IS *IPS GRANDICOLLIS* DISRUPTING THE BIOLOGICAL CONTROL OF *SIREX NOCTILIO* IN AUSTRALIA?

Angus J. Carnegie[1] and Andrew D. Loch[2]

[1]Forest Health and Resource Assessment, Biosecurity Research, Industry and Investment NSW, Forest Science Centre, PO Box 100, Beecroft, NSW, 2119, Australia

[2]National Wine and Grape Industry Centre, Industry and Investment NSW, Locked Bag 588, Wagga Wagga, NSW, 2678, Australia
Email: angus.carnegie@industry.nsw.gov.au

ABSTRACT

Sirex woodwasp (*Sirex noctilio*) is considered one of the most serious threats to exotic *Pinus radiata* plantations in Australia. This exotic wasp has been established in Australia for more than six decades. The most significant outbreak occurred in the Green Triangle region of southeastern South Australia-western Victoria in the late 1980s, where more than 5 million trees were killed (Haugen 1990). This outbreak highlighted the need for a national strategy for *Sirex* control and led to the development of the National Strategy for Control of *Sirex noctilio* in Australia (Haugen 1990). The implementation of this strategy during the 1990s resulted in a significant reduction in outbreaks of *Sirex* in Australia (Carnegie et al. 2005, Collett and Elms 2009).

Over recent years, an inconsistency, and in some cases gradual decline, in nematode parasitism rates of *Sirex* has been emerging from inoculated trap trees in several regions in Australia. In parallel with this has been an increase in the numbers of *Ips grandicollis* bark beetles in several pine-growing regions. Like *Sirex*, *I. grandicollis* is also attracted to stressed trees (Erbilgin et al. 2002); and in New South Wales (NSW) and South Australia, it has been attacking trap trees poisoned for the *Sirex* biological control program. This is likely to create a problem for *Sirex* control. *Ips grandicollis* populations peaked in NSW in 2006-2007, resulting in large areas (more than 17,000 ha) of tree mortality associated with a corresponding drought and bark beetle attack (Carnegie 2008). It is believed that milder winter temperatures enabled more generations to overwinter than in more normal years with colder winters. In parallel with the increase in *I. grandicollis* numbers, surveys have revealed that the majority of trap trees (established for the *Sirex* biological control program) in Hume Region (NSW) have been attacked by *I. grandicollis* over the past few years. With the decrease in nematode parasitism and increase in *I. grandicollis* numbers, is *I. grandicollis* (plus *Ophiostoma ips* and/or *Ips*-nematodes) disrupting the biological control of *Sirex*? Several research projects have been initiated in Australia to investigate this problem.

The first project aimed at quantifying the efficacy of anti-aggregation pheromones (deterrents) in reducing *I. grandicollis* numbers and damage to *Sirex* trap trees. It was thought that *I. grandicollis* attack on trap trees may be reducing the attractiveness of trees to *Sirex* and/or the efficacy of the biological control agents. Five paired trap-tree plots were established in mid-November 2007 in *P. radiata* plantations in each of two State Forests in Hume Region, NSW (a total of 200 trees). North American colleagues recommended a push-pull strategy for *Ips* control (K. Dodds and D. Miller, U.S. Forest Service). The "push" part of the strategy involved putative anti-aggregation pheromones (verbenone pouches and *Ips*dienol caps) placed on trees in treatment plots, two of each per tree per month. Control trees were left untreated. Early field observations indicated that *Ips*dienol was not an effective anti-aggregant for *I. grandicollis* (and in fact may be an aggregant/attractant), so its use was discontinued after 1 month. Several researchers also showed *Ips*dienol to be an aggregant (Dodds and

Miller, unpublished) while others showed it to be an anti-aggregant (Wilson 1995). The "pull" part involved intercept panel traps, baited with *Ips*enol and alpha-pinene, placed near the plots. Monthly assessments were made of *I. grandicollis* and *Sirex* attack and the rate of tree morbidity (i.e., how quickly poisoned trees were dying), as well as emergence data (in 2008/2009)

The main finding was that the push-pull strategy did not work; *I. grandicollis* attacked treated and untreated (control) trees similarly. All but a few trees had been attacked by *I. grandicollis* by May 2008 (Fig. 1). *Ips grandicollis* appeared to attack trees once the foliage changed to less than 50 percent green and greater than 50 percent red (Figs. 1-2), which occurred 2 months after trees were poisoned. There may be several reasons for this failure; perhaps levels of *I. grandicollis* were too high (i.e., too much bark beetle pressure) or poisoned trees emitted a higher level of attractants than the deterrents we applied.

Results also showed that 50 percent of trees were also attacked by *Sirex*. Observations (and evidence) of female *Sirex* ovipositing indicated they preferred

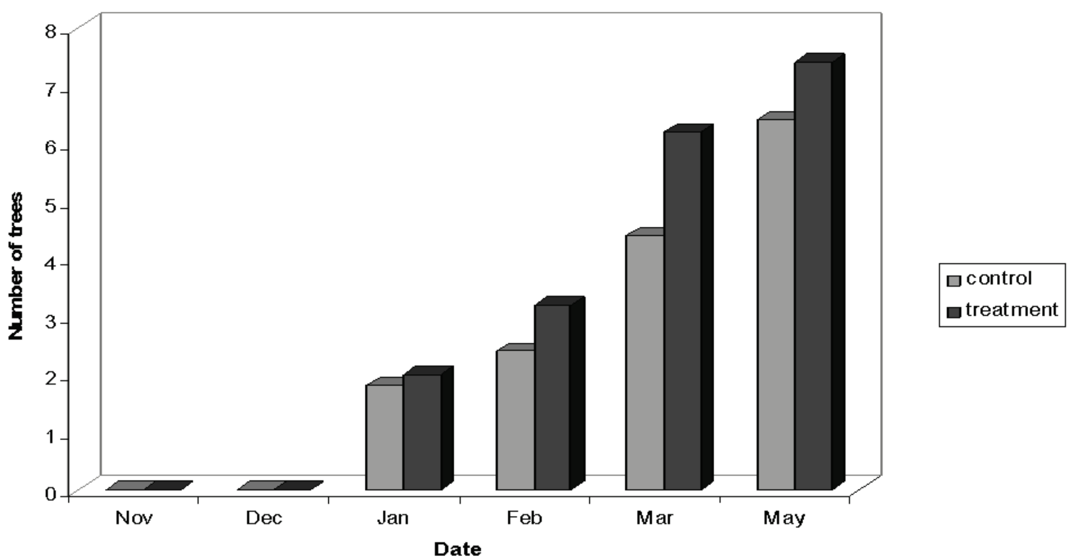

Figure 1—Observed *Ips grandicoli* attack on paired trap-tree plots (treated and untreated) in Buccleuch State Forests.

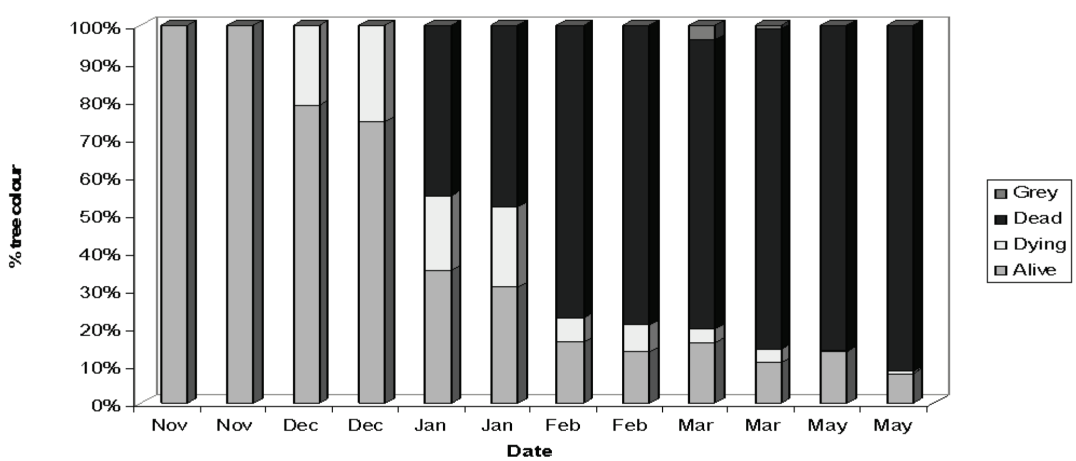

Figure 2—Rate of tree morbidity of trap trees in Buccluech State Forest following poisoning in November 2007.

Ips-free trees and trees with some green foliage. Observations of *Sirex* emergence holes on billets from selected trees showed that wasps emerged not only in areas (on billets) where there was no *I. grandicollis* attack, but also in areas of high levels of attack. Importantly, nematode parasitism of *Sirex* emerging from *Ips*-attacked trees was variable and inconsistent, but low (7 to 44 percent). Similarly, parasitism by *Ibalia leucospoides* was variable (15 to 90 percent, mean 50 percent).

In summary, it appears that *I. grandicollis* attack does not stop *Sirex* or *I. leucospoides* developing in trees, but may affect the length of time (window of opportunity) that *Sirex* can oviposit in trees and may affect nematode parasitism. Research on this is continuing: further investigations are planned on interactions between *Sirex* and *I. grandicollis*, and associated fungi and nematodes, and on optimization of trap tree establishment techniques.

Literature Cited

Bedding, R.A. 2009. **Controlling the pine-killing woodwasp, *Sirex noctilio*, with nematodes.** In: Hajek, T.R.; Glare, T.R.; O'Callaghan, M., eds. Use of microbes for control and eradication of invasive arthropods. Springer Science+Business Media B.V: 213-235.

Carnegie, A.J. 2008. **Exotic bark beetle turns nasty in pine plantations**. Bush Telegraph. Autumn 13.

Carnegie, A.J.; Eldridge, R.H.; Waterson, D.G. 2005. **The history and management of sirex wood wasp, *Sirex noctilio* (Hymenoptera: Siricidae), in New South Wales, Australia.** New Zealand Journal of Forestry Science. 35: 3-24.

Collett, N.G.; Elms, S. 2009. **The control of *Sirex* wood wasp using biological control agents in Victoria, Australia**. Agricultural and Forest Entomology. 11: 283-295.

Erbilgin, N.; Nordheim, E.V.; Aukema, B.H.; Raffa, K.F. 2002. **Population dynamics of *Ips pini* and *Ips grandicollis* in red pine plantations in Wisconsin: within- and between-year associations with predators, competitors, and habitat quality.** Environmental Entomology. 31: 1043-1051.

Haugen, D.A. 1990. **Control procedures for *Sirex noctilio* in the Green Triangle: review from detection to severe outbreak (1977-1987).** Australian Forestry. 53: 24-32.

Wilson, I.M. 1995. **Antiaggregants for the mountain pine beetle.** Burnaby, BC: Simon Fraser University: 1-78. Masters Thesis.