GENE EXPRESSION IN ECOLOGICALLY MEANINGFUL CONTEXTS: EVOLUTION OF PLANT DEFENSE IN COMPETITIVE ENVIRONMENTS

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ABSTRACT

Plants in the wild are attacked by herbivores and pathogens and often grow next to other plants that represent potential competitors. Therefore, in some cases one would expect the simultaneous evolution of defense and competitiveness in plants. However, the optimal defense hypothesis predicts a tradeoff between these factors. Plants that compete effectively against neighbors are expected to have lower defense levels because growth diverts limited resources away from production of defensive compounds. In contrast to these predictions, recent studies have found evidence that some plant species may be able to simultaneously compete and defend effectively. One hypothesis for this result is that some defensive traits, such as toxin concentration, have dual functions in defense and competition.

In two growth room experiments in which we examined glucosinolate (plant toxin) concentrations and transcript profiles of Boechera stricta, a close wild relative of Arabidopsis thaliana, we tested (1) whether neighboring plants elicit defense responses, and (2) whether there was overlap in gene expression patterns between herbivory and competition treatments. In one experiment involving three treatments (herbivory, competition, control) we observed over 500 significantly differentially expressed genes and evidence that competition elicited genes with known function in defensive pathways.

Key Words

Fenomics, microarray, Optimal Defense Hypothesis