Parasitic and mutualistic life-styles of plant-associated fungi under pressure of plant defense responses

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Abstract

Plants in nature are associated with a great diversity of fungi. *Colletotrichum* fungi are well-studied as parasitic fungi causing severe anthracnose disease symptoms on various plant species. To penetrate host epidermal cells, most of the host-adapted parasitic *Colletotrichum* fungi develop a black melanized infection structure, called appressorium. Firstly, I found that the non-adapted anthracnose fungus adopts a previously undocumented hyphal tip-based entry (HTE) against *A. thaliana* mutants exhibiting defective pre-invasive nonhost resistance[1)]. Importantly, this new entry strategy is strongly induced by sugars and preferentially observed in wound margins where sugar leakage occurs, suggesting that parasitic *Colletotrichum* fungi sense the host status via leaking sugars. Secondly, I reveal molecular mechanisms of *Arabidopsis* nonhost resistance with two different defense layers, namely pre-invasion and post-invasion resistance[2)]. The two-layer defense system is effective to protect plants from non-adapted parasites taking HTE. Thirdly, I characterized a novel root endophyte *Colletotrichum tofieldiae* isolated from healthy wild *Arabidopsis thaliana* population. Importantly, despite that this fungus is closely related to parasitic *Colletotrichum*, this fungus transfers phosphorus to host plants via the hypha, and promote plant growth under low-phosphate conditions[3)]. The beneficial interaction is tightly regulated by a host anti-fungal metabolite pathway. Thus, these findings suggest that *A. thaliana* plants with proper immune responses have established beneficial interactions with facultative endophytes for better nutrient uptake in nutrient limiting environments.

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