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SIREX MANAGEMENT- SYLVICULTURE, MONITORING AND BIOLOGICAL CONTROL (AN INTRODUCTION)

John Madden, University of Tasmania, Agricultural Science Department, GPO Box 252C, Hobart, Tasmania 7001, Australia.

Although the subject of the workshop was "Training in the Control of *Sirex noctilio* by the use of parasitoids" reference was made to the complementary role of nematodes and the necessity to rigorously execute sylvicultural practices and management at the correct time. It is appropriate therefore to reflect on the early attempts to control *Sirex* within the context of the host tree and the dynamics of *Sirex* infestation and outbreak behavior. This discussion Is extended to highlight key strategic aspects of *Sirex* management which, in practice, are considered more fully in subsequent contributions.

A number of hypotheses have been advanced as to the cause of *Sirex* outbreaks among which the incidence of drought and tree suppression are featured as causal factors as discussed by Rawlings and Wilson (1949). These authors also stressed the importance of sound sylviculture. In a review of major outbreaks in Australasia Madden (1988) found that most outbreaks were characterized by managerial or environmental events. These events preceded the damage that was attributed to *Sirex* and which negatively affected plantation performance at the individual tree level. Such events included thinning and harvest operations during the *Sire-x* flight season, fire in the case of outbreaks at Mt Gambier and wind damage as experienced at two sites in Tasmania.

The capacity of the host tree, *Pinus radiata D.* Don., to progressively reduce the activity of its physiological systems to basal metabolic levels in response to increasing soil-water deficits (Rook *et al.* 1976) strongly suggests that drought *per se* is not a causal factor. This response of the tree to either progressive drought or low availability of water due to intense root competition In overstocked stands is an adaptation which favours survival during periods of environmental stress.

Therefore the weakening effects of fire or the accumulation of slash resulting from thinning or harvesting operations during the *Sirex* flight season and excessive damage and slash arising from forest operations during the flight season can provide an adequate supply of host material suitable for larval development. In addition the occurrence of high intensity rainfall over a short period of time can be sufficient to briefly terminate the period of aestivation which, in the absence of any immediate compensatory mechanism, results in acute physiological stress to individual trees rendering them attractive to attack, inoculation

of the tree with both mucus and *Amylostereum* arthrospores, oviposition and tree death. Such conditions are aggravated in unthinned stands and the process can be simulated experimentally by high girdling, herbicide poisoning or the injection of the *Sirex* mucus into living trees.

Consequently in the presence of an abundance of suitable host material a *Sirex* population will grow and as numbers increase any latent resistance can be overcome by the mucus to render a tree attractive within and between seasons. Thus an infestation may remain undetected for some time after which the momentum generated by numbers and the availability of hosts will result in an epidemic outbreak of tree deaths. The outbreak is only limited by an absence of suitable host material.

Given the above scenario, which applies in fact if not necessarily in detail, then what does it tell us with respect to the development and implementation of a strategy for *Sirex* control

The plantation is a resource that can be located and exploited by *Sirex* females arising from either infested material or migrant females from a previously infested area. Exploitation generates numbers of wasps which then exert pressure on the plantation estate. If this estate has many units e.g. several unthinned stands, then ultimately the numbers of insects produced will increasingly exert greater pressure via the mucus effect to overcome more and more trees. The outbreak is only limited through the exhaustion of susceptable trees. If plantations are properly pruned and thinned then the availability of suitable resource for exploitation by *Sirex* is lacking and the reproductive and inoculation potential of the wasp isrestricted. Trap trees can affect localized and known units of infestation that can be either destroyed or utilized for production of parasitoids and nematodes. These agencies In turn will add to the general environmental resistance to increases of *Sirex noctilio* and collectively to the containment of pest numbers to sub-economic levels. In conclusion an operational strategy should address the following points:

- ensure tree health through good site selection and preparation, use of proven seedling stock and attending to pruning and thinning schedules so as to attain a height/diameter ratio which is consistent with optimum tree growth and form.

Attention to these qualities is of fundamental importance to any strategy for it maximises the potential resistance of individual trees which in turn acts to retard *Sirex* increase.

- plantation areas should be systematically monitored for their health and particularly after periods of strong winds, rains and other catastrophic events.

- frequent estimates of tree growth e.g. diameter increments, should be made to relate short term changes with respect to environmental variables particularly rainfall and levels of available soil water. Such an activity would provide invaluable Information re intra and inter-site diferences and infestation/ infection levels of pests and diseases and overall stand performance and at the same time remove much of the conjecture as to the possible cause of outbreaks.

- Trap trees should be established even in the apparent absence of the pest. These trees should be carefully examined on a routine basis.

There remains a lot to be learnt with respect to dosages of herbicide required for different tree sizes and the rate of tree morbidity for this will relate to the drying out of the tree which in turn impacts on the suitability of the tree as a resource for *Sirex* and in turn the parasitoids and nematodes.

- parasitoids and nematodes should be established and sustained to supplement the resistance delivered by good sylvicultural management.

- operations have to be executed ideally not during the *Sirex* flight season or in the period immediately preceding it (Spring-Summer). However if operations must proceed at those times then all slash must be buried or destroyed/removed and the areas closely monitored and sampled for possible invasion by *Sirex*.

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