Identifying invasive insect pests: DNA barcodes and sentinel plants

Identifying invasive insect pests is problematic. There are not enough experts (taxonomists) to classify insects. Many alien species arrive in ports as larvae or eggs and classification keys are for the adult life stages; and there over one million insect species a quarter of which have not yet been named or discovered. You get some idea of the scale of the problem.

It is important to identify insect pests accurately to recognize if they are an invasive alien and to control them effectively. Trained entomologists can identify a specimen to a family group but assigning a species name is almost impossible. Researchers from INRA-Orléans and BOKU-Vienna are addressing the problem of insect pest identification in ISEFOR[1] http://www.isefor.com/ a collaborative research project funded by EU-FP7-245268.

One way round some of the problems is to use genetic markers. Genetic marker, or molecular, methods are fast and mostly reliable. They can help identify eggs and larval instars that cannot be identified by traditional methods and they can distinguish between similar (cryptic) species. Known insect species in a sample of plant material can be identified by distinctive bits of their genetic material called DNA-barcodes. Unknown species can be resolved by classical DNA-sequencing. Specimens from mass catches in pheromone and other traps can be identified by comparing extracted DNA against a database of DNA-barcodes. This stepwise approach to identification is cheaper, faster and more reliable for insect pests compared with Next Generation Sequencing (NGS) that is commonly used to identify pathogens. "*NGS methods are unsatisfactory for insects because the species dominating in insect traps can outnumber under-represented species and some insects would be undetected"* said Marie-Anne Auger-Rozenberg, a senior scientist from INRA Orléans.

Identifying insects that are known to be pests may be problematic enough but identifying unknown or potential pests requires really imaginative approaches. One such novel approach is the Sentinel Tree Plantation. A sentinel plantation is

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a group of trees examined regularly to detect unknown potential pests: it is an early-warning technique for new invaders.

Most serious invasive plant pests and pathogens are not pests in their region of origin. They become pests in other regions because they are introduced without their natural enemies and their original host plants are more resistant than plants in the invaded region. "*A straightforward experiment, in that sense, is to use sentinel trees to detect new potential pests* ***before*** *they leave their region of origin*" said Alain Roques from INRA who is leading the Sentinel Tree Plantation research in ISEFOR.

Alain's team planted **European** trees as sentinels in China in 2008: monitoring them at regular intervals to survey colonization by indigenous arthropods. A total of 39 Asian insect species were found to regularly infest these sentinels: mostly coleopterans, followed by lepidopterans, a few bugs (hemiptera) and phytophagous hymenopterans.

In spring 2012 ISEFOR researchers started another Sentinel Tree experiment to identify the pests attacking **local** (Asian) tree species that are imported into Europe: *Buxus microphylla*, *Acer palmatum*, *Fraxinus chinensis*, *Ilex cornuta*, and *Zelkova schneideriana*. Two nurseries in Fuyang and Beijing were surveyed for insects and insect-damage every two weeks and the larvae and adult insects collected. To date 71 insect types corresponding to more than 20 families were found with large differences in insect communities between the tree species. One tree species carried as many as 63 insect types and three tree species only one insect type. Only 11 of the insect types captured could be identified by traditional methods: the remaining 60 types will be characterized by DNA sequences and the analyses are in progress. Marie-Anne Auger-Rozenberg said *"Our findings from these sentinel plantations will be most relevant for forest owners, importers and phytosanitary control managers*".

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