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Fatal attraction: bacteria exploit fungal heterokaryon incompatibility to obtain nutrients

Phyllosphere (above ground plant structures) is an interesting habitat where many plant associated bacteria, fungi and viruses coexist. Leaves, which form the major part of the phyllosphere serve as food resource for many epiphytic bacteria as well as fungi. The paper by Wichmann *et al.* (2008) describes a unique interaction of a plant pathogenic bacterium *Pseudomonas syringae* and filamentous fungus *Neurospora crassa*. It was a serendipitous finding. The authors observed a *N. crassa hetC* homologue in the genome of *P. syringae* by analysing the genome sequence of several *P. syringae* strains.

In *Neurospora,* the *hetC* gene is involved in heterokaryon incompatiblity (HI), and the presence of dissimilar *hetC* allele is sufficient to trigger a HI mediated programmed cell death (Debets *et al.* 1994). There is another locus in *N. crassa* called *pinC*, which is also involved in HI. For example, a *hetC1pinC2*, non allelic combination and/or a *hetC1 hetC2* allelic interaction can trigger HI mediated programmed cell death. HI has been proposed as a barrier against non-self recognition which in turn may prevent virus transmission within fungal populations and resource plundering between genetically dissimilar individuals (Debets *et al.* 1994).

Wichmann *et al*. (2008) showed that the *P. syringae phcA* (*P. syringae het-c* homologue) is sufficient to trigger HI in *N. crassa* and HI induced by heterologous expression of PhcA in *N. crassa* is dependent on the presence of a fungal counterpart of *hetC* and *pinC*. This results in growth inhibition of *N. crassa* a characteristic hallmark of HI. They further showed by co-immune precipitation and western blotting that PhcA and HetC1 interact with each other and form a hetero-complex *in vivo* in *N. crassa* hyphae undergoing HI.

The authors did some elegant experiments in which they incubated *P. syringae* strains labelled with different fluorescence colours in close proximity to growing hyphae of *N. crassa* and observed that the bacterium efficiently colonizes the growing hyphae.

By limiting the carbon and nitrogen source, *P. syringae* could grow only in the presence of only *N. crassa*, as a sole carbon source. These results indicated that *P. syringae* exploits the HI phenomena in filamentous fungi, thereby inducing programmed cell death, which may in turn leak out nutrients for the feeding of the bacteria.

This study indicates an important ecological relationship, in which leaf associated microbes like bacteria and fungi interact and the bacteria try to manipulate a well conserved genetic pathway of non-self recognition in fungi, to get nutrients for growth.

DNA analysis of several *P. syringae* strains indicated that *phcA* homologues are present in diverse strains isolated from soil, plant as well as water. The phenomena of HI are conserved in many different divisions of filamentous fungi, including ascomycete, basidiomycete and zygomycete species.

This research work opens up a yet another very interesting aspect of inter-kingdom interactions which occurs in nature where members try to exploit each other resources by manipulating conserved pathways.

Keywords. Hypersensitive reaction; type III secretion

References

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