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The dynamics of cooperative bacterial virulence in the field.

Raymond B, West SA, Griffin AS, Bonsall MB

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Recommendations:

Very Good **30 Jul 2012**

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GOOD FOR TEACHING | INTERESTING HYPOTHESIS | NEW FINDING

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This paper shows that bacterial cooperation is relevant in the wild. Bacillus thuringiensis (Bt) is a well-known bacterium used for pest control. It produces a pore-forming toxin, Cry, to invade its insect host. However, some Bt strains do not produce Cry themselves. They are still able to infect their hosts when they cooperate with Cry-producing strains. In this paper, Cry producers and non-producers were released on bagged plants with diamondback moth larvae. As predicted by theory, both producers and non-producers increased in frequency when rare, indicating that negative frequency-dependent selection led to coexistence of both types in nature. Intriguingly, the spread of non-producers (i.e. social cheaters) at high bacterial density may explain why Bt rarely causes epidemics in the field. This connection between cooperative virulence and epidemiology is probably also relevant for other toxin-producing bacteria, including human pathogens.

Disclosures
None declared

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Good **08 Oct 2012**

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NEW FINDING

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Bacterial populations undergo rapid adaption when under selective pressure. These adaptations can be genetic (mutations for example) but they can also be changes to the relative prevalence of a particular genetic trait compared to another, as sub-populations might have different selective pressure depending on population attributes such as density. Secreted virulence factors, exotoxins for example, can be expensive to produce but benefit all bacteria occupying the same clinical site. It is therefore conceivable that bacteria of a population can benefit from not producing the toxin and instead rely on their neighbors. This paper demonstrated that there is an optimal relation between bacteria producing the toxin and bacteria that are not, and that this fraction is reached from different starting points (under constant density). Selective pressure on an individual is hence dependent on population density and composition where bacteria not producing toxins would be at an advantage at high density but at a disadvantage at lower densities assuming the relative fraction of producers and non-producers are the same.

Disclosures
None declared

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Abstract:

ABSTRACT

Laboratory experiments have shown that the fitness of microorganisms can depend on cooperation between cells. Although this insight has revolutionized our understanding of microbial life, results from artificial microcosms have not been validated in complex natural populations. We investigated the sociality of essential virulence factors (crystal toxins) in the pathogen Bacillus thuringiensis using diamondback moth larvae (Plutella xylostella) as hosts. We show that toxin production is cooperative, and in a manipulative field experiment, we

observed persistent high relatedness and frequency- and density-dependent selection, which favor stable cooperation. Conditions favoring social virulence can therefore persist in the face of natural population processes, and social interactions (rapid cheat invasion) may account for the rarity of natural disease outbreaks caused by B. thuringiensis.
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