A Biometrical Analysis of the Giant Constricting Ring Mutant of the Predacious Fungus *Dactylella brochopaga*

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With 3 Figures

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Summary

Mutagenesis of the nematophagous fungus *Dactylella brochopaga* resulted in the production of a giant constricting trap strain. This strain regularly produced traps with a diameter of about five times that of wild type. Subsequent analysis of the dimensions of the various trap sizes suggests that the organism regulates the trap cell's surface to volume ratio in order that the trap remain functional. This is achieved by reducing the trap cell's length to width ratio, allometrically. The equation expressing this proportionality is derived.

1. Introduction

Several genera in the fungal orders *Zoopagales* and *Moniliales* entrap amoebae, rotifers and nematodes using more or less specialized hyphal snares; the cellular contents of the prey are subsequently liquified and absorbed by trophic hyphae. The most elaborate of these traps are the constricting-ring types of representatives of the *Moniliales*, which have attracted the attention of cell biologists because of the unique cell expansion mechanism they employ in order to arrest a nematode which has inserted itself into the ring of three cells. The mechanism has not been explained, and with the aim of doing so, we attempted to obtain mutants of *Dactylella brochopaga* with impaired or altered function in their ring traps. The most striking mutant strain obtained, MG-20, regularly produced traps in a spectrum of sizes, ranging in diameter from about 10 to 120 μm. All its traps were functional, and physiological studies indicated that the sudden swelling of the three trap cells resulted from the direct entry of water into the cells, from their surroundings. Cell expansion mechanisms based on the generation of a gas, or by entry material from the mycelium via the trap stalk, could be ruled out. Thus, the trap cell surface was implicated as an important component of the mechanism. This paper is
addressed to the question of whether the organism, in increasing the size of its traps, regulates the surface to volume ratio of their cells in order to maintain them in a functional condition. An analysis of the dimensions of the cells of traps of the giant trap mutant MG-20 is presented.

2. Materials and Methods

The strain of *Dactylella brochopaga* which produced giant three-cell ring traps (hereafter referred to as megatraps), MG-20, was grown in petri dishes on corn meal extract agar following the procedure of Duddington (1956). As inoculum, small blocks of agar containing mycelium were excised from a stock culture plate and placed centrally and singly in the experimental plates. After ten days of mycelial growth, traps were induced by supplying the cultures with nematode prey (Pramer and Stoll 1959). Each plate was given a population of approximately 100 individuals of the free-living nematode *Panagrellus silusae* at various stages of development. About 14–21 days later, the dishes were opened and randomly selected fields of traps were photographed through a brightfield microscope with a ×10 objective. Prints were made at a final magnification of 190× and the radii of 500 traps and their cells measured. Only traps which had not yet captured prey were scored in this way. Finally, traps were sprung en masse by holding a heated steel wire above them, photographed and their expanded dimensions measured and recorded as before.

3. Results and Discussion

About two days after the plates were supplied with nematodes, traps of normal size appeared, and their numbers increased thereafter until a maximum was reached; concomitantly, the prey, which had been feeding on the bacterial colonies they carried into the plates at the time of their introduction, reproduced actively, and spread out to occupy all parts of the petri dish. From the moment that the first traps appeared nematodes were captured, and the numbers of victims increased progressively. About 14 days after the introduction of prey, the first megatraps appeared; their distribution was restricted to the circle of mycelium of about 1 cm radius around the point of inoculation of the fungus, that is, to the oldest portion of the fungal colony. Later, more megatraps, and traps of intermediate sizes, formed elsewhere on the colony in more or less isolated groups. This contrasted with the uniform distribution of normal-sized traps over the surface of the mycelium.

The mutant MG-20 of *Dactylella brochopaga* produced traps with all their basic features identical with those of the traps of the wild type strain, except that some were of larger size. Thus, all its traps consisted of a ring of three curved, roughly cylindrical cells attached to the parent hypha by a two-celled short stalk (Fig. 1). Megatraps, though not as plentiful as normal-sized traps, greatly outnumbered those in the other class intervals of the range, and were very conspicuous. Another feature of interest was the mode of ring formation; each trap resulted from the growth of a short lateral hypha, the tip of which followed a curved path so as to complete the ring.