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GENETICALLY ENGINEERED (GE) TREES

WHAT ARE GE TREES?

GE trees are trees which have had genetic material inserted into their genetic code through the techniques of bioengineering. This is done to produce trees with a particular attribute, like resistance to a specific disease, or sometimes to block the expression of a certain trait in the trees. Such inserted genetic sequences are not necessarily from a tree species, but can be from a species of any kind, including insects or even viruses.

Some examples of genetically engineered characteristics include herbicide tolerance; cold adaptation; low or altered lignin production to make pulp production easier; delayed ripening of fruit to allow mechanical harvesting or to permit longer shipping times; and prevention of flowering or seed production in order to speed growth rates for faster biomass production. Most of these GE trees are intended for use in commercial tree plantations.

Trees are genetically engineered to have a particular attribute, like resistance to a specific disease.

CLAIMED BENEFITS AND CONCERNS

WHAT POTENTIAL BENEFITS ARE CLAIMED FOR GE TREES?

Socioeconomic

Specific possibilities depend on the particular qualities that are linked to the added genes, but claimed benefits involve economically valuable qualities like disease resistance, faster rates of growth, and decreased lignin (the material that gives stiffness to wood) in trees for pulp production. For example, papaya trees in Hawaii (a non-native, commercially grown species) sustained heavy damage by the ringspot virus in the late 1990s, but the introduction of a genetically engineered strain of papaya that contained genes from the virus offered resistance to the disease and helped save the export industry for the immediate future (though not necessarily for the long-term, as noted below).

Environmental

Some researchers are trying to design GE trees for certain environmental benefits. One area of re-

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CLAIMED BENEFITS (contd.)

search involves using the capacity of various plants and micro-organisms to absorb and thus "mop up" particular pollutants. For instance, a York University scientist is trying to produce a tree that incorporates genes from soil bacteria that could take up carcinogenic chemicals from soils contaminated by explosives in war zones and weapons test ranges. Other investigators are interested in engineering trees to have a faster uptake of carbon dioxide, a major "greenhouse" gas, in order to help slow climate change.

WHAT SUSTAINABILITY CONCERNS HAVE BEEN RAISED?

Ecological

Unlike annual field crops in agriculture, trees are a long-lived feature of landscapes, and forests provide many ecological services, including habitat for an enormous range of species and the regulation of climate and rainfall regimes. Trees produce large quantities of pollen and seed that can travel for many kilometres, and it is widely considered inevitable that trees in unmanaged forests as well as in parks and on private property, including nurseries, woodlots, and residential areas, would be genetically contaminated by GE trees.

The escape of genetic traits from GE tree plantations into native forests could potentially have severe consequences. Specific effects could include contamination from the Bt toxin gene, which kills butterflies and moths and could also affect their predators, including songbirds. The low lignin gene could lead to forest trees with lowered protection against herbivores, insect attacks, and storms, and the gene for faster growth could lead to transgenic trees that out-compete native vegetation for light, water, and nutrients. Because of the complexity of interactions in forest ecosystems and the long life span of trees, impacts are very difficult to predict and could take decades or even generations to become evident.

Even deliberately engineered changes in GE trees may not create simple or entirely desirable solutions to perceived problems. Ringspot-resistant papaya trees, for instance, are proving very susceptible to blackspot fungus. The ecological dictum that "You can never do only one thing" is especially relevant to genetic engineering, in part because gene expression remains highly complex and scientific understanding is far from complete. And as past experience shows, disease- and pest-resistance are not necessarily permanent. The rapid rate of reproduction by insects as well as other mechanisms in pathogens generally allows them eventually to adapt to new conditions.

It is widely considered inevitable that other trees would be genetically contaminated by GE trees.

To counter these various problems, some proponents of the technology have suggested that GE trees be genetically engineered to make them sterile in order to avoid interbreeding with other trees (using "Terminator technology" (see CIELAP's Fact Sheet on this topic), but environmentalists have responded that sterile forests without flowers or seeds are problematic in themselves. Many forestry professionals consider that natural regeneration of forests after harvesting is a better practice than replanting. Moreover, some scientists consider that genetically engineered sterility would not be reliable and could be overcome by the tree during its lifetime.

Ethics and Equity

Some believe that access to the rich heritage represented by forest ecosystems is a right, and that it would be compromised by replacing natural forests with patented GE trees, especially if the technology is controlled by private interests. In agricultural crops, Monsanto, which holds patents to many GE crops, has initiated more than 100 civil suits. These involve alleged patent infringement by farmers, many of whom claim that their crops had been contaminated by nearby GE crops. There are fears that a similar situation could develop with trees.

CONCERNS (contd.)

Economic

There is increasing consumer interest in and pressure for environmental certification programs, such as that of the Forest Stewardship Council for "green" forestry products. Producers who could not obtain such certification because of contamination by GE trees would have to forego any associated economic benefits. This situation would also apply to fruit growers for organic crop certification. For the same reason, environmentally certified producers would face losses if their trees or crops were to lose their status through inadvertent contamination by nearby GE trees.

WHAT IS THE STATUS OF GE TREES IN TERMS OF COMMERCIALIZATION?

Unlike medical and industrial applications in biotechnology, where there has been much interest by investors, it has mainly been forest products corporations and governments and universities in forested countries like Sweden which have funded GE tree research. In Canada, the Canadian Forest Service and some companies are investing in research projects, which include limited field trials, on a number of GE tree species, such as various fruit trees, spruce, tamarack, poplar, and willow. In the U.S., large scale commercialization could be on the horizon for forests in the Southeast and Northwest (this, however, is being actively opposed by many citizen groups). In China, it has been reported that more than 8000 square kilometres have already been planted with GE poplar in efforts to reverse the lack of forest cover.

WHAT ABOUT GOVERNMENT OVERSIGHT AND POLICY?

Research and Development (R&D)

Canada, which has about 10% of the world's forests and is a major forest products producer, is spending only a modest portion of its biotechnology research dollars in the natural resource sector, which includes GE trees.

More than 8000 square kilometres of GE Trees are reported to have been planted in China

Regulatory Framework

As with other biotechnology applications, the regulatory framework in Canada is a patchwork, with no single agency in charge overall of biotechnology regulation. Depending on the specifics of the application, the main departments responsible include Industry; Agriculture and Agri-Food; Health; Environment; Natural Resources; Fisheries and Oceans; and International Trade. Field trials are approved for genetically engineered plants – "Plants with Novel Traits" or PNTs – by the Plant Biosafety Office (PBO) of the Canadian Food Inspection Agency. However, much of the forested crown land in Canada is within provincial jurisdiction, and provincial decisions would be required for use of GE trees there. Elsewhere, there have been individual countries within the EU, such as Greece, which have outlawed GE trees. In the U.S., despite the salvage of Hawaii's papaya industry through the technology, that state's legislators have recently banned outdoor field trials for GE trees.

Liability Regime

There is no legislated liability regime in Canada. In Canada, biotechnology issues are subject to the traditional common law rules of civil liability. If the use of biotechnology causes damage to a person, their property or their economic interests, the producer or user of that biotechnology might or might not be held liable for that damage by a court. The common law, as it has developed in Canada, may not be flexible enough to meet the novel challenges raised by the potential for harm that biotechnology applications may cause. These technologies bring up general policy issues that are better resolved by legislators rather than judges. A strict liability regime, entrenched in legislation, would hold producers of biotechnology responsible for damage to human or environ-

GOVERNMENT OVERSIGHT (contd.)

mental health.

Transparency & Citizen Engagement

The main avenue provided for formal citizen input about the technology is the Canadian Biotechnology Advisory Committee (CBAC), set up through the Canadian Biotechnology Strategy and assisted by the Canadian Biotechnology Secretariat (CBS).

WHAT INTERNATIONAL IMPLICATIONS ARE THERE?

There are many concerns in the South that forest-based livelihoods and cultures would be negatively affected by ecological change and access issues.

As well, the U.N. Convention on Biodiversity's Cartagena Protocol requires the parties to the treaty to obtain prior consent for the introduction into the environment of genetically modified organisms if this involves the intentional crossing of international boundaries. (Canada has ratified the Convention on Biodiversity but has only signed the Cartagena Protocol; the U.S. has not signed or ratified either.) However, although there is evidence that tree pollen can travel hundreds of kilometres, this Protocol does not apply to transboundary movement through insects, birds, or wind borne pollen and seeds. Nevertheless, a statement from the Eighth Conference of the Parties Regarding Genetically Engineered Trees held in March 2006 recognized potential social, environmental and transboundary impacts and recommended that the parties take a precautionary approach.

ADDITIONAL SOURCES OF INFORMATION

Specific to GE Trees:

- **Northwest Resistance Against Genetic Engineering (NW RAGE)** www.nwrage.org
- **CIELAP's *The Regulation of Agricultural Biotechnology in Canada*** (November 1999) and ***A Citizens' Guide to Biotechnology*** **(March 2002)** - at www.cielap.org

Concerned about Biotechnology

- **Union of Concerned Scientists** www.ucsusa.org/
- **Greenpeace Canada** www.greenpeace.ca

Pro-Biotechnology

- **Biotechnology – Good to Grow** www.biotechgoodtogrow.com/
- **BIOTECanada** – www.biotech.ca/
- **Council for Biotechnology Information** http://whybiotech.com/

Government of Canada

- **The Government of Canada's BioPortal** www.bioportal.gc.ca/
- **The Government of Canada's BioStrategy** http://biostrategy.gc.ca/
- **Canadian Biotechnology Advisory Committee -** www.cbac-cccb.ca/

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