The evolution of pathogen-induced leaf shed

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Leaf shed as a response to plant pathogen attack is a mechanism to reduce disease load [?]. However, some literature [?, ?] suggests that this defensive shed reduces a crop's reproductive potential. Leaf shed responses have been intensively studied on both biochemical and biophysical level, but has hardly received attention from a population or evolutionary perspective. We studied the evolutionary ecology of leaf shed responses.

A size-structured plant population model [?] was developed to study the effect of pathogen load on pathogen-induced leaf shed under different environmental conditions. The Evolutionary Stable Strategy (ESS) was calculated for two scenarios: i) a constant leaf shed rate parameter and ii) a disease load dependent leaf shed rate parameter.

For both a constant and a disease load dependent leaf shed rate parameter the results were qualitatively similar for both situations.

We show that the rate of immigration of infections from an external infection source decreases the ESS leaf shed rate parameter whereas the effective number of infections produced per lesion per day within the system increases the ESS leaf shed rate parameter. This difference is caused by the fact that only in the case of within system spore production, shedding leaves and therefore reducing the infection load early in life has benefits for the plant's future.

Under a low external disease pressure adopting a disease load dependent leaf shed strategy seems to be much more efficient than adopting a constant leaf shed strategy. This because a plant adopting a disease load dependent leaf shed strategy does not shed any leaves in the absence of infection.

Additional results derived from the model show that the leaf shed rate parameter increases with nutrient availability and decreases with plant density, which has led to defining new hypotheses that are testable in the field. Experimental tests of these hypotheses are underway.

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