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A BIOLOGICAL CONTROL FOR ARMILLARIA ROOT DISEASE?

Armillaria species are found naturally in indigenous forests where they generally occur as harmless wood decay fungi. However, in exotic pine stands some are significant pathogens and cause growth loss and mortality in infected trees. Armillaria root disease was once a serious problem when pine stands were established on land cleared of indigenous forest. Although of less concern in current plantations, the main pathogen, *A. novae-zelandiae*, remains widespread in many forests. As a result, the disease still appears unexpectedly in particular stands, leading to enquiries from growers wanting to know what they should do.

***Armillaria novae-zelandiae* attacks healthy trees after colonising stumps. This image shows the intimate contact between the root systems of a previous crop pine stump and a young, partially excavated radiata pine tree. The dead tree behind has been killed by the pathogen from an adjacent stump and the one to its right is in decline.**

We have been running a small research programme for a number of years aimed at providing an integrated control procedure as an alternative to the costly, but effective, recommendation of removing stumps before establishing the next crop. Methods that have proved successful in reducing disease incidence significantly include the planting of vigorous healthy stock[1] and timely treatment for dothistroma needle blight[2]. Disease levels were not reduced by silvicultural thinning and a search for genetic resistance has so far proved unavailing. It was therefore decided to try biological control as a further option.

Armillaria novae-zelandiae is able to overcome the resistance of healthy hosts by colonising and growing within the wood provided by tree stumps. Other fungi also naturally colonise pine stumps and compete with *Armillaria* species for the same wood substrate. By increasing the incidence of these fungi, in order to give them a competitive advantage, it might be possible to confine *Armillaria* species to insignificant segments of the stump, limiting their ability to cause disease (see Forest Health News: 241: 1-2).

Two studies were undertaken in which freshly cut *Pinus radiata* first thinning stumps were treated at opposing positions with an isolate of *A. novae-zelandiae*, on the one hand, and one of the following wood decay fungi, on the other: *Ganoderma applanatum, Hypholoma acutum, H. fasciculare, Phlebiopsis gigantea, Resinicium bicolor, Rigidoporus concrescens, Sistotrema brinkmannii* and *Stereum sanguinolentum*. Treatments were applied either

Treating the stump surface with aqueous mycelial suspension.

[1]Hood, I.A.; Kimberley, M.O.; Gardner, J.F. (2006): Stock-type susceptibility and delineation of treatment areas for a cryptic *Pinus radiata* root disease. Phytopathology 96: 630-636.

[2]Bulman, L.S.; Gadgil, P.D.; Kershaw, D.J.; Ray, J.W. (2004): Assessment and control of Dothistroma needle-blight. Forest Research Bulletin No. 229, 48 pp. Rotorua, New Zealand: Forest Research Institute.

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as wooden dowel cultures inserted into drill holes or as an aqueous macerated mycelial suspension spread over the cut stump surface. Stumps were harvested and examined after periods of between one and two years.

Despite being inoculated, *Armillaria* was isolated from stumps at a low frequency, and did not differ significantly in incidence between the various treatments, including the controls. This may imply some level of resistance to pathogen invasion in new stumps. Nevertheless, the study also showed that treatment had tangibly boosted stump colonisation by some of the potential control fungi, which were isolated more frequently from inoculated stumps than from untreated controls. Results indicated that the two common pine fungi, *P. gigantea* and *S. sanguinolentum*, in particular, should be tested further. Future work would evaluate the presence of *Armillaria* within the root system and root collar zones, where incidence may be greater, rather than in the stump as a whole. It is from those zones that the pathogen attacks the roots of healthy trees.

The work in this article is reported in greater detail in: Hood, I.A.; Oliva, J.; Kimberley, M.O., Arhipova, N.; Bakys, R. (2015): *Armillaria novae-zelandiae* and other basidiomycete wood decay fungi in New Zealand *Pinus radiata* thinning stumps. *Forest Pathology*. doi: 10.1111/efp.12171.

Ian Hood (Forest Protection Scion)

GIANT PINE SCALE IN AUSTRALIA

Established populations of the giant pine scale (*Marchalina hellenica*), a Mediterranean sap-sucking insect, have been recently discovered on pines in Australia. It has been found in two separate locations: Melbourne (Victoria) and Adelaide (South Australia); and to date has only been recorded from three hosts: *Pinus halepensis, P. pinea* and *P. radiata*.

Giant pine scale is native to pine forests of the eastern Mediterranean region where it is found mainly on *Pinus brutia* and *P. halepensis*, and occasionally on other *Pinus*, *Abies* and *Picea* species. Large populations of the scale can cause severe dehydration, defoliation and branch dieback of host trees, and in some cases, tree death. Despite its pest status, the scale is highly valued in Greece and in Turkey for its role in the production of honeydew honey ("pine honey"); at one time up to 65% of all Greek honey was estimated to have been derived from giant pine scale honeydew. Indeed, between 1996 and 2000, Greek beekeepers were encouraged to artificially introduce the scale in pine forests to increase their honey production!

Although it is too early to know the potential impact of giant pine scale in Australia, the case was considered sufficiently serious to initiate an eradication programme targeting the affected areas.

Giant pine scale develops in bark crevices and favours the lower parts of the host tree. It is usually found on the trunk, but may also occur on branches and exposed tree roots. As they feed, scale nymphs produce a conspicuous white wax secretion that protrudes from the surface of the tree (see photo below), as well as large amounts of honeydew, which can support the growth of sooty mould. There is usually one generation per year (although two generations in one year has been recorded). Mature females each produce 200-300 eggs, which are laid in batches in bark crevices and covered with the same white wax secretion by the female. Like many scales, this species has very low natural dispersal.

Pine branch with *Marchalina hellenica*. Photo D. Spinellis. Nymph of *Marchalina hellenica* (inset). Photo: A. Battisti.

In its native range, the giant pine scale cohabits with a relatively large scale insect community, most of them competing with each other for food sources. A recent study in Turkey also shows the scale is attacked by a variety of predators, among which one species appears more common and effective (*Neoleucopis kartliana*, which belongs to the Chamaemyiidae - a small group of predatory flies specialising in sap-sucking insects).

Based on its apparent reliance on humans for long distance spread, its breeding cycle of one generation per year and its conspicuous appearance the scale is not likely to get to New Zealand. If it did chances are good that it would be detected early and be able to be eradicated. Nevertheless, New Zealand readers are encouraged to be alert for the distinctive signs of this potential pine pest. We wish our Australian colleagues all the best for a successful eradication programme and thank David Smith from the Department of Economic Development, Jobs, Transport and Resources in Victoria for his assistance.

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