Scientists reveal how natural systems limit the spread of "cheating" bacteria

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Bagged plants at experimental field site

(Phys.org) -- In the first field study of its kind researchers at Royal Holloway, University of London and the University of Oxford have investigated the competitive dynamics of pathogenic and non-pathogenic strains of bacteria.

Bacteria are increasingly seen as living and interacting in groups and sharing resources such as virulence factors, biofilms, and proteins used to scavenge iron. Investing in these shared resources can be thought of as cooperation.

However as in human societies, this type of cooperation is threatened by “cheaters” that exploit the hard work of others, but fail to contribute themselves. Lead researcher, Dr. Ben Raymond, from the School of Biological Sciences at Royal Holloway, explains: “These interactions are particularly important for pathogens and for understanding disease since many bacterial toxins are secreted outside of cells into a common pool and are potentially exploitable by pathogenic and non-pathogenic strains alike.”

Up to now these ideas have principally been investigated in the laboratory in well-understood model systems but the study published today (6 July) in the journal *Science* is the first to have been carried out in a natural setting using the bacteria Bacillus thuringiensis. The research was funded by the Natural Environment Research Council (NERC), the Biotechnology and Biological Science Research Council and the Royal Society.

Dr. Raymond adds: “Both co-operators and cheaters do well when rare, but the cheaters cannot totally exclude co-operators as toxin production is essential for getting access to the rich resources contained within their caterpillar hosts.

“We also found that co-operators tend to live in patches with other co-operators in the field, meaning that cheaters will have limited opportunities to exploit the toxin producers. This is of broad importance because bacterial toxins cause damage during disease, so many bacterial pathogens secrete toxins in order to attack their hosts. Bacillus thuringiensis is an important biological insecticide, widely exploited for its ability to produce large quantities of toxins. We now understand why massive investment in these metabolically costly products is stable in the field.”

Non-pathogenic and pathogenic strains of many dangerous species including cholera, E. coli and Streptococcus all co-exist in nature and this new research could help scientists to understand how and why.

Dr. Michael Bonsall, Reader in Mathematical Biology in Zoology at Oxford, said: “The challenge now is to understand more thoroughly how changes in bacterial population abundance affect these sorts of evolutionary patterns."

Provided by Royal Holloway, University of London

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