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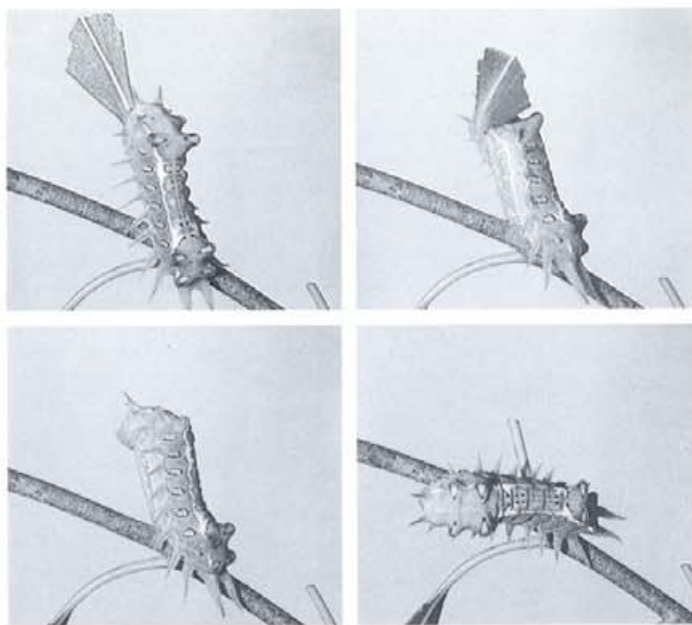
David Brett

Response and attitudes of the public after one year of ADVISE dynamic signs. R.S. Trayford, T.B. Crowle, and J. Graves. *14th Australasian Transport Research Forum, Perth, W.A., September 1989.*

Insect outwits tree?

Plants and the insects that eat them have been 'at war' for aeons. Although the plants may sometimes seem to be struggling (for example, when trees lose all their leaves to Christmas beetles), many fight back by producing toxic or at least digestion-inhibiting compounds in their leaves.

A step more refined than this is the chemical defence that is actually 'switched on' by the insects' attack. Such induced defences have recently been demonstrated in several species of deciduous and coniferous trees. Nobody yet knows whether our native trees, the eucalypts, are similarly gifted, but some interesting observations by Dr



A larva of the cup moth, *Doratifera oxleyi*, feeds on a eucalypt leaf and then removes the half-eaten leaf. The third picture shows it chewing the remaining stump; finally it moves away to find another leaf.

Penny Edwards of the CSIRO Division of Entomology have suggested that they may well be.

She and her colleague Mr Wolfgang Wanjura observed a number of different insect larvae 'cutting off' the eucalypt leaves on which they had been feeding.

All the insect species involved showed remarkably similar behaviour. After feeding on a leaf for an hour or more, the larva moved to the stem and started to chew at the petiole or leaf-stalk, at the base of the leaf. Eventually the leaf fell off. Then, curiously, the larva continued to chew at the stump on the stem for several minutes before heading off to find another leaf.

If the insect was disturbed it appeared unwilling to leave the task uncompleted, for it returned to the job rather than departing to find a new leaf.

The larvae of sawflies often feed together in a clump on one leaf; Dr Edwards found that when a group moved from a leaf the last larva to leave carried out the cut.

Now, this leaf-cutting behaviour has occasionally been observed on other species of plants overseas. A

fairly obvious explanation for it is that damaged leaves could 'give away' the insects' presence to predators or even parasitic wasps seeking clues to the whereabouts of potential hosts in which to lay their eggs.

But Dr Edwards has a convincing case for a completely different explanation. She believes that, by removing the leaf upon which they have been feeding, the insects are sabotaging an induced defence in the tree.

Usually, induced defence works like this: the damage to the tissues brought about by insect feeding causes the release of a chemical that is thought to diffuse from the leaf to neighbouring leaves, which respond by increasing their levels of toxic or repellent compounds.

By cutting off the leaf before a certain time has elapsed, the larvae prevent the signal from getting through. They can then feed in safety upon another nearby leaf of the same plant.

Evidence for this idea comes from the observation that most of the insect species involved do not always carry out these actions; the variation may depend on the host plant. If the behaviour were providing protection from parasites and predators, the pressure of natural selection would most likely have ensured that it was always performed, but clearly if at times the plant produces little or no induced response and the insect can detect this, then the behaviour is not necessary.

Moreover, several of the species that pursue this habit don't seem to be trying to hide themselves from anyone — they may be conspicuously coloured, or already have

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defence mechanisms in the form of offensive fluids. Furthermore, they often rest between feeding bouts on a partly eaten leaf.

The need to chew on the remaining stump once the leaf has fallen also requires some explanation. If removing evidence of your feeding is the aim of cutting off the leaf, why bother to spend several minutes chewing where the leaf joined the stalk? Dr Edwards speculates that perhaps the insects are applying secretions to neutralise any signal molecules that may already be present.

Of course, these ideas are still only speculative, and more research is needed. However, the concept of insects sabotaging induced defences should not be considered as unrealistic. Scientists know that some species of beetle prevent the transmission of defensive molecules by plants in the cucumber family by cutting a trench around the area of leaf that they are eating.

Dr Edwards and Mr Wanjura are currently carrying out more experiments. They are preventing a group of leaf-cutting larvae from performing their ritual; every time the larvae start cutting, they will be removed to another leaf, thus allowing the originally eaten leaf to send any signal.

If the plant does produce defensive compounds as a result, we may know by following the fate of the insects condemned to feed on it. Will they grow more slowly than an identical group of larvae permitted to carry out their putative 'sabotage'? Watch this space.

Roger Beckmann

Eucalypt feeding insects bite off more than they can chew: sabotage of induced defences? P.B. Edwards and W.J. Wanjura. *Oikos*, 1989, **54**, 246–8.