C7a: DEVELOPING SUCCESSFUL BIOLOGICAL CONTROL PROGRAMS IN FOREST PLANTATIONS

Is classical biological control viable in large scale forest plantations?

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The forest plantations (*Eucalyptus*, *Pinus*) have low biodiversity, increasing risks of pest outbreaks and difficulting biological control, mainly in *Eucalyptus* plantations due to short rotation (6-7 years). The last two decades had a substantial increase in the introduction of exotic pests, mainly to *Eucalyptus*. The strategy to manage these pests is only Classical Biological Control (CBC) wit the introduction of specific parasitoids from Australia. In Brazil, the use of *Cleruchoides noackae* x *Thaumastocoris peregrinus* in *Eucalyptus* and *Xenostigmus bifasciatus* x *Cinara atlantica* in *Pinus* had succesand that of *Psyllaephagus bliteus* x *Glycaspis brimblecombei* success and *Anaphes nitens* x *Gonipterus platensis* (parasitism decreasing since 2012 in SP and Parana States) partial success *Selitrichodes neseri* x *Leptocybe invasa* is under evaluation. The forest plantations have the advantages of receiving fewer spraying of chemical insecticides; maintenance of native forest in 25 to 30% of the total area in Brazil and understory, which promoting refuge areas; fast establishment of natural enemies in tropical and subtropical regions; few intense silvicultural procedures and better acceptance to CBC due to forest certifications systems. The main constraints are farmers without full information access on new exotic pests and to CBC programs; regulatory rules increasingly harder; slow parasitoid production in laboratory conditions; difficult field releasing in large areas; complicated logistic to shipping natural enemies in distant areas; lack of governmental programs and funds to implement them.

Biocontrol in practice: managing *Gonipterus platensis* in Portugal

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In Europe, Portugal is the country with the largest area planted with *Eucalyptus*. These plantations are the main source of raw material for pulp and paper production, one of the most important industries in the country. The Tasmanian blue gum, *Eucalyptus globulus*, is the forest species most planted in the Country, covering more than 0.8 million ha. This species is particularly susceptible to the attacks of the *Eucalyptus* snout Beetle, *Gonipterus platensis*, an Australian insect present in Portugal since 1995. Even though the populations of the Snout Beetle have been partially controlled by the Australian egg parasitoid Anaphes nitens, wood losses have accrued to about 1 million m^3 per year. In order to reduce the Snout Beetle's impact, an integrated pest management programme has been implemented. The programme includes the development of classical biological control with Australian egg and larval parasitoids, the replacement of vulnerable eucalypts with more resistant or tolerant ones, and the use of insecticides. In the present work we describe this strategy and discuss its results.

Biocontrol in practice: managing *Sirex noctilio* in South Africa

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The woodwasp *Sirex noctilio* was first reported in South Africa in 1994. Since then this invasive insect has spread throughout the main pine growing regions of the country. Mortality of pine trees caused by infestations of *S. noctilio* have been severe, especially in the summer rainfall areas of the country. In response to these infestations, a management programme was initiated, with biological control using the parasitic nematode, *Deladenus siricidicola*, as the main control method. Initial low and varying parasitism levels using this nematode led to studies to examine the influence of environment and genetic diversity on the establishment and virulence of *D. siricidicola*. Inoculation trials and laboratory experiments indicate that the tree environment, particularly the moisture content and bluestain fungi present in the wood, indirectly influence parasitism levels by competing for the fungal food source of the nematodes. Development of molecular markers for the nematode has enabled comparison of populations within South Africa and between other countries, revealing a clonal population in South Africa. This has led to the collection and characterisation of *D. siricidicola* populations from around the world, comparing the virulence of these populations and investigating possibilities to increase fitness through hybridisation. Research is ongoing to further our understanding of factors influencing parasitism and use this information to optimize the biological control programme.

Biocontrol in practice: managing *Thaumastocoris peregrinus* (Hemiptera: Thaumastocoridae) in Brazil

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Biological control is the main strategy to manage the bronze bug *Thaumastocoris peregrinus* (Hemiptera: Thaumastocoridae) in Brazil. This important exotic pest has been introduced in Brazil, severely damaging eucalypt plantations. The bronze bug biological control program has been supported by studies including pest life table analyzes, impact of native natural enemies and using the exotic parasitoid *Cleruchoides noackae* (Hymenoptera: Mymaridae). Laboratory studies indicated the specificity and efficiency of *C. noacke* to control bronze bug. After its first release in the field in 2012, the establishment of *C. noackae* has been found in several Brazilian states. In 2013, the area infested with *T. peregrinus* decreased compared to 2012, which was attributed to parasitoid efficiency in field. Otherwise, variations in bronze bug infested area from 2013 to 2018 may be related to non-establishment of this parasitoid in some regions and the impact of chemical control. The results obtained with the biological control program of the bronze bug in Brazil show the efficiency of *C. noackae* in adequate conditions. Instead of its results controlling the bronze bug, several issues need to be addressed to increase its efficiency and use. Which include: establishing facilities for mass rearing; periodic releases of this parasitoid in the same site; evaluation of impact by chemical and microbiological insecticides and maintaining of the parasitoid in forestry companies, research institutes and universities. The successive use of *C. noackae* and the answers to questions addressed will increase the beneficial effects of this parasitoid in integrated management of *T. peregrinus*.