

TRANSGENIC TREES AND TRADE PROBLEMS ON THE HORIZON?

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While genetically engineered food continues to be a source of controversy for citizens and trade officials alike, transgenic wood may well pass into the global marketplace without all that uproar. The same propagation techniques—the artificial insertion of genes into plants to give them traits desired by humans—that have been applied to core agricultural crops, such as corn and soybeans, are now being tested on trees.



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But unlike “Frankenfood,” the potential health and safety threats from the wood of modified trees are widely recognized to be essentially nonexistent and the possible regulatory and trade problems should be easier to surmount. As a result, the major concerns with transgenic trees have more to do with their possible effects on other plants and on the environment.

Although still at the experimental stage, high-yielding species of transgenic trees could have a significant effect on international trade in timber, a major traded commodity for the United States and a major export for much of South America. The reason why is that forest plantations now generate roughly one-third of today’s timber harvest, compared to an essentially negligible portion 50 years ago.

Industrial forestry is moving forward on two fronts with tree improvements from traditional breeding techniques and with major research efforts oriented to the production and commercialization of transgenic trees. While many of the productivity gains to date have come from traditional species selection and breeding, it appears only a matter of time before transgenic trees become commonplace.

Propagation innovations and the widespread introduction of fast-growing exotics have increased industrial wood production and even changed regional and international patterns of forest resource production and forest products trade. In the United States, plantations largely account for shifting the center of forestry from the West to the South. Abroad, South America is becoming a leading producer and exporter of plantation-grown wood and wood products, along with New Zealand, Australia, and South Africa.

Potential Barriers

International trade rules do not differentiate between indigenous and exotic wood or restrict trade in the wood or seed of genetically superior tree stock developed through traditional tree improvement programs. Although transgenic trees are, with very few exceptions, not yet commercialized, there are no international trade regulations for the wood of transgenic trees in world markets. However, the planting of living germplasm—the seed—is another story. Transgenic tree germplasm is generally regulated at the country level throughout the world, as it is for other transgenic crops. Of course, many transgenic agricultural crops are already integrated into domestic and international agricultural markets; why not trees?

Genetic engineering in forestry has tended to follow the pattern in agricultural crops. Early work focused on the transfer of an herbicide-resistant gene already implanted in



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“Roundup-ready” corn and soybeans. Other research has been undertaken to incorporate the Bt gene (*Bacillus thuringiensis*) that provides natural protection against certain pests. However, these activities seem to be attracting less research attention recently because of both regulatory and market forces.

Regulatory issues about transgenic plants center on health, safety, and environmental risks. Health and safety concerns arise when humans or animals consume a transgenic plant—generally not a problem for trees. The environmental effects of a transgenic include concerns that the transgenic itself might become a pest or, of greater concern, the possibility that a transferred gene might “escape” and alter the genetic makeup of a wild relative, perhaps increasing the fitness of the native plant and turning it into an invasive pest. In addition, an escaped gene might affect a pristine species and compromise its usefulness for developing improved hybrids the old-fashioned way.

Because of such fears, in most countries, a transgenic plant is automatically regulated. Before it can be commercialized in the United States, however, a transgenic plant is required to undergo a “deregulation” process that assesses the potential risks of adverse or damaging effects. Deregulation of trees with a Bt gene would involve two agencies—USDA’s Animal and Plant Health Inspection Service, under the Plant Protection Act, and EPA, under its regulatory responsibilities for toxics—making it costly for the plant developer. Moreover, deregulation of a transgenic in the United States does not necessarily mean that it can be marketed in other countries.

Market size is another consideration. In a tree plantation with a 20-year rotation, for example, only 5 percent of the land may be harvested and replanted each year. As a result, the market is small compared with that for annual crops like corn and soybeans. Furthermore, the market potential may not justify the costs of developing a plant and submitting it for deregulation in a particular country. Chile’s forest industry, for example, has an interest in the herbicide-resistant gene, but apparently the U.S. developer does not consider the market sufficiently attractive to justify adapting the gene to Chile’s planted Monterey pine (*Pinus radiata*) forests.

Transgenic Possibilities

Given the hurdles—deregulation costs, possible trade restrictions, and small markets—developers are focusing their efforts on modifying wood fiber characteristics of the most widely planted species. It now appears that traditional breeding approaches will be used to achieve increased growth and biomass yields, while genetic engineering will focus on desired wood characteristics, such as increased useful fiber or fiber that is more cheaply processed into wood pulp.

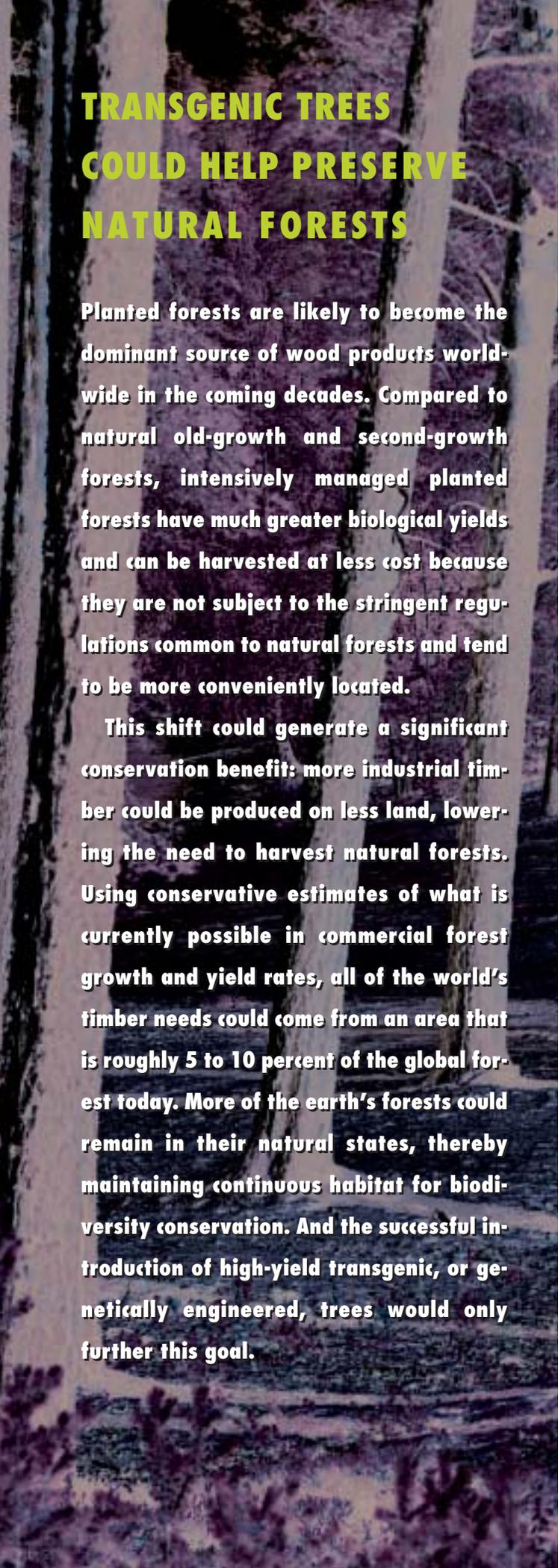
A U.S. tree biotech firm is working on innovations for loblolly pine, which is both the dominant plantation timber tree at home and a major species in several countries of South America. The innovations are largely fiber modifications to improve pulping characteristics, thereby lowering mill costs. The technical challenges involve transferring the genes for these particular fiber modifications and then developing a technique for low-cost, rapid transgenic seedling replication on the scale required for plantations.

Another attractive target is eucalyptus, and major innovations are now under way in Brazil, which currently prohibits some transgenics. However, transgenic food crops have recently been deregulated and are being grown, and the Brazilian forest product firms are betting that the transgenic tree ban will be removed. The payoff could be huge: eucalyptus grows very rapidly and is extensively planted worldwide, for both pulp and timber.

Other species of transgenic trees that are under development include a papaya that has been officially deregulated by the United States but is facing some resistance abroad, and a Monterey pine in New Zealand, where deregulation of new species has been put on hold. Finally, China is reported to have deregulated a hybrid poplar, which has been planted as a 700-acre commercial forest.

International Trade Issues

According to the basic rules of international trade, goods will flow from the country with a comparative advantage to countries with higher costs. In the case of international trade in wood, the basic product is raw wood, from which a great



TRANSGENIC TREES COULD HELP PRESERVE NATURAL FORESTS

Planted forests are likely to become the dominant source of wood products worldwide in the coming decades. Compared to natural old-growth and second-growth forests, intensively managed planted forests have much greater biological yields and can be harvested at less cost because they are not subject to the stringent regulations common to natural forests and tend to be more conveniently located.

This shift could generate a significant conservation benefit: more industrial timber could be produced on less land, lowering the need to harvest natural forests. Using conservative estimates of what is currently possible in commercial forest growth and yield rates, all of the world's timber needs could come from an area that is roughly 5 to 10 percent of the global forest today. More of the earth's forests could remain in their natural states, thereby maintaining continuous habitat for biodiversity conservation. And the successful introduction of high-yield transgenic, or genetically engineered, trees would only further this goal.

variety of products—building materials, pulp and paper, packaging materials—can be made. Consequently, the sheer number of products, as well as the benign nature of transgenic wood, makes prohibitions to international trade in transgenic wood unlikely.

However, trade in tree germplasm—seed or seedlings—may be viewed very differently. Concerns vary. Little gene escape is likely to occur in the natural environment if different plant families are involved. Since pines are not indigenous to South America, for example, gene transfer from a transgenic exotic pine to native tree species is unlikely. Similarly, eucalyptus is native to Australia, and the genes from bioengineered eucalyptus are unlikely to escape into native trees in other regions. Where native trees are modified, sterilization techniques would be used to control gene flow. But improved transgenic trees might well generate major shifts in the comparative advantages of timber-producing countries. The world has already seen a major restructuring attributable to traditional tree improvement: exotics have been widely planted in suitable regions, and intensive planted forest management is increasingly common. There is every reason to expect these trends to continue and even accelerate with transgenic forestry.

Transgenic forestry could also modify the geographic shifts in what can grow where. If bioengineering can improve tree performance in northern temperate and boreal sites, production could become more profitable there and improve the competitive position of areas with otherwise low productivity.

Some countries, for example Brazil and China, will undoubtedly deregulate transgenic trees and allow the production, sale, and export of transgenic wood. Other countries, and perhaps the European Union, may not allow production but will find it difficult to prohibit importation of harvested transgenic material, especially paper and wood products, due to the variety of forms and products that use wood and wood fiber, and also due to the rules of the World Trade Organization. As a result, we may see transgenic and nontransgenic wood trading and competing in the worldwide marketplace.

Enter Forest Certification

To promote sustainability and assure consumers that the wood products they purchase have come from well-managed forests, several organizations have created standards, sponsor forest audits, and represent themselves as certifiers of commercial forests. One of the major certifying groups, the Forest Stewardship Council (FSC), will not certify a forest that contains transgenic trees. Of course, at this point, such a standard is moot: there are essentially no deregulated transgenics to plant. However, FSC has withheld certification from

forest firms that conduct research related to the development of transgenic trees.

Whether such actions will halt the commercialization of transgenic trees and stall research and development remains to be seen. Although FSC certifies forests in most parts of the globe, there are other major forest certifiers, such as the Sustainable Forestry Initiative and the Pan European Forest Certification that are less skeptical of transgenics, requiring only that forest managers follow existing laws, practice sound science, and meet certification environmental standards. In theory, public demand for certified wood and a preference for FSC certification could inhibit the development of a transgenic wood market. However, there is little evidence that consumers today are willing to pay higher prices for certified wood. The lack of a price premium may reflect a relatively weak overall preference for certified wood, which may or may not transfer to transgenic wood.

And so we arrive at a curious situation: the goods (raw wood and products with wood from transgenic trees) will likely be widely traded but the important technology (transgenic seeds) may not. Firms in countries that already have a comparative advantage in wood production are more likely to import or develop the technology, undergo the deregulation process, and plant transgenic trees. Specialization in wood production might become even more intense in the few countries that employ the latest transgenic technology, further increasing their share of worldwide timber production, at the expense of those countries resisting the new technology. ■

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Further Readings

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