaetomium*, a saprophytic endophytic fungus, stands out as a prominent member of the phylum Ascomycota, class Pyrenomycetes, order Sordariales, and family Chaetomiaceae. With over 163 accepted species, more than 60 of which thrive in Indian domains, *Chaetomium* plays a crucial role in decomposing cellulose-rich materials, contributing to the ecological balance (Doveri, 2013; Wang *et al.*, 2014). One standout member of this genus is *Chaetomium globosum* Kunze, globally recognized and acknowledged as a biocontrol agent of paramount importance. Its omnipresent nature allows it to inhabit diverse habitats, ranging from deserts to mountain ecosystems, and exhibit successful colonization as a saprophyte in various organic and inorganic materials. Beyond its saprophytic lifestyle, the fungus also functions as an endophyte, colonizing both above and belowground plant organs, showcasing its adaptability and importance in various ecosystems (Li *et al.*, 2014; Longoni *et al.*, 2012; Zheng *et al.*, 2014; Naik *et al.*, 2009).

This versatility positions *Chaetomium globosum* as a compelling candidate for exploration as a source of secondary metabolites with diverse biological activities. Its significance extends to agriculture, medicine, and industries. Notably, its role as a biocontrol agent has been

extensively studied and reported, defining its effectiveness against soil and foliar pathogens in crops such as rice, maize, and wheat. Additionally, the fungus exhibits insecticidal activity against cotton aphids and beet armyworms, while also displaying inhibitory effects against root-knot nematode (*Meloidogyne incognita*) and its reproduction (Zhou *et al.*, 2016). Its antibacterial activities against *Bacillus subtilis* and herbicidal activities against lettuce and Amaranthaceae weeds further underscore its multifaceted potential (Xu *et al.*, 2015; Wang *et al.*, 2017). In view of the aforementioned information's, evolved idea of this chapter with the primary objective of highlighting the importance of *C. globosum* research as biocontrol agents in forestry, its efficacy against plant pathogens and to draw taxonomy and biodiversity of this genus.

HISTORICAL PERSPECTIVE

The genus *Chaetomium* is an exemplary representation of the ascomycetous clan. It belongs to the class Pyrenomycetes, order Sordariales and family Chaetomiaceae. This is one of the important soil-inhabiting genera and is a well-known mesophilic member, which Gustav Kunze established in 1817 based on its type species *C. globosum* (Von *et al.*, 1986). Corda was the first mycologist who studied *Chaetomium* in detail. He described eight new species (Corda 1837, 1840). Among those described, two of them (*C. indicum* and *C. murorum*) are still accepted (according to Arx *et al.*, 1986). The genus *Chaetomium* has been a centre of attention for many studies and their authors since time immemorial.

Multiple reports highlighted the potential of *C. globosum* as a biocontrol agent, depicting its ability to inhibit pathogens through the secretion of