THE ENEMY OF MY ENEMY IS MY FRIEND

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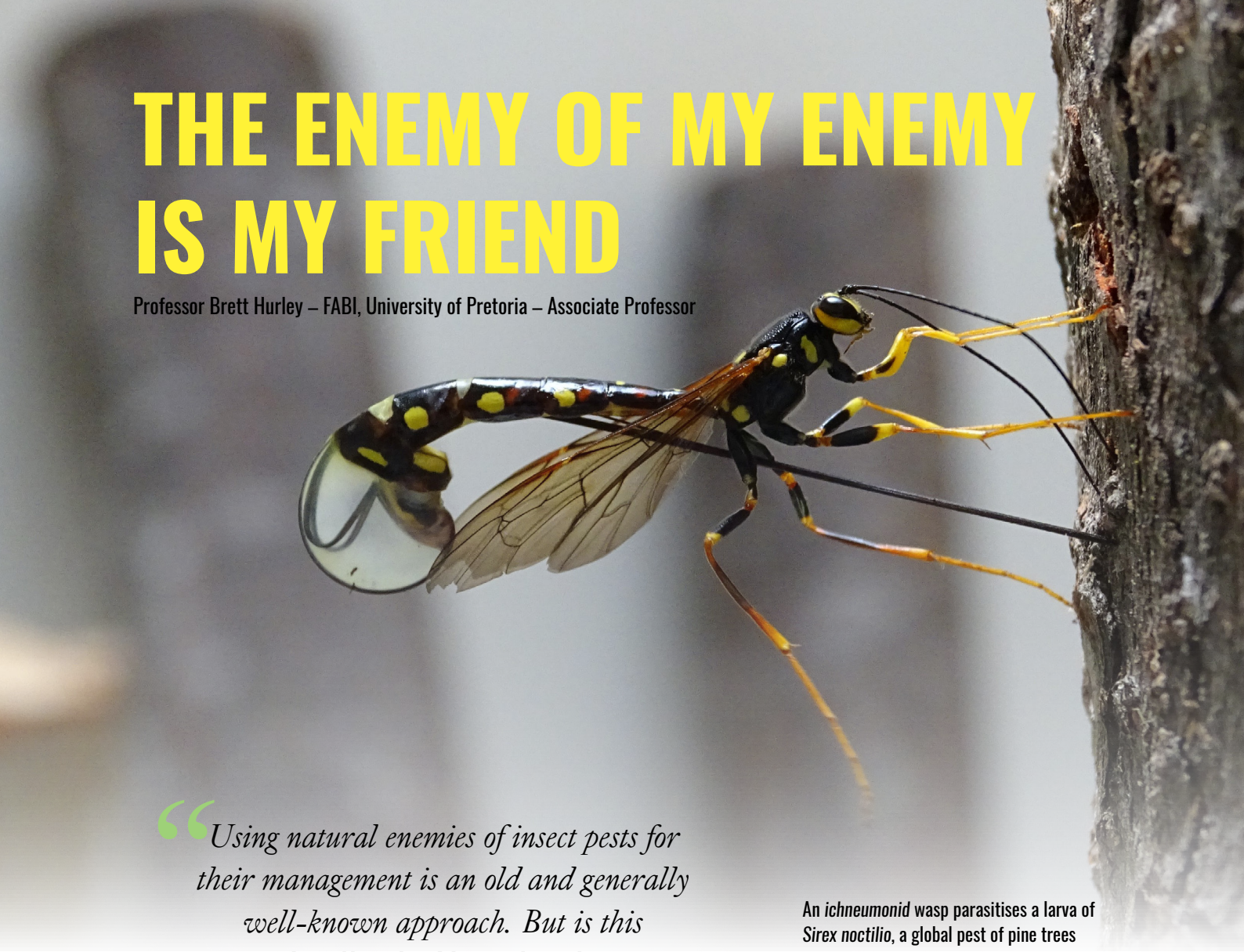

An *ichneumonid* wasp parasitises a larva of *Sirex noctilio*, a global pest of pine trees

"Using natural enemies of insect pests for their management is an old and generally well-known approach. But is this approach still valuable within the current and future plantation forestry landscape?"

The opinion shared in this article are the views of the author and not necessarily those of the University of Pretoria

THE PROVERB '*the enemy of my enemy is my friend*' is known from as early as the 4th century BC, where it is mentioned in the ancient Indian Sanskrit treatise, the Arthaśāstra. The doctrine underpinning this proverb has subsequently been referred to and followed in numerous major historic events, perhaps most notably the cooperation between the Allies (US and Britain) and the Soviet Union against the common Nazi enemy in World War II.

This proverb is also useful in explaining the pest management approach known as biological control. Simply put, this involves the use of a pest's natural enemies to reduce the population of that pest in the environment where it is not wanted. This approach is nearly as old as the proverb itself, being first reported around the 3rd century AD.

But is this approach still valuable as a pest management approach? Especially within today's plantation forestry environment, where new pests are being reported at an exponential rate and budgets to manage these pest incursions are tight.

THE VALUE: CURRENT AND POTENTIAL

Interestingly, biological control is particularly suited for use in plantation forests, due to the longer rotations in forestry, as compared to most agricultural crops, which offers

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more stability in the environment for the natural enemies to establish. Thus, establishment rates and successes of natural enemies are higher on pests of woody plants than on pests of herbaceous plants.

Most of the biological control used in South African plantation forests has been classical biological control (CBC) which involves the intentional introduction of biological control agents, usually non-native, with no further intervention. This approach is generally used as a tactic against non-native pests. A recent example is the release of a parasitic wasp (*Selitrichodes neseri*) of the Eucalypt gall wasp (*Leptocybe invasa*). Limited releases of hundreds of these parasitic wasps have resulted in their establishment (of likely millions or trillions) across eucalypt growing areas of the country – at very little initial cost.

Perhaps the best-known biological control programme in South African plantation forests is that of the Sirex woodwasp. Here, a form of augmentative biological control has been used, involving the mass production and annual inoculations of thousands of Sirex-infested trees with a parasitic nematode (*Deladenus siricidicola*). Contrary to a CBC programme, this augmentative approach involves continual expenses associated with the nematode production and in-field releases. That said, evaluations of the South African Sirex Control Programme showed that the reduction in losses associated with the use of biological control exceeded the costs by approximately R350 million over ten years.

Inoculations of a parasitic nematode to control populations of the *Sirex* woodwasp

Besides the economic value of biological control, this approach also offers an alternative to the use of insecticides when the use of the latter is not feasible due to environmental, regulatory or cost considerations. In some cases, biological control is the only effective management option available.

What is generally not considered is the massive value provided by natural biological control. This refers to the effect of indigenous biological control agents already present in the environment. For example, naturally occurring small tetraviruses that are thought to regulate populations of the pine emperor moth, causing muscular flaccidity and internal liquefication of the larvae. The action of these unsung, and largely unknown, heroes likely saves the forestry sector millions every year.

But perhaps of greater relevance is the potential to improve the role of these agents in regulating the pest populations. A conservation biological control approach involves modifying the environment or existing practices to protect and enhance the populations of existing natural enemies. This could be by providing a food source or shelter for the natural enemies. Such approaches are used very successfully for forestry pests in countries such as Colombia but remain largely unexplored in South Africa.

THE CHALLENGE... AND PROPOSED SOLUTIONS

Of course, if biological control was the 'silver bullet' for pest management, we would have no pest problems – and that is certainly not the case.

One of the benefits of biological control is also one of its challenges

– biological control agents, at least in a CBC approach, are host-specific. That's great news in terms of not having non-target effects, an attribute that often makes biocontrol preferable over insecticides. But it means that a biological control programme needs to be developed for each insect pest. This can be a costly and lengthy process; and, of course, not guaranteed to result in successful control of the pest.

A commonly acknowledged strategy within the biological control field to reduce this challenge is collaboration. The growing movement and establishment of many of the major insect pests is in a sense a saving grace, as it means there are many institutes and countries around the world with the same problem. Sharing of information and even the biological control agents themselves is commonplace between research programmes working on insect pests of plantation trees, thanks to initiatives such as BiCEP (Biological Control of Eucalypt Pests, bicep.net.au).

Changes in climate, new pest introductions and further introductions of new diversity of current pests complicate biological control approaches. Broader collections of biological control agents need to be considered and tested, to better match the agent with the pest population and climate. Collaborative networks can help to offset these challenges.

As with insecticides, the use of biological control needs to be regulated. Introduction of non-native species need to be tested for potential non-target effects on native or beneficial species, and new biological control products, such as entomopathogens, need to be registered. This can be a timely and very costly process.

In my experience, engaging with the government and other relevant bodies to provide input for the development of responsible and efficient regulatory and implementation policy is critical. Not many governments have the capacity to develop policy in response to the growing and changing needs associated with pest management options. Here, internationally relevant guidelines can be helpful, such as the recent publication of "Guide to the classical biological control of insect pests in planted and natural forests" by the Food and Agricultural Organization (FAO) of the United Nations (http://www.fao.org/documents/card/en/c/CA3677EN/).

Release of minute parasitic wasps imported from Australia for the control of an invasive eucalypt pest

But perhaps the biggest challenge with biological control is this – sometimes it just doesn't work. The reality is that although biological control is often a key tool for the management of forestry pests, this is not always the case. And even for insects where biological control has been used successfully, the addition of other approaches could be very valuable. Thus, an integrated approach, considering other viable control options such as host resistance, silvicultural control and chemical control is a must.

LOOKING AHEAD

Despite its long history, I believe the potential of biological control as a pest management strategy remains largely untapped. There have been many success stories of biological control to manage forest insect pests, in South Africa and abroad. But for this approach to remain a viable tool in a rapidly changing environment, we will need to adapt. Increased collaborations, including with relevant government departments; improved monitoring and optimizing of biological programmes to address potential drops in efficacy from new pest strains or a changing climate; and better use of natural enemies that are already present.

We will certainly face an increasing number of pest 'enemies' in the future. Some of these could threaten the sustainability of the forestry sector. It will be important not to forget our friends.