Forest Tree Biotechnology

A Position Statement of the Society of American Foresters

This position was initially adopted by the Society on December 1, 2007. It will expire on December 1, 2012, unless, after subsequent review, it is decided otherwise by Council

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Position

The Society of American Foresters (SAF) supports and encourages scientific advancements in forest tree biotechnology and its use to improve forest productivity, wood quality and forest health. SAF believes that well-studied applications of appropriate biotechnology methods for forest tree improvement have the potential to enhance the quality, productivity, and value of plantation forests managed for wood, pulp, and bioenergy; protect tree species from serious insect and disease problems; and provide other social, economic and environmental benefits.

SAF supports science-informed government regulatory oversight of certain forest tree biotechnology applications, such as genetic engineering (GE, also called genetic modification), but encourages consideration of both the benefits and risks. SAF supports the continued evolution of federal regulations that affect forest tree biotechnology, particularly changes to make the regulations more focused on the products' safety and environmental impact, rather than on the process or method used to create them. SAF recognizes that discovery and subsequent development of appropriate technologies can be accomplished only through both laboratory and field testing. Given the rapidly growing costs and risks of regulatory compliance for GE field studies, SAF urges government regulators to consider the cumulative opportunity cost to society of compliance with GE regulations for companies and public-sector researchers. Regulations that make field tests excessively costly, onerous, or limited in duration may impede the conduct of economically and ecologically significant research and, thus, the delivery of benefits to society.

Issue

The rapidly developing field of biotechnology, including forest tree improvement and especially GE, has generated controversy and debate. While the use of biotechnology for tree improvement can bring economic, social and environmental benefits, there are concerns regarding the safety of introduced genes and clonal varieties, and their impacts on natural ecosystems.

Background

Humans have intentionally engineered their environment, and the organisms therein, for millennia. Some of these activities resulted in the domestication of animals and plants, and some directly or indirectly affected the genetic make-up of forest tree populations. Early tree domestication began more than 5,000 years ago by propagating individuals that produced higher yields of fruits, nuts, and/or oils. Forest tree domestication accelerated during the latter half of the 20th century with the idea that conventional breeding methods applied to forest tree populations would enhance timber production and other important economic traits, and could provide reliable quantities of well-adapted seed for planting (reviewed in Burdon and Libby 2006).

The term forest tree biotechnology arose during the 1980s. It encompasses a broad collection of tools for breeding, propagation, and research, all of which apply technology to management of biological organisms and systems. As commonly used, forest tree biotechnology encompasses structural and functional studies of genes and genomes (including development and application of genetic markers); various methods of vegetative reproduction such as micropropagation, tissue culture, and somatic embryogenesis; and GE, which is the physical manipulation and asexual insertion of genes into organisms (FAO 2004). Currently, the environmental introduction of plants produced through GE, which is a process (method) of genetic manipulation that can use native or foreign genes, and can affect all types of traits, is regulated by the government.

Potential Benefits and Risks of Forest Tree Biotechnology

Initial applications of forest tree biotechnology targeted improved productivity and quality of intensively managed plantation forests. Such use, with appropriate social controls, can help reduce impacts on natural forest ecosystems from timber harvest-related perturbations (Sedjo 2001). Trees genetically engineered for pest resistance may promote plantation survival and yield, and also lead to restoration of native tree species. For example, American chestnut and American elm have nearly vanished from the North American landscape as the result of exotic pathogens, and are the subject of intensive efforts to produce genetically resistant planting stock (Burdon and Libby 2006). Other potential benefits include enhancing the ability of trees to tolerate abiotic stress; restoring contaminated sites through phytoremediation; facilitating weed control using more environmentally benign treatments; producing new industrial products; modifying biomass chemistry to improve pulp and biofuels production; and improving carbon sequestration to mitigate greenhouse gas emissions. In addition, biotechnology, especially GE methods, offers unique and important tools to conduct research to identify the biological mechanisms for control of many ecologically and economically significant traits.

Application of new technologies frequently leads to concerns sparked by their novelty and initial uncertainties. The most visible concerns are those associated with GE trees, and include: unintended consequences of inserted genes on tree biology; reliability of the newly encoded traits to produce the desired outcomes; effects of the new traits on forest ecosystem structure and function; and persistence and potential impacts of the introduced genes in native populations through the dispersal of pollen, seeds, or vegetative propagules (van Frankenhuyzen and Beardmore 2004). Other perceived risks from biotechnology are associated with loss of genetic diversity from vegetatively propagating a small number of highly selected varieties, which may result in vulnerability to insect and microbial pests, and to stressful climatic events. There are also concerns associated with family- or clone-based varietal forestry, whose applications are expanding due to results of advanced breeding programs, and from improvements in asexual propagation methods. Due to the complexity of forest ecosystems, many kinds of ecological benefits and risks, and the effectiveness of risk management tactics, can be evaluated via thorough review of scientific literature and well-designed field experiments.

Government Regulation of Tree Biotechnology

Field testing and approval for large-scale plantings of transgenic trees in the United States are governed by several federal regulatory agencies. The United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), Food and Drug Administration (FDA), and Environmental Protection Agency (EPA) coordinate the regulation of GE plants. The agencies' roles in assessing the safety and approval of GE products depends on whether the product is intended for food and feed (FDA) or insect pest (EPA) management (Re et al., 1996, Just et al. 2006). APHIS, as authorized by the Plant Protection Act of 2000, plays the major role in overseeing field tests and approval of GE plants. In 2002, APHIS created the Biotechnology Regulatory Services unit within the Agency; it now manages all activities with respect to GE organisms (www.aphis.usda.gov/brs/).

Although a well-established regulatory framework exists in the United States, APHIS is conducting an Environmental Impact Analysis of its regulatory system, and is considering a number of proposals for substantive modification of this framework to make regulation more proportional to product novelty and risk. In addition, recent court rulings (Charles 2007) have forced APHIS to re-evaluate and strengthen some dimensions of its regulatory procedures. Federal regulations affecting biotechnology, particularly changes focused on product's safety and environmental impact, continue to evolve (e.g., Strauss 2003, Snow et al. 2005).

References

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