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## Plant wound responses

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## Abstract

The existence of several distinct plant signaling pathways regulating changes in gene expression in response to wounding has been demonstrated using cDNA microarray analysis.

## Significance and context

Being sessile, plants are subject to various types of physical damage from insect feeding, wind, hail and other environmental stresses. Such damage is commonly referred to as wounding. The complex responses of plants to wounding have been extensively studied in recent years, and numerous wound-responsive genes have been identified in various species. The phytohormones ethylene and jasmonic acid (JA) and some of its derivatives have been implicated in the regulation of such genes. Using a cDNA microarray with 150 selected *Arabidopsis thaliana* expressed sequence tags (ESTs), Reymond *et al.* performed a comparative gene expression profiling analysis with various distinct wound-related stimuli in wild-type *Arabidopsis* as well as in two *Arabidopsis* signaling mutants.

## Key results

A time-course study of mechanically wounded *Arabidopsis* leaves revealed groups of genes with similar expression behavior. Among the earliest responses was the activation of various genes implicated in pathogen resistance, including *PR-1*, *PR-2* and *PR-5*, as well as two genes encoding mitogen-activated protein kinases (MPK3 and MEKK1). The early activation of a set of genes with a potential function in defense could reflect the need to prevent opportunistic pathogen infections at open wounds. Another group of co-regulated genes includes two genes encoding enzymes involved in JA biosynthesis (LOX2 and AOS). Interestingly, the temporal expression pattern of these genes coincides with the kinetics of JA accumulation after wounding, suggesting a causal relationship between LOX2 and AOS transcript accumulation and JA biosynthesis.

Using the JA-insensitive *Arabidopsis* mutant *coil*, the authors could categorize wound-responsive genes into two basic classes: a class of *COII*-dependent genes for which activation, or repression, by wounding appears to be mediated by JA; and a class of *COII*-independent genes whose wound-responsiveness appears not to be mediated by JA. To identify a potential signal involved in the regulation of the *COII*-independent group of genes, ethylene was investigated. Surprisingly, expression

of none of the wound-responsive genes analyzed in this study was substantially altered in the ethylene-insensitive *ein2-1* mutant as compared to wild-type plants. Thus, ethylene plays no essential role in the regulation of the large number of wound-responsive genes examined in this study.

Dehydration of the leaves was found to induce expression of many wound-inducible genes, including 13 *COII*-independent genes. Hence, water stress as a result of tissue damage might constitute a distinct stimulus responsible for the activation of some genes after wounding. Only a subset of genes activated by artificial wounding was activated in response to insect feeding by larvae of the cabbage white butterfly *Pieris rapae* however; and feeding of these larvae had little effect on water stress-inducible genes. The authors suggest that these profound differences might result from the specific feeding strategy of *P. rapae* larvae, which avoid generating large surfaces of crushed leaf tissue, thereby minimizing water stress within the leaves. This specific feeding behavior may limit the activation of host defense genes to a subset that has no significant impact on insect fitness.

## Links

[Supplementary information to \*Plant Cell\* 12:707-719](#) including technical details about the cDNA microarrays used, can be accessed from the [Farmer research group](#) website. A comment on this paper appeared in the [In this issue section of \*Plant Cell\* 12\(5\)](#) and is available free online.

## Reporter's comments

This study is an interesting example of the dissection of a regulatory pathway based on the economical use of cDNA microarrays representing only a limited number of genes. The high reliability of this study was demonstrated by multiple repetitions (up to nine) of selected experiments.

## Table of links

[Plant Cell](#)

[Supplementary information to \*Plant Cell\* 12:707-719](#)

[Farmer research group](#)

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## References

1. Reymond P, Weber H, Damond M, Farmer EE: Differential gene expression in response to mechanical wounding and insect feeding in *Arabidopsis*. *Plant Cell*. 2000, 12: 707-719. 1040-4651