BACTERIAL ECOLOGY

Mutual benefits?

A new report in *Applied and Environmental Microbiology* describes the first identification of a symbiotic bacterium with the ability to enter and reside in mitochondria. Representing a novel clade of α -proteobacteria, the bacterium — designated as IricES1 — is found in the medically important tick *Ixodes ricinus*.

Using electron microscopy and *in situ* hybridization, Beninati *et al.* report that IricES1 is restricted to ovarian cells of *I. ricinus*. Interestingly, the authors found that the bacteria were widespread in *I. ricinus* females from various parts of Europe — 96% of female ticks were found to be infected; however, IricES1 was absent from males.

On the basis of the very high prevalence of IricES1 in female ticks, its distribution throughout Europe and the absence of sex ratio biases, the authors argue against a parasitic or commensal relationship between IricES1 and *I. ricinus*, despite the apparent damage the bacteria do to a large number of mitochondria. Instead, they postulate that IricES1 has an obligate mutualistic

IricES1 in ovarian cells of *Ixodes ricinus*. Image courtesy of Nathan Lo, Milan, Italy.

relationship with *I. ricinus* females. As IricES1 is only located in the ovarian tissue, it is unlikely to have an important role in host metabolism; however, in a similar manner to *Wolbachia* in populations of *Asobara tabida*, IricES1 could be required for *I. ricinus* oogenesis.

Further studies are required to confirm this hypothesis; however, establishment of an

obligate relationship between IricES1 and *I. ricinus* might provide a model for an unusual type of symbiosis.

Jane Saunders

References and links

ORIGINAL RESEARCH PAPER Beninati, T. *et al.* A novel α -proteobacterium resides in the mitochondria of ovarian cells of the tick *Ixodes ricinus*. *Appl. Environ. Microbiol.* May 2004 (doi:10.1128/AEM.70.5.000-000.2004)

ENVIRONMENTAL MICROBIOLOGY

Suck it up!

Endophytic bacteria modified by natural gene transfer can improve the phytoremediation of volatile organic compounds such as toluene, according to a recent report in *Nature Biotechnology*.

Phytoremediation — the use of plants to remove harmful contaminants from the environment — is an emerging bioremediation strategy. Genetic engineering techniques can be used to introduce phytoremediation properties, often from bacteria, into suitable plant species. Another approach, now described by Barac *et al.*, is to introduce the appropriate degradation properties into endophytic bacteria, which are found in the vascular tissues of most plants.

For this proof-of-concept study, Barac *et al.* used the yellow

lupin and *Burkholderia cepacia*. *B. cepacia* strain G4 — a soil microorganism that carries a plasmid encoding the toluene catabolic pathway — was conjugated with *B. cepacia* BU0072, a derivative of the natural endophytic strain *B. cepacia* L.S.2.4. The resulting toluene-degrading endophytic strain was named *B. cepacia* VM1330.

Lupins were then inoculated with BU0072, VM1330 or G4 and grown for 21 days. Analysis of the bacterial content of the roots and shoots confirmed that colonization with all three *B. cepacia* species was successful. The effects of the presence of toluene on plant growth were then assessed. In hydroponic culture — soil-free growth in water containing dissolved nutrients — the growth of plants inoculated with VM1330 was unaffected at toluene concentrations up to 1 g l⁻¹; by contrast, toluene levels >100 mg l⁻¹ proved to be toxic for the uninoculated controls and plants inoculated

with G4 or BU0072. In plants grown in non-sterile soil in a greenhouse, the protective effects of the toluene-degrading plasmid in VM1330 were evident at toluene concentrations up to 500 mg l⁻¹. It was additionally found that plants inoculated with VM1330 released 50–70% less toluene by evapotranspiration — the combination of evaporation and transpiration — than those inoculated with the control strains, indicating that inoculation with VM1330 improves the degradation of toluene.

B. cepacia expressing the toluene catabolic plasmid therefore not only protects yellow lupins against the toxic effects of toluene but also improves the *in planta* degradation of this common pollutant. Barac *et al.* now intend to extend their study to poplar, a deep-rooting tree species used in phytoremediation, and have already identified 150 different poplar endophytes.

Sheilagh Clarkson

References and links

ORIGINAL RESEARCH PAPER Barac, T. *et al.* Engineered endophytic bacteria improve phytoremediation of water-soluble, volatile, organic pollutants. *Nature Biotechnol.* **22**, 583–588 (2004)