Ecological Observations

7. The simultaneous evolution of plant defense and competitiveness: natural selection.

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ABSTRACT: Plants in nature that are attacked by herbivores and pathogens often occur in communities with other plants that represent potential competitors. Therefore, one would expect the simultaneous evolution of defense and competitiveness in many cases. However, optimality theory for plant defense evolution, currently the best theoretical framework to understand this problem, predicts an evolutionary tradeoff between competitiveness and defense. To test for the tradeoff, we recently took a more direct approach than previous studies by examining the effects of genetic variation in competitiveness on defense expression. Our results were in apparent contrast to optimality theory. We found that competitiveness and defense were sometimes positively correlated, possibly because some plants deploy defenses that also function in competition. More interesting was our result on how plants may deploy defenses with putative dual functions. When fed upon in competitive environments, better competitors switched from an apparent toxin-based strategy to a growth-based compensatory (tolerance) strategy. Recent theoretical studies on the simultaneous evolution of resistance and competitive ability found that plants may switch to a tolerance strategy when natural selection by competitors is greater than selection by herbivores. These patterns of selection may also have shaped the plastic switch that we observed. To estimate the strength of natural selection we conducted path analysis and microsatellite genotype mean correlations on field collected data and tissues within a population of Boechera drummondii in the Black Hills. Microsatellites identified variation among inbred lines. Path analysis showed selection by competitors to be relatively high, but this may be cancelled by facilitation. Microsatellite correlations showed curvilinear selection gradients by herbivores, and thus far we have found significant variation among inbred lines in competitiveness measured in the lab, and most competitive inbred lines are more common in the population. Patterns of selection in nature are likely to be more complicated than predicted by theory.