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# HOST AND ENVIRONMENTAL FEED-BACKS ON INVASIVE PLANT PATHOGENS: ECOLOGICAL AND EVOLUTIONARY CONSEQUENCES ON NOVEL PLANT PATHOGEN INTERACTIONS

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It is well understood that environmental factors drive plant epidemics alongside variables such as host density, variation in susceptibility to infection, and plant community composition. However, the basic assumption underlying our understanding of the success by emerging pathogens is that of acute susceptibility of hosts due to the lack of a co-evolutionary process between host and pathogen. Increasing evidence is suggesting that ecological factors may play an equally important role in novel pathosystems, and may drive outbreaks even in the absence of acute susceptibility in host populations. This talk focuses on two important aspects of invasive diseases: (i) what alternative strategies do exotic pathogens adopt to become successfully established and cause epidemic outbreaks? (ii) how do successful exotic pathogens increase their phenotypic variability to adapt to novel environments. Examples will be drawn from the invasion of the North American *Heterobasidion irregulare* in Central Italy, and from the invasion of California by *Phytophthora ramorum*. These two organisms provide examples of successful but different strategies. In the first case, the invasion appears not to be driven by enhanced susceptibility of European host species to a North American fungus, but rather to an ecological adaptation of the invasive species that outperforms its native congener *H. annosum.* This adaptation is quantifiable by a superior sporulation potential of the invasive species, and by a broader host range. Both factors seem to be in part explained by a greater saprobic ability of the invasive organism. Variability among individuals is generated both by intraspecific sexual recombination and by rampant hybridization between the two sympatric congeneric species: this hybridization is leading to a significant number of recombined alleles, forever changing the evolutionary trajectories of these two species in Europe. In the case of *P. ramorum*, generalized high susceptibility is encountered throughout the novel invaded ecosystem, however epidemic outbreaks are convincingly driven by the conjuncture of sporulating hosts and favorable climatic conditions. We show that *P. ramorum* follows a typical reproductive K-strategy with populations booming very rapidly in response to the onset of favourable climatic conditions. Intraspecific variation in susceptibility appears to play an important role and the density of sporulating hosts is of paramount importance. We show that rapidly sporulating genotypes become dominant during epidemic outbreaks spreading from rare refugia. The presence of such refugial hosts may be as important as the density of infectious hosts. As expected, variability of *P. ramorum* is maximum during unfavorable climatic conditions, when local genotypes are not outcompeted by highly infectious super-spreaders. For the first time for a plant pathogen, we provide evidence that phenotypic variability in this clonally reproducing organism is controlled by epigenetic regulation mechanisms. Our conclusion is that a wholistic approach and a combination of ecological, genetic, and epigenetic studies are needed to understand invasions by exotic microbes.