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Double impact of sterilizing pathogens: added value of increased life expectancy on pest control effectiveness

Sterilizing pathogens are commonly assumed not to affect longevity of infected individuals, and if they do then negatively. Examples abound, however, of species in which the absence of reproduction actually increases life expectancy. This happens because by decreasing the energy outlay on reproduction individuals with lowered reproduction can live longer. Alternatively, fertile individuals are more susceptible to predators or parasitoids if the latter can capitalize on mating signals of the former. Here we develop and analyze an SI epidemiological model to explore whether and to what extent does such a life expectancy prolongation due to sterilizing pathogens affect host dynamics. In particular, we are interested in an added value of increased life expectancy on the possibility of successful pest control, that is, the effect of increased lifespan and hence increased potential of the infected individuals to spread the disease on pest control effectiveness. We show that although the parameter range in which we observe an effect of increased lifespan of infectives is not large, the effect itself can be significant. In particular, the increase in pest control effectiveness can be very dramatic when disease transmission efficiency is close to birth rate, mortality rate of susceptibles is relatively high (i.e., the species is relatively short-lived), and sterilization efficiency is relatively high. Our results thus characterize pathogens that are promising candidates for an effective pest control and that might possibly be engineered if not occurring naturally.