

ERMA hearing for applications to field trial genetically-modified *Pinus radiata*

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The Environmental Risk Management Authority (ERMA) met on 1-3 October, 2000, to consider two applications by the New Zealand Forest Research Institute (NZFRI) for permission to field test genetically-modified *P. radiata* and *Picea abies*. The hearing had already attracted media attention since it was scheduled to occur some time after the setting up of the Royal Commission on Genetic Modification (RCGM), with the delay owing to the protracted length of time between the original lodging of the applications and the ERMA hearing.

The capability to genetically-transform Radiata pine has been built up progressively by the NZFRI since molecular biology programmes were first established there in 1992. Transformation as used for these trials comprises the use of a biolistic device (or 'gene gun') for inserting foreign genes into tissue of Radiata pine produced through the somatic embryogenesis process. Each gene of interest was inserted along with a promoter, which acts as a 'switch' in turning the gene 'on'. Two additional genes were inserted to express proteins that provide either a visible expression in the plant (for a protein that stains blue under specific treatment), or that confers resistance to specific antibiotics (in this case, resistance to kanamycin, an antibiotic that is rarely used in human medicine). These are the 'selectable markers' that allow the very few tissue cultures of transformed clones to be separated from the many cultures that have not been transformed i.e., the new genes are either not inserted, or are not being expressed.

The NZFRI application was aimed at field testing of select Radiata pine (and Norway spruce) transformed principally with genes expected to influence either herbicide resistance or altered flowering traits. These were not the first applications for field testing of transformed pine. The NZFRI had already (in 1998) established a small trial of *P. radiata* transformed only for selectable markers - intended as a 'proof of concept' for the gene transformation technology. This application had been authorized by the Interim Assessment Group (IAG), the forerunner to ERMA, which was subsequently established under the Hazardous Substances and Noxious Organisms (HASNO) Act. There had also been a 1999 ERMA hearing on an application by Carter Holt Harvey Ltd (CHH) for field testing of a similar trial of Radiata pine, transformed for the selectable marker traits. CHH subsequently waived their right to immediately establish their test in response to expressions of public concern, and agreed to await the findings of the Royal Commission.

The main objectives of the NZFRI experiments are to determine the long-term stability and integration of genes affecting traits that are of potential economic significance to New Zealand plantation forestry - in this case, herbi-

cide resistance and control of reproductive development. The herbicide resistance genes may in future confer resistance to herbicides like 'Buster' and 'Escort', while the genes involved in reproductive development may allow future use of sterility of male and/or female organs, either for exerting some control over gene flow from plantations, or to transfer plant resources to stem biomass production versus the production of 'wasted' pollen and female cones. However, the present applications were designed as a first step in understanding the long-term impacts of transformation of pines, both in terms of genetic influences within the pines themselves, and any associated influences on human health, or the New Zealand environment.

While the brief of the ongoing RCGM is very broad, and is aimed at examining social and ethical issues of genetic modification in addition to science/technical issues, the role of ERMA is simply as the name suggests - its job is to ensure that an appropriate risk management process is in place for every project that comes before it. ERMA provided a panel of three Authority members for the NZFRI hearing, chaired by Dr Oliver Sutherland. In a break with its own convention, ERMA agreed to hold the hearing outside Wellington, in Rotorua, largely as a gesture to local Maori. This action was clearly appreciated, with Te Arawa representatives providing a formal welcome for the authority, and a group representing local iwi later presenting evidence to the hearing.

Prior to the hearing, the NZFRI applications had attracted an unusual level of public interest, and a total of 735 submissions were received by ERMA - 96 per cent opposing the applications. Of these, 682 submissions were made by email, mainly on the 'participatory democracy advocate' web site on which Greenpeace New Zealand had identified its concerns and encouraged submissions. In the event, 143 submissions came from outside New Zealand through this source. ERMA subsequently summarized these inputs, to conclude that the 5 main issues were (in descending order):

1. General opposition to genetic modification (60 per cent of submissions).
2. Uncertainty/unknown consequences/lack of research and testing (46 per cent).
3. Adverse environmental effects (25 per cent).
4. Corporate concerns, e.g. domination, irresponsibility, profit motive (21 per cent).
5. Adverse ecological effects (13 per cent).

Other issues included concerns about disease, containment procedures, and damage to New Zealand's 'clean green' image.

Presentations by Dr Christian Walter, of NZFRI focused on providing a clear explanation of the scientific goals of the experiments, and attempting to rebut the scientific basis for many of the claims made in the written submissions. For example, a number of submitters raised concerns about perceived risks that 'horizontal

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gene transfer' (HGT) could occur from the trial plants. HGT is essentially a poorly-understood process by which soil microorganisms might transfer genes from genetically-modified plants to other soil microorganisms through a range of mechanisms. Greenpeace called up a soils specialist to draw attention to the relative abundance and plasticity of soil microorganisms. The NZFRI response was to accept that HGT probably did occur as a natural process, and to note that this suggested that most, if not all, genes present in the environment were subjected to HGT over very long periods of time. Since the genes used in the transgenic pines could all be found in the natural environment, Dr. Walter argued that there was no basis for saying that transgenic conifers would create any new risks.

Evidence presented by the writer touched on the fact that pollen (and therefore, gene) flow from pines can be copious, and pine pollen has been known to travel very large distances and remain viable. The Radiata pine trials were designed to minimize any risks that might be envisaged from movement of pollen from the transgenic conifers, through a combination of regular monitoring to detect flowering structures, hedging of trees to prevent the production of male and female cones, and removal of trees before sexual maturity occurs. Most of the ERMA questions related to determining whether this containment would be effective in preventing pollen flow.

There were relatively few verbal submissions made to the hearing, with many 'no shows' of submitters who had indicated a wish to speak. However, a number of verbal submissions were made, mainly giving emphasis to points already given in written form. The exception were the presentations by local iwi, some of which were delivered in Maori, and which ranged from the cautiously supportive, to total opposition to genetically-modified organisms (GMOs), on largely cultural grounds. The ERMA representatives showed great patience in listening to all submissions, but were at pains to point out to several submitters that cultural and spiritual issues were outside their statutory role. The hearing was interrupted at one point by three individuals (with a photographer in tow) dressed as monkeys, carrying cards saying 'JUST SAY NO', and offering bananas to the ERMA representatives. My first thought was that this must be an oblique reference to Darwin's apes, and the Bishop Wilberforce/Huxley debate of last century, but then I realized that the intended image was to 'see no, hear no, and do no evil'. It provided an excellent illustration of the fear with which many people regard changes brought about through scientific advances, and the size of the gulf that exists between different lobby groups in terms of their relative perceptions of the associated risks and benefits.

Despite predominantly negative reporting of the hearing in the news media, the result was an approval by ERMA that the trials could go ahead, with a number of controls required (described in seven typed pages!). In the event, the NZFRI Board had concluded the day before the hearings that they would defer any trial establishment until after the Royal Commission has presented its findings in June this year. Full marks to ERMA for

efficiently executing their role, in a balanced and positive manner. Apparent confirmation, also, that the HASNO legislation has provided New Zealand with up-to-date and effective procedures for assessing and improving risk management for GMOs.

What are the long-term implications for the New Zealand forestry sector? The preparation of these applications by the NZFRI, and the hearing of them by ERMA, has cost the taxpayer several hundred thousand dollars - simply to get research trials with genetically modified trees from the laboratory to strictly-contained field trials. Clearly, any future commercial use of GMOs will face similar or greater costs, unless the rules are modified. Commercial use of modified pines still seems to be several years away, both because of the need to better-determine and understand the factors that might constitute risk, and because there are still technical hurdles (for example, gene 'silencing') to surmount. However, the large potential benefits predicted for genetically modified pines argue for continued support for research in this area.

One issue that should be of concern to forest planners intending to utilize GMO trees in future - current Forest Stewardship Council (FSC) standards include an obligation not to use GMOs. FSC certification is being adopted by a number of New Zealand forest growers, and considered by others. How will these organizations be able to respond to the future availability of clones with superior attributes contributed by gene transfer techniques?