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Short Communication

The First Occurrence of Entomopathogenic Fungi *Ophiocordyceps nutans* in Tamil Nadu, India

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Abstract: The novel observation of *Ophiocordyceps nutans* infecting *Erthesina fullo* in Kargudi, Tamil Nadu, emphasizes the potential of entomopathogenic fungi (EPF) as natural agents for controlling pests. *O. nutans* is known for its host spectrum (primarily ants), which now includes a significant pest, the stink bug. This discovery highlights the complex connections in ecosystems and indicates the possibility of utilizing EPF for environmentally friendly pest control. This work suggests more research on the ecological and agricultural impacts of EPF to investigate sustainable pest management techniques and support biodiversity conservation.

Keywords*:* Insect-fungi interactions, Sustainable pest management, Ecosystem dynamics, Fungal ecology

Entomopathogenic fungi (EPF) majorly fall under the taxonomic divisions of Zygomycota and Ascomycota. EPF use the mechanism of direct penetration of the host species by using several entry mechanisms, such as the usage of spores via which they adhere to the epicuticle, germinate, and then grow through the procuticle (which poses a significant physical and chemical barrier to infection). This is accomplished through a combination of mechanical pressure from hyphal tips and the secretion of proteolytic enzymes (Samson, *et al.,* 1988; Chandler, 2017). There have been multiple occurrences of EPF parasitizing insects, which were observed in *Beauveria bassiana* on *Cephalcia tannourinensis*, and in *Beauveria lii* sp. on *Henosepilachna vigintioctopunctata,* as well as in *Cordyceps javanica* on sweet potato whiteflies (Abdo, *et al.,* 2008; Zhang, *et al*., 2013; Wu, *et al.,* 2021).

Ophiocordyceps nutans (Figure 1) belongs to the Phylum Ascomycota, the genus *Cordyceps*, and the family of Ophiocordycipitaceae which includes organisms that can feed on fungi, plants, or animals (Chandler, 2017). They are known to infect arthropods and turn them into fruit bodies. They are also known to follow host-specific pathogenicity which makes them ideal control agents (Ito and Hirano 1997; Evans, *et al.,* 1999). Previous studies showed that the *Ophiocordyceps* species were observed in ants where they had a unique method for altering infected individual's behaviour as a means of transmission. In these infections, the host behaviour serves as an extended phenotype of the fungus. The infected individuals migrate from nests in the forest canopy to the understory vegetation, where conditions are ideal for the formation of stromata and ascospore generation on corpses. Repeated convulsions by behaviourally compromised ants cause them to fall from plants and prevent them from climbing back up into the canopy (Hughes, *et al.,* 2011; Boomsma, *et al.,* 2014).

Similar to this phenomenon, on 14 July 2023 in Kargudi, Tamil Nadu, India (Figure 2), *Ophiocordyceps nutans* was observed to have infected *Erthesina fullo* (Thunberg,

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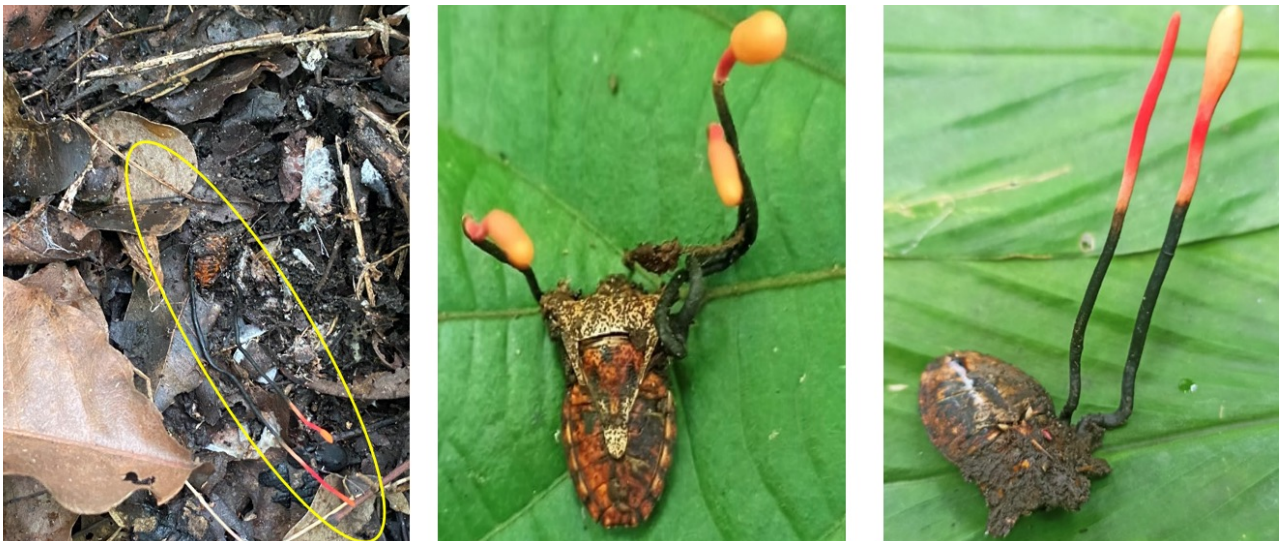


Figure 1. Observation of *Ophiocordyceps nutans.*

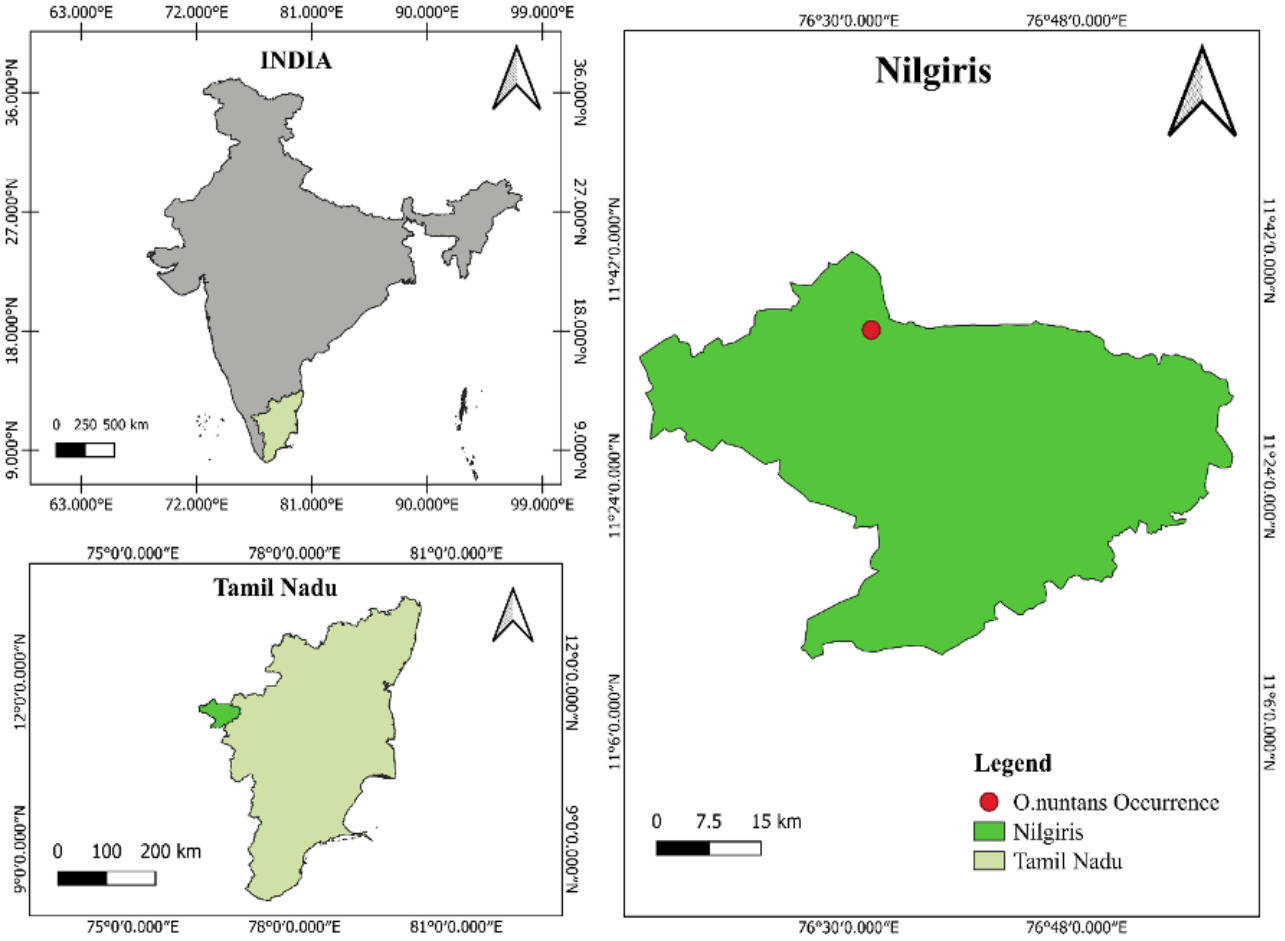


Figure 2. Occurrence record of *Ophiocordyceps nutans* in Nilgiris, Tamil Nadu.

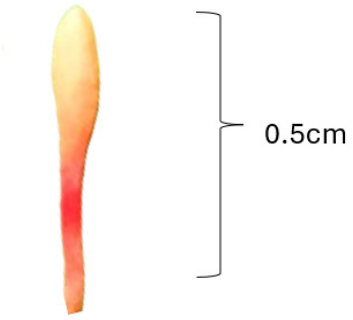
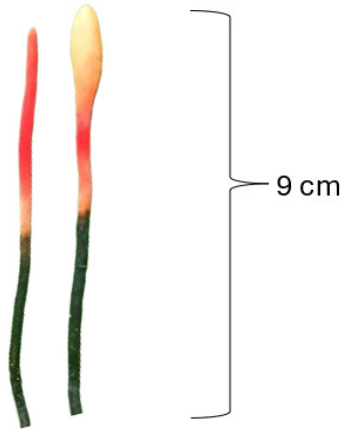
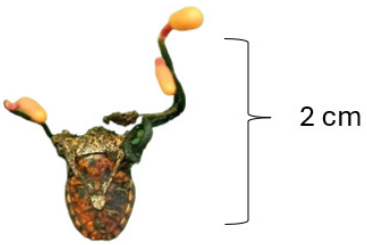
1783) commonly known as the Stink Bug, which was identified using taxonomic keys (Biswas, *et al.,* 2014). The distribution status of *Erthesina fullo* in India was recorded in Chhattisgarh, Assam, Andhra Pradesh, Andaman and Nicobar Islands, Kerala, Meghalaya, Sikkim, Tamil Nadu, Uttar Pradesh, Uttarakhand, and West Bengal.

Ophiocordyceps nutans was identified using the taxonomic keys provided by Sung, *et al.* (2007). Ophiocordyceps is a diverse group of fungi that infect arthropods. Several species have black pigmentation and are found in the juvenile stages of hosts buried in dirt or decomposing wood. Exceptions are notable for both characteristics in organisms that prey

on the mature stages of hosts. The stromata or subiculum can be darkly pigmented or occasionally brilliantly coloured and are rigid, fibrous, or pliant (Hywel, 1995). Sridhar and Karun (2017) observed a similar scenario where *Halyomorpha halys* was reported to be infected with *O. nutans*. Several instances of *Erthesina fullo* infected with *O. nutans* were observed across the study area. Infected bugs displayed characteristic symptoms such as the attachment to vegetation and the emergence of fungal hyphae from the host's body (Figure 1), forming a distinctive stalk and spore-bearing structure (Table 1). The stipes were observed to emerge from the thorax and the abdomen region. They were black, with a bright yellowish orange bulbous head. Further research is warranted to understand the prevalence, dynamics, and effectiveness of this fungal infection as a biocontrol strategy within the forest ecosystem. Previous studies have reported that *O. nutans* has been only found in high-altitude landscapes with temperatures ranging from 21 to 24 °C. In this study, EPF is recorded in the Kargudi region of Nilgiris which provides the optimum environmental conditions to promote its growth and distribution within the area.

In conclusion, the discovery of *Ophiocordyceps nutans* infecting *Erthesina fullo* in Tamil Nadu highlights the potential of

Table 1. Description of Fungal Anatomy and Morphology of *Ophiocordyceps nutans*.

Sl. No	Observation	Scale for Reference	Description
1	Stroma		Yellowish - orange Stroma was measured to be around (0.52-1.27) cm (n=3)
2	Stipe		Two or three wiry blackish green stipe (8.9-9.4) cm (n = 3)
3	Stink Bug cadavers infected with *Ophiocordyceps nutans*		*O. nutans* infection observed on the abdominal area of the stink bug

entomopathogenic fungi for environmentally friendly pest control methods. The study emphasizes the need for further ecological research to support sustainable agriculture and biodiversity conservation.

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