Proactive chemical ecology: Portable instrumentation for identifying pheromones of invasive insect pests

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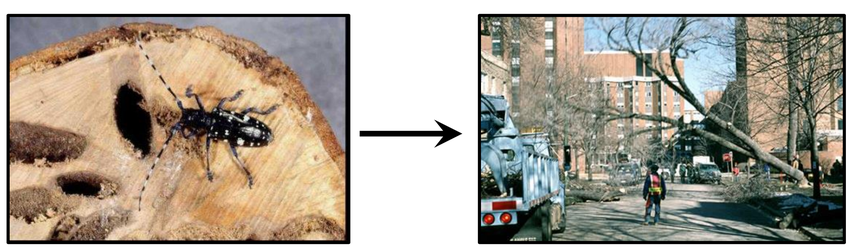
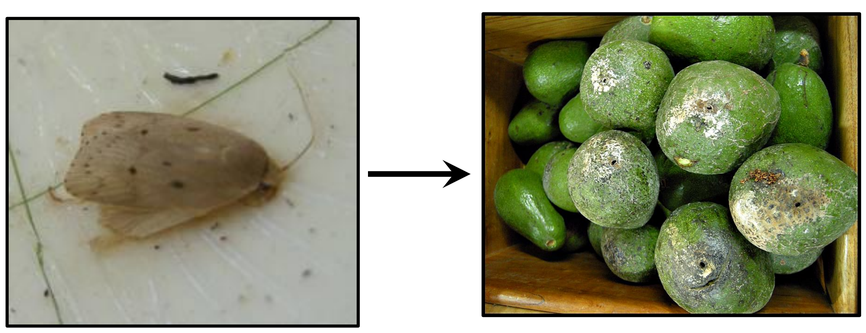
Introduction: The rapid expansion of global trade has resulted in a flood of invasive insects and pathogens entering California and the United States. Recent examples include the Asian citrus psyllid (the vector of citrus greening disease), light brown apple moth, European grapevine moth, and the stink bug *Bagrada hilaris*. California is particularly susceptible to invasive species because of its many ports of entry, its temperate to subtropical climate suitable for exotic insect species, and its diversity of habitats and hosts.

To date, most efforts to control this onslaught have been reactive rather than proactive. That is, effective methods of detecting, controlling, or eradicating exotic insects often are only intensively studied after the pests have arrived. In most cases, this is too late because by the time effective detection and control methods have been worked out, invaders have become too widely established to eradicate. Difficulties with eradications are exacerbated by widespread and well publicized opposition to the methods needed. As a result, new insect pests become permanently established, resulting in damage to crops, urban landscapes, and forests, increased pesticide applications for their control, and increased fumigation of commodities for export markets.

Examples of invasive insects and their damage



Tree-killing Asian longhorned beetle



Avocado seed moth

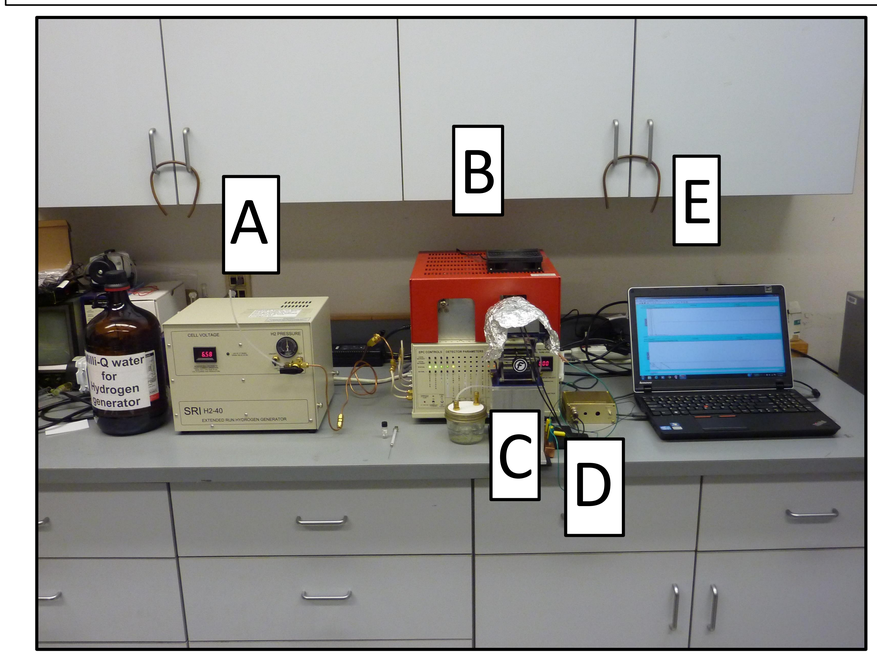
Red palm weevil

Project rationale:

- Target exotic insects that are likely to be introduced into California, with a high risk of becoming established, and a high risk of causing major economic damage.
- Identify pheromones or related attractants of these pests **in their native countries, before the insects arrive in the US.**
- **Use these attractants to detect incursions of exotic pests into the US at the earliest possible moment.**

Project Goals:

- **Develop a fully portable, coupled gas chromatograph-electroantennogram detector to identify pheromones from invasive insects in their native countries.**
- **Develop these pheromones for use in detecting incursions of invasive insects into California and the US.**



Portable gas chromatograph-electroantennogram detector.
A: Portable hydrogen generator, to supply carrier gas
B: Portable gas chromatograph
C: Live antennal preparation for detecting pheromones
D: Custom-built amplifier
E: Data system, simultaneously records GC and antennal signals

Acknowledgments:
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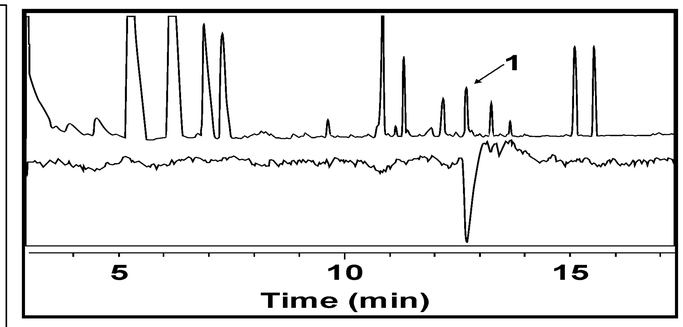
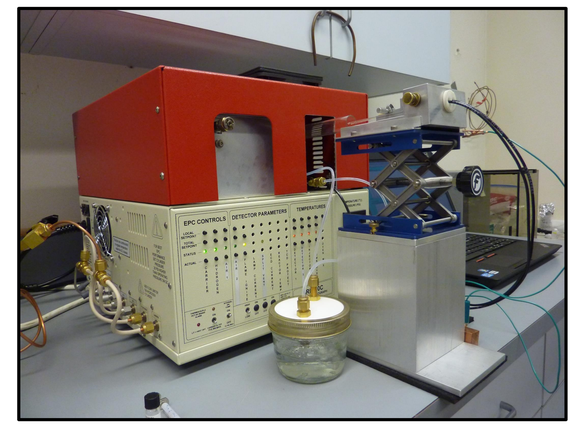
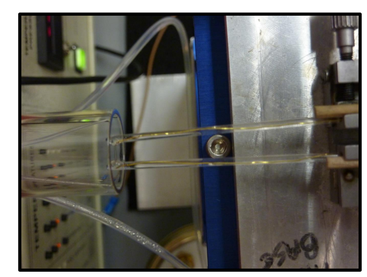


Gas chromatogram-electroantennogram responses of an insect antenna to a pheromone extract.
Top trace: Gas chromatogram
Bottom, inverted trace: response from a live insect antenna.



Front of GC and antennal mounting block.



Live insect antenna between two electrodes

Summary:

- All required instrumentation assembled.
- System going through final lab checkout.
- **Next step**: Pack and take equipment on US field trips to identify any problems before taking equipment overseas as checked baggage.