



Plant Cells "Black Out" when Eaten by Leafworms

A German-Italian team of researchers shows that when plant tissue is eaten by insects, it causes a decrease in electric voltage

When an Egyptian cotton leafworm eats the leaves of a lima bean plant, the natural voltage at the membranes of the plant's cells changes in a matter of seconds. This insight is the result of investigations by scientists led by Professor Massimo Maffei of the University of Turin, Italy, and Professor Wilhelm Boland, of the Max Planck Institute for Chemical Ecology in Jena. The membrane potential drops abruptly; within a short space of time, depolarisation spreads out across the leaf under attack. This "electrical black out" drastically reduces the ability of the plant's cells to react and protect themselves against getting eaten by the leafworm. The scientists are now trying to determine the identity, origins, and functioning of every substance responsible for these electrical changes (Plant Physiology, March 13, 2006).

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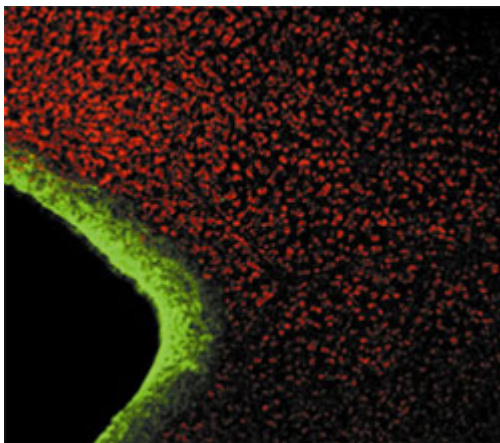


Fig.: *Magnified view of a leaf where leafworms have been feeding. The green colouring indicates calcium-ion influx.*

Image: Simone Bossi, University of Turin

Every cell is surrounded by a plasma membrane. It determines the cell's dimensions and controls differences between the cell's contents and its environment. The membrane thus determines how nutrients enter the cell. This creates varying ion concentrations between its interior and exterior and generates membrane potential. Experiments in the current study have shown that in the case of lima bean leaves (*Phaseolus lunatus*) attacked by Egyptian cotton leafworms

(*Spodoptera littoralis*), the voltage at the membrane drops from about -130 to -90 millivolts within seconds. This depolarisation spreads out quickly across the attacked leaf.

The scientists then moved on to investigate if this electrical effect plays any role in protecting lima bean plants against their attackers. The researchers investigated two defence and signalling substances in leaves attacked by pathogens: Hydrogen peroxide (H_2O_2), and calcium ions. The scientists used soybean cell cultures to determine that cellular calcium ion amounts increased with concentration of hydrogen peroxide in the nutrient solution. A confocal Laser Scanning Microscope (see image) then showed that calcium ion concentration in the attacked leaves - in the presence of H_2O_2 - was clearly smaller than in mechanically wounded leaves. That could itself drastically reduce the ability of the plant's cells to react.

Voltages across biological membranes are important and measurable features of every living cell - human, animal, or plant. Thus, plasma membranes also serve to detect and communicate external signals, allowing cells and entire tissues to react efficiently to changes in their environment. Pests eating plants are one example. Whether the depolarisation measured in this experiment ultimately benefits the pest, as it appears, and not the plant, still needs to be investigated.

[EC]

Original work:

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Effects of Feeding *Spodoptera littoralis* on Lima Bean Leaves. III: Membrane Depolarization and Involvement of Hydrogen Peroxide

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