

## Stingless bees (Hymenoptera, Meliponini) feeding on stinkhorn spores (Fungi, Phallales): robbery or dispersal? <sup>1</sup>

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**ABSTRACT.** Records about stingless bee-fungi interaction are very rare. In Brazilian Amazonia, workers of *Trigona crassipes* (Fabricius, 1793) and *Trigona fulviventris* Guérin, 1835 visiting two stinkhorn species, *Dictyophora* sp. and *Phallus* sp., respectively, were observed. The workers licked the fungi gleba, a mucilaginous mass of spores covering the pileum. Neither gleba residue nor spores were found on the body surface of these bee workers. These observations indicate that these bee species include spores as a complement in their diet. On the other hand, they also suggest that these stingless bees can, at times, facilitate spore dispersal, in case intact spores are eliminated with the feces.

**KEY WORDS.** Stingless bee-fungi interaction, *Dictyophora*, *Phallus*, Phallales, robbery, spore dispersal, *Trigona*

Studies on stingless bee-fungi interaction are rare. This may be due to the fact that bees have been seen on very few fungi species, many of which have a very short life cycle. Many stinkhorns, for example, fruit in the middle of the night and last only until noon.

Near Coca, Ecuador, BURR *et al.* (1996) observed individuals of *Trigona cf. branneri* Cockerell, 1912 collecting the gleba of the stinkhorn *Staheliomyces cinctus* Ed. Fischer (Phallales) and depositing it on the corbiculae. Years before, however, ROUBIK (1989: 39) and ROUBIK (*apud* BURR *et al.* 1996) reported *Trigona fulviventris* Guérin, 1835, *T. nigerrima* Cresson, 1878 and *T. amalthea* (Olivier, 1789) collecting liquid exudates and possibly spores from *Dictyophora* sp. in Panama, but he did not offer further details.

The stinkhorns exhibit a structure called the gleba, which is an often mucilaginous mass of spores and associated structures (GUGLIOTA & CAPELARI 1999: 94). According to PUTZKE & PUTZKE (1998: 425) the gleba frequently has an unpleasant odor that attracts insects, mainly flies that act as dispersal agents when spores stick to their bodies. However, TUNO (1998) verified that when flies ingest the spores of two stinkhorns species, *Dictyophora indusiata* (Vent. & Pers.) and *D. duplicata* Fisch. Some spores can pass intact through the alimentary canal, and they are eliminated together with the feces. He rarely found gleba stuck to the body surface of the flies.

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In 1989 at approximately 06:00h, the first author observed workers of *Trigona crassipes* (Fabricius, 1793) visiting an individual of *Dictyophora* sp. (Fig. 1a-b). The stinkhorn was beside a tree stump in reserve number 1501, belonging to the BDFFP/INPA-SI (Biological Dynamics of Forest Fragments Project/National Institute for Amazonia Research-Smithsonian Institution) near Manaus, Amazonas state, Brazil. The gleba was dark green, with a mucilaginous aspect, and it had no noticeable odor. The workers spent a long time on the pileum of the stinkhorn, licking the gleba, but they were never seen depositing it on the corbiculae. Recently, in November 1998, between 8:30 and 9:15 h, the second author observed several workers of *Trigona fulviventris* visiting an individual of *Phallus* sp. (Fig. 1c-d) beside a fallen trunk near Rio Branco, Acre state, Brazil. Voucher specimens were deposited in the bee collection of the University of São Paulo, at Ribeirão Preto, São Paulo state, Brazil (RPSP). The form and scent of the fungus was seemed that described above, and the bees behaved in a way similar to *T. crassipes*. A worker of *Tetragona goettei* Friese, 1900 was also observed on the pileum without collecting any substance, and the bee did not interact in any way with the *T. fulviventris* workers that were already present. Also in November 1998, between 6:30 and 7:30 h, near Xapuri, Acre state, Brazil, C. Salimon (pers. comm.) found several workers of *Trigona* sp. visiting an individual of *Dictyophora* sp., which was beside two other withered individuals. However, no note was taken concerning whether the bees were feeding on or collecting the gleba. In southeast Brazil, G. Azevedo (pers. comm.) observed workers of *Partamona helleri* (Friese, 1900) carrying pellets of unidentified spores on the corbiculae, enroute to the nest.

According to CAMARGO & ROUBIK (1991: 32) *Trigona crassipes*, *T. hypogea* Silvestri, 1902 and *T. necrophaga* Camargo & Roubik, 1991 have vestigial corbiculae, feed on fresh meat, lack pollen storage pots in the nest, and do not use pollen for brood feeding. For these authors, such characteristics constitute strong evidences that this group is obligatorily necrophagous. However, the observations presented here suggest that *T. crassipes* includes spores in his diet as a complement to necrophagy. This conclusion is reinforced by CAMARGO & ROUBIK (1991: 28) because they observed *T. crassipes* nests with pots containing a yellow paste, composed of small amounts of pollen and many spores.

BURR *et al.* (1996) do not know the chemical composition of the gleba of *S. cinctus*, however, they suggest that it may serve as a sugar and protein source for *T. cf. branneri*. This is based on the fact that such composition is very common in other stinkhorns. One of us (EFM) tasted the gleba of *Phallus* sp., but it was bitter, an indication that the basic composition of the gleba may not be sugars, but rather amino-acids and proteins.

BURR *et al.* (1996) proposed two hypotheses to explain the *T. cf. branneri* and *S. cinctus* relationship: stingless bees of the genus *Trigona*, in addition to flies, could be dispersing the spores; or, these bees could play a role as parasites (?) in a mutualist relationship between stinkhorns and flies. However, they admit that any conclusion is still premature, because there is little knowledge about the necessary conditions for spore germination in Phallales. In a recent study from Japan, Drosophyllidae and Muscidae flies feeding on the gleba of *Dictyophora indusiata* and *D. duplicata* Fisch

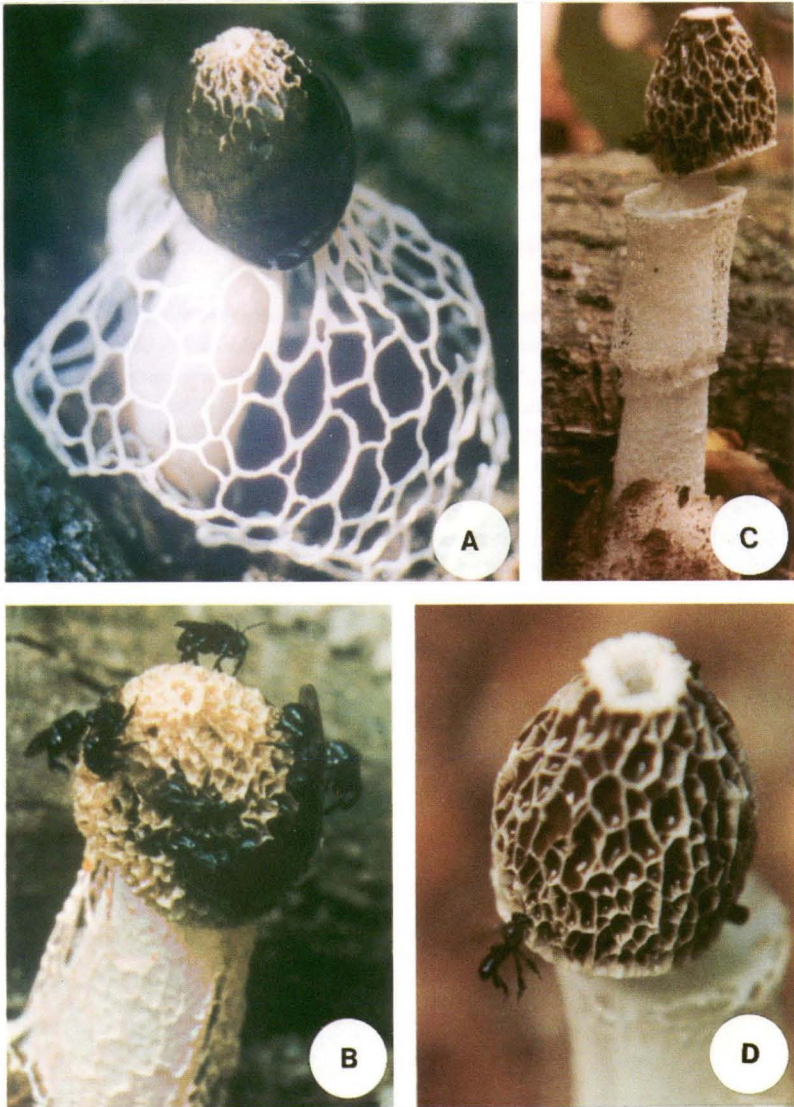


Fig. 1. (a) *Dictyophora* sp., general aspect of an individual found near Manaus, Amazonas, Brazil; (b) the same individual, some hours after, with *Trigona crassipes* workers licking the rest of gleba; (c) *Phallus* sp., general aspect of an individual found near Rio Branco, Acre, Brazil; (d) a *Trigona fulviventris* worker landing on the *Phallus* sp. pileum.

eliminated intact spores in the feces with high germination rates (TUNO 1998). According to this author, the gleba of both *Dictyophora* species was rarely found stuck to the body surface of the flies, in spite of the gleba's adhesive character.

Neither gleba residue nor spores were found on the body surface of *Trigona crassipes* or *T. fulviventris* and these bees were not observed depositing gleba on the corbiculae. In spite of the fact that *T. crassipes* has vestigial corbiculae, workers

have been observed carrying resin in this structure (ROUBIK 1982). Although stingless bees can digest spores, the observations presented here are a strong indication these bees can, at times, facilitate spore dispersal of some stinkhorn species, if intact spores are eliminated in their feces. In contrast, BURR's *et al.* (1996) observations suggest that bees may hinder spore dispersal, because *S. cinctus* gleba on the corbiculae of *T. cf. branneri* workers clearly indicates that this bee species uses the material to feed offspring or to construct and repair nests.

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