NATIVE FOREST NETWORK

Eastern North America
Special Report--March, 2000

Genetically Modified Trees: A Global Threat

Native forests such as this rainforest in southeast Mexico are threatened worldwide by genetically engineered tree plantations **Photo: Langelle/ ACERCA**

Introduction

The purpose of this paper is to provide a general introduction to the issues of plant biotechnology as applied to tree species. Discussed will be the current status of research, how the new technologies are likely to be applied, and some of the threats posed by biotechnology in forest products. Also included will be responses to the usual glowing promises made by industry, and a short section on solutions. Many of the topics in this paper will be covered in greater depth by Native Forest Network and other organizations as work in this area develops. Until the last year there has been limited awareness within the activist community about the scope of the issue, and exactly how close we are to having Frankentrees in the forest. Now that we know, how will we choose to act?

The questionable contributions of biotechnology to agriculture have been well documented, and include increased use of toxic herbicides, decreased yields, complete crop failures, and the unintended decimation of Monarch butterflies. Many staple crops now contain alien genes and antibiotic-resistant markers. These patented organisms are primarily designed to survive massive doses of proprietary herbicides such as DuPont's Liberty (glufosinate), or Monsanto's Round-Up (glyphosate).

In spite of glowing promises to feed the world, these herbicide-resistant plants have reported lower yields. The increasing control of all the world's seed stock by a handful of transnational corporations has also made many people concerned about food security. In Europe and India there is strong public opposition to agricultural biotechnology (agbio), and in the U.S. there is growing opposition to the takeover of the food supply as people learn about the health and safety issues surrounding Genetically Modified Organisms (GMO).

The beleaguered biotech and chemical giants have also been developing genetically modified trees for the forest products industry. Since much of the opposition to agbio has focused on human health and threats to the food supply, this was not expected to generate similar opposition. The potential profits are enormous with the estimated value of the world's total annual timber harvest in excess of US$400 billion. This includes all harvests for domestic use as well as the part destined for international trade, which is now in excess of US$150 billion. While biotech companies are promising substantial ecological benefits, the obvious benefit will be financial gain for the corporations who have patented the trees.

> **"Protesters, who for the large part are unorganized, have driven away important businesses, technology and money."--Steve Strauss, Oregon State University**

The first genetically modified trees were manufactured as early as 1987, and limited experimentation continued over the next decade. The last few years have seen both the largest joint ventures in forest-biotech, and the greatest number of new field trials for these altered organisms. Growing plants in greenhouses prevents spread of the genetic material, while field trials "release" the plants in open plantings. Between 1988 and 1998 there were at least 116 releases of GE

(continued on next page)

(Intro continued from prev. page)

trees, with nearly half occurring in 1998. Most of these are species used by the pulp and paper industry, and the majority of these releases have been in the U.S.

The predominance of research and trials in the Northern hemisphere belies the fact that most of the genetically altered eucalyptus and pine will be grown in plantations in the Southern hemisphere. Production costs in the South are dramatically lower in part due to warmer conditions, longer growing seasons, low land costs, cheap labor, and limited environmental restrictions. This has led to a doubling of the acreage in plantations over the last 15 years, and this trend is expected to accelerate. Brazil alone has over 10 million acres in commercial eucalyptus plantations. To date, these plantations have probably not been planted with GE trees (although there have been reports of GE plantings in Mexico, and the year 2000 will likely see an expansion of the acreage in GE throughout the world).

Although industry promises that plantations use otherwise marginal land, the reality is that they replace native forests. In most cases, the diverse native forest is clearcut, which generates capital for the plantation. Burning to clear land also occurs, with millions of acres of original forest lost in Indonesia in the late 90s to make way for palm oil plantations. There are also instances of plantations established by corporations on communal agricultural land, as in southeast Mexico. This invariably leads to clearing of rainforest for subsistence agriculture by those forced off their traditional lands.

"Terminator trees, genetically engineered never to flower, could ensure a silent spring in the forests of the future. Such trees will grow faster than before, but will be devoid of the bees, butterflies, moths, birds, and squirrels which depend on pollen, seed, and nectar." -- London's Daily Telegraph

The argument that plantations will relieve pressure on native forests makes little sense since they are producing primarily pulp species, not tropical hardwoods like mahogany and teak. Demand for these valuable species will only encourage the continued destruction of rainforests; only changes in consumption will stop the loss of the world's forests.

The industry would like to replace diverse forests with fast-growing, herbicide-resistant mono-crops in even rows with no competing understory. Native forests will exist only as vestiges in inaccessible areas.

The Wall Street growth mania has also affected the forest products industry, and while the recent Time-Warner-AOL merger received more media attention, in February 2000, Champion International became the world's largest paper producer. The acquisition of Champion by Europe's UPM-Kymmene has increased capacity for paper production beyond that of International Paper. IP, with operations in 30 countries, exports to 130 countries, and remains the top producer of paperboard. These and other companies, including Boise-Cascade, own vast tracts of land around the globe, and have greater economic power than many countries. Alliances between the timber giants and biotech/chemical companies, pose a tremendous threat to the world's remaining forests.^

Genetic Engineering 101

Public relations experts for the biotech industry have said that genetic engineering is no different from earlier efforts to breed plants and animals to better meet human needs, only the outcomes can be achieved more quickly. The truth is that geneticists can alter the structures of life in ways that could never occur in nature, and that the consequences of those actions, for the most part, are unknown.

Genes are responsible for all the traits expressed by an individual, whether a fish or a tree. Genes are made of long strands of nucleic acids. There are four nucleic acids, adenine, thymine, cytosine, and guanine (abbreviated A, T, C, G). Every genetic letter is matched with another to make nucleotide pairs, and a gene may be composed of several thousand pairs. Three pairs form an amino acid, and chains of amino acids make up a cell's DNA. A single organism may have 100,000 genes which interact in various combinations to create all the characteristics of the organism. Any single gene may participate in the expression of a variety of traits (pleiotropy), while a single trait may involve one hundred genes working together.

Genetic mapping of an organism attempts to create a library of genes identified by the traits they produce. Genetic engineers would then be able to select a desired trait from this library and insert it into another cell. The new individual grown from that cell should then exhibit the desired trait. The method of insertion is referred to as a vector, and one of the first used in plants is the bacteria (Agrobacterium tumefaciens) which causes tumorous growths in conifers. This bacteria is comparatively large and easily manipulated, and will carry the alien genetic material into plant cells that it infects. Agrobacterium has been modified to infect a wider variety of plants, thereby allowing it to be used as a vector for many food crops. Other vectors are engineered viruses and biolistics (firing microscopic bullets coated with genetic material into cells).

These efforts to insert new genes are not always successful, so methods have been devised to identify cells which have accepted the new genes. Antibiotic-resistant genes are tagged on to the other desired genes so that, when grown on an antibiotic medium, only the altered cells survive. For commercial applications in plants, the next step is tissue culturing the growing cells to generate endless identical clones. New robotics have speeded up this process, with ForBio's facility in Indonesia able to produce 12 million tree clones per year.

GE Brings Weird Things to Life

Despite the desire to have evolution conform to agendas set in corporate boardrooms, not surprisingly, there are a number of inherent problems. Descriptions in the popular media minimize the complexity of genetic structures, and frequently use metaphors comparing genes to lightswitches, suggesting that desired characteristics can be switched on or off at will. With tens of thousands of genes in a complex organism, anticipating the effect of adding or removing portions of a sequence is difficult or impossible. This is made more difficult by the fact that individual genes are usually responsible for more than a single trait (pleiotropy), and that

(continued next page)

GE 101 **(continued from prev. page)**

a few or a hundred genes may be involved in a single trait.

When alien genes are added to a cell, they are added as discreet units, not in the context in which they exist in the DNA of the originating organism. When they arrive in the host cell, if the insertion is successful, they become attached somewhere in the genetic material, exactly where remains undetermined. Piggy-backing the additional gene sequences in the cell leads to an inherent instability of the genome. Succeeding generations of the genetically modified organism (F1, F2, F3, etc.) are likely to place the alien genes in different locations, altering the manner in which the specific trait may be manifested. One possible effect is called "gene silencing", when a gene responsible for enhancing a characteristic (e.g. height or color) ends up producing the opposite effect. If the desired effect is delayed flowering to prevent the spread of transgenic pollen, gene silencing could have profound ecological consequences by actually bringing on precocious flowering.

"Those who are manipulating the DNA of trees, using a very powerful but dimly understood technology, show contempt for our planet and the life it supports, including human life. They respect only profit for themselves and their shareholders."

--Anon. communique following destruction of GE trees in U.K.

Antibiotic-resistant markers are also cause for concern. With decreasingly effective medicinal antibiotics, and increasingly resistant bacterial strains, will this be another way that pathogens will develop antibiotic resistance? Clearly the problem is cumulative, and this is yet another way to promote super pathogens.

Unexpected allergenic or toxic qualities are another consequence of genetic manipulation. This occurred when a methionine-producing gene from the Brazil nut was added to soy to increase protein. The transgenic soybeans were able to produce severe allergic responses, as some people experience with Brazil nuts. This illustrates the unintended consequences inherent in a single gene. How escaped transgenes could affect wild populations remains unknown.

One of the greatest concerns is that genetic engineering is driven by commercial interests. The economic incentive to capture patents and to bring new products to market overrides a precautionary approach that would test generations of plants to ensure "stability of expression". This has not been done in short-lived annual plants before they are brought to market, and is extremely unlikely to occur in trees where testing could take decades.^

GE Trees: Who Are the Players?

The first major reports in the media about genetic engineering in the forest products sector came with the announcement in April '99 of the joint venture between Monsanto, International Paper, Fletcher Challenge Forests, and Westvaco. Though not the first venture in forest biotechnology, it is the largest, and has committed the most resources to acquiring genetic patents and other intellectual property rights from smaller biotech research firms.

Monsanto was already involved in another joint venture with ForBio, an Australian biotechnology company. ForBio had improved the commercial feasibility of cloning by robotizing the tissue culturing process. The new company, called Monfori Nusantra, is based in Indonesia with trials in Sumatra and Kalimantan. ForBio has also recently purchased companies in Europe, Asia, and the U.S. where tissue-culturing will occur. Plans include up to 500,000 acres of eucalyptus in Hawaii, replacing sugar cane plantations.

GenFor SA involves Silvagen from Canada, Interlink from the U.S., and the Chilean Development Agency. Planting of transgenic pines are said to begin this year.

Shell Forestry and Toyota have both been involved, presumably to take advantage of carbon credits (see discussion of carbon sequestration). According to some sources, Brazil would be the most likely site for Shell's plantings. Toyota has apparently focused their attention on the artificial doubling of chromosomes to increase growth rates. Where these trees could end up is open to speculation.

Other examples of companies that are involved in GE trees include Genesis Research and Genetic Engineering for Future Forests, both of New Zealand, and AstraZeneca from England. Genesis is involved with Monsanto, and AstraZeneca is working with Shell. In the U.S., collaborations are occurring between academia, industry, and government. Oregon State University's Tree Genetic Engineering Research Cooperative and North Carolina State University's program are the most prominent, and both have strong ties to the timber industry. Apparently NCSU has also received $4.4 million in government grants for GE tree research to benefit the timber industry.

A Plantation is Not a Forest

There are many similarities between Agbio and forest biotechnology, with most of the concerns raised about genetically engineered food crops applying equally to GE forests. A key concern is the growing dominance of a few corporations with the power to affect all life on earth. This seems especially threatening when biotech/chemical giants are partnered with some of the world's largest landowners.

"The corporation cannot be ethical. It's only responsibility is to make a profit"
--Economist Milton Friedman

Many of us see forests as diverse habitats providing the last refuge for the earth's declining biodiversity. The industry would prefer to employ the agricultural mono-culture model with even rows of identical trees. In fact, the regulating agency for GE trees in the U.S. is the Department of Agriculture (USDA). The USDA, rather than protecting the public from the consequences of this unproved technology, has been biotechnology's biggest champion.

The principal players in Agbio are also involved in forest biotechnology. Not surprisingly, they are anxious to apply the same patented herbicide resistance and insecticide- producing technologies developed for agriculture to trees. Adding GE forests will increase sales for Monsanto's Round-up herbicide, which was already their most profitable product. Although some work has been undertaken with food-producing trees, virtually all efforts have been on tree species and characteristics sought by the pulp and paper industry.

There are specific issues about forests

(continued on next page)

(Plantations continued from prev. page)

and trees that are very different from agricultural crops. Annual food crops are, to some extent, self-limiting because of the plants' short life-span. Trees, on the other hand, can live for hundreds or sometimes thousands of years. While GE proponents plan for trees that grow to harvestable size within five years, this may still allow for unintended and undesirable characteristics to surface, especially in response to stress. During its life, a tree may be exposed to many stressors including extremes of temperature, flood, drought, disease, and insect attack.

Trees are complex organisms. Recent studies have shown that some trees, when attacked by caterpillars, release a chemical warning to surrounding trees, which alter the chemical structure of their leaves to be unappealing to the caterpillars. How will altering gene codes affect these and other little understood behaviors?

Genetic manipulation in trees can range from single goals (e.g. elimination of the mechanisms of reproduction to increase growth rate), to changes in the complex coding that controls shape, intervals of branching, and characteristics of the wood. Increasing the number of altered gene sequences increases the potential for undesired effects.

As mentioned above, genetically manipulated trees are destined for large-scale plantations. While certain areas in the continental U.S. will see expanding plantations, notably the coastal Southeast and the Pacific Northwest (where poplar plantations already cover more than 40,000 acres in Oregon), most plantations will be in the Southern hemisphere. These plantations replace native forests, yet fail to provide the wide range of ecological functions provided by natural forests. These include watershed services, plant and animal diversity, and a local resource for wood, food, and medicines.

Loss of diversity is already a significant problem. The journal *Nature* reported that 34 tree species in Brazil may become extinct due to "disrupted ecological processes".

Plantations are in areas of low human habitation, which reduces the scrutiny under which they operate, and will make reporting of problems of genetic anomalies unlikely. The remote locations will also make monitoring of peripheral ecosystems difficult. This is critical, especially through the first several generations of these novel plants, to detect and control problems especially with transgenic/normal hybrids.

Plantations are very different from agricultural lands because of the types of surrounding utilization. Ag crops are frequently grown in areas dedicated to crop production, with entire landscapes dedicated to farming. This is especially pronounced with industrial agriculture using genetically modified organisms. GM tree plantations are very different in that they are typically surrounded by normal trees. This increases the risk of problems with transgenic pollen crossing with native species.

Planfosur eucalyptus nursery, Tabasco, Mexico Photo: Langelle/ ACERCA

The outcome of such a cross is open to speculation, but the possibilities are herbicide resistant feral species crowding out natural forests (as many exotic invasive species do presently), loss of beneficial insects, and increased insect damage to adjacent natural forests from a disruption in the ecological balance. The issue of transgenic pollen on other plants cannot be minimized. Pollen from cloned poplar has been found at great distances from the trees, and studies in Oregon are attempting to develop models of dispersion. The long distance champions for pollen are pines with some pollen found as much as 600 km from the trees. Fifty-foot buffers, as have been suggested in agriculture to prevent problems from escaped transgenic pollen and as a "refuge strategy" for insects, are clearly inadequate.

In native forests, soil productivity is maintained by natural processes of death and decay; nutrients are recycled back into the soil through the interactions of many life forms including arthropods, bacteria, and fungi. Larger animals also assist in the breakdown of woody structures through the creation of shelter or the search for food. Soil created over centuries can be depleted in two or three cycles of rapid growth and removal, leading to abandonment of land (a persistent problem in the South), or requiring massive and costly inputs of chemical fertilizers. Another problem unique to plantations is that indigenous insects and soil organisms may be unable to utilize the leaf litter and branches of non-native species (e.g. eucalyptus and radiata pine). Without decomposition this material cannot be recycled into the soil. Herbicides and insecticide producing plants also affect these organisms. Mychorrhizal fungi, for example, are known to be instrumental in nutrient uptake in trees, creating symbiotic relationships with and between tree species. Creating toxic soils is likely to disrupt the nutrient uptake and decrease soil productivity.

Creating super-trees that grow more than a meter a month and can be harvested after four years puts increased pressure on water resources. This is referred to as hydrological cycling, and in many regions may create unsustainable demand for limited water. Trees utilize water to move nutrients up from the soil to the branches and leaves, where it is used in the cell structures or excreted into the atmosphere. The flow is constantly upward, and increases with the growth rate. When trees are cut and removed, residual moisture is removed at the same time. This problem is compounded when the understory, essential to retaining soil moisture, has been destroyed with herbicides. Depletion of the water resource is already a problem with plantations and will only worsen with GE super trees.

Glyphosate herbicides such as Round-up have been tied to human health problems, and their impact on other species is well documented. Glyphosate is water-soluble and is especially harmful to fish. Use of Round-up tolerant agricultural crops has led to heavier applications of the chemical. This is likely to occur with trees as well. Plantations are going in on indigenous lands. The land and water that these native people depend on will be increasingly contaminated with these herbicides.^

Altering Life for Corporate Profit

How are the world's trees, having evolved for tens of millions of years to fit perfectly into particular climates and ecosystems, suddenly unsatisfactory to transnational corporations, and how would these businesses "improve" life to better fit their needs?

The specific characteristics sought will be discussed individually, but the ideal supertree designed by industry would manifest several of these traits. The willingness to create these traits through the insertion of alien genetic material is but one sign of the scientific arrogance that would then alter ecosystems without expecting a progressive series of reactions. Such changes may well take place outside the time-frames set by corporate investors.

Round-Up, a glyphosate-based herbicide, and Monsanto's most profitable product is marketed as Faena in Mexico.
Photo: Langelle/ ACERCA

Reduced Lignin

Lignin is a component of the cell walls in trees and other plants that is essential for the structure of the plant, lending strength, and aiding in vascular functions. Lignin comprises one-third of the dry weight of a tree's wood. However, the lignin must be removed from wood pulp to make paper. This is a costly process, both in the expense for chemicals used to remove the lignin, and from smokestack emissions and toxic discharges into rivers by pulp mills.

"The benefits for genetically altered trees far outweigh the potential costs thanks to increasing demand for forest products."
--Ken Munson, Interim Head of Monsanto-IP joint venture

The solutions to these problems are already available. Naturally low-lignin annual agricultural crops (hemp and kenaf), and residues from food crops (corn stalks, grain chaff, etc.) would meet demands for paper with significantly less environmental impact. Pulp and paper companies with tens of millions of acres of woodlands have not embraced these alternative fibers. Neither have they replaced aging pulp mills with cleaner processes such as oxygen delignification and closed loop systems which would not contaminate the air and water. Even the simple step of substituting hydrogen peroxide for chlorine to prevent the formation of dioxin has been resisted by the major mills. All of these solutions have been proven successful, making excellent paper and having a much smaller environmental footprint. Unfortunately, they exist only in smaller niche markets, and have not enjoyed the economies of scale that the world's pulp and paper giants wield.

More Environmental Trees?

The genetic codes of trees can now be altered to substantially reduce lignin, and this has been heralded by the industry as an environmental improvement. Substantial money and effort has gone into this because of the potential for cost savings in pulping. Known field trials are focused primarily on poplar and eucalyptus.

Decreasing lignin is accomplished by disrupting metabolic pathways affecting the production of enzymes within the tree. The actual processes that form lignin are poorly understood, and how diminished production of essential enzymes may affect other functions is unknown. One noted consequence in several trials was wood of unusual color. Other studies have shown substantial chemical alterations in transgenic plants (e.g. radical increases of ferulic and sinapic acids in transgenic plants). Because lignin is essential to a trees strength, lowering lignin could adversely affect a tree's ability to withstand wind without damage. Escape of low-lignin genes into the wild is a significant worry, and could have devastating consequences on native forests.

"I still have the alarming vision of what one campaigner described as 'wobbly trees'."
--Hugh Warwick

Impact on disease and insect resistance is likely to be affected by decreased lignin since it is essential to a tree's defenses. This may well lead to increased dependence on pesticides for commercial plantations.

Herbicide Resistance

Herbicide resistance is certain to be utilized primarily because the technology exists (having been developed for agricultural use), and because the herbicide manufacturers have positioned themselves to control the direction of biotechnology. This is especially true of Monsanto, with Round-Up, their proprietary version of glyphosate. This chemical is already used by some industrial landowners to kill all broadleafed vegetation when pine or spruce are the desired species. Pines which can withstand exposure to phosphinothricin-based herbicides are being field tested in New Zealand, and resistance to sulfonylurea is being researched. Herbicide resistant soy beans have had problems with fungal disease. If this problem is encountered with trees, fungicides would likely be used in addition herbicides and insecticides.

Agricultural crops with engineered resistance have led to greater, not lesser, dependence on herbicides. The advent of tolerance to these chemicals in tree species will undoubtedly have a similar effect. The effect of herbicides on soil micro-organisms and fertility was previously raised but downstream effects on fish and amphibians is well documented, and should be of concern.

"Companies like Monsanto want to get their insect and herbicide-resistant genes into forestry and the quickest and most effective way is a tie-up with us."
--Bill Henderson, ForBio

Pest-resistant Plants

Bacillus thuringiensis (Bt) is a naturally occurring soil bacteria which contains a substance toxic to the leaf-eating larvae of moths and butterflies. Bt has been used successfully by organic farmers to control specific pests such as cabbage loopers.

Engineered versions of corn, cotton, and potatoes now exist which have this same toxoid protein throughout the plant. Monsanto has patented versions of all these plants in wide commercial use. Companies such as Ciba-Gigy and Novartis are also active with this technology, but the largest number of patents on Bt technology is held by Mycogen, an affiliate of Dow Chemical.

Widespread use in forest biotechnology is again likely, in part because the tech-

(continued on next page)

Altered Life (cont'd from prev. page)

nology is available. Field trials of Bt versions of poplar, spruce, apple, and walnut have been reported. GenFor SA and the Forest Research Institute have trialed Bt pine in New Zealand, and Bt larch trees are being developed by Germany and China.

There are a variety of concerns about insecticidal plants, and most have been well articulated by those working on Agbiotechnology. Bt is a wide-spectrum insecticide, and can destroy non-targeted species. This point has been questioned by industry, but the recent widespread destruction of Monarch butterflies from exposure to transgenic pollen has effectively ended the dispute. Although some insects can cause damage to plants, this is most likely when the ecological balance is disrupted (monocrop plantations are particularly susceptible). The unintended destruction of beneficial species may ultimately have significant negative effects both for transgenic trees and their neighbor natural trees.

Widespread use of Bt will quickly diminish its effectiveness. The current form of Bt is not expected to remain useful for more than 3-4 years before the evolutionary advantage for resistant insects creates entire resistant populations. This may have already occurred in Bt cotton. The impact on forests from creating "super pests" is not known.

There has been some discussion of soil toxicity, especially since Bt plants have this toxin throughout their makeup, not just as a topical application during specific infestations. Bt supposedly breaks down quickly with exposure to UV radiation, but measurable amounts of Bt have been detected in the soils where transgenic crops are grown. Long-term effects are not known, but Bt use has gone from very limited use to an estimated $25 billion business.

Eucalyptus plantations, such as this one in southeast Mexico (on former agricultural land) are marked by a total lack of undergrowth vegetation. Photo: Langelle/ ACERCA

Rapid Growth

The proponents of forest biotech promise environmental benefits from transgenic trees. Rapid-growing trees, they say, would produce more wood on less land, lessening the demand on native forests (although, as has already been pointed out, plantations usually replace native forests). Higher rates of growth require more nutrients, and place greater demand on water resources. This has a long-term impact on site productivity. Theoretically, massive applications of chemical fertilizers are possible, but unlikely considering the scale of the enterprise. The only model that we have is existing plantations which often lead to rapid degradation of the land. More native forest is then removed to make way for new plantations.

High growth rate has been achieved in clones of eucalyptus and in hybrid and transgenic poplar. Efforts have been made to alter a plant's response to decreasing daylight. This would be an advantage in Northern climates. Trees typically grow in the warm months, and reserve energy in the cold months when daylight wanes. Transgenic aspen have been created which will grow with as little as six hours of daylight per day. These trees lost their ability to survive in the cold, so, to date, this avenue has not yielded the desired results.

The most promising solution viewed by industry is to create sterile trees. Eliminating the mechanisms of reproduction such as flowers, nuts, cones, fruits, and seeds would allow that effort to be used for growth. This is significant, with 25% or more of a tree's energy directed toward procreation.

The Sterile Forest

The escape of engineered gene sequences into the wild would have unknown and unpredictable consequences. Since the pollen of many tree species can travel very long distances, containment would appear to be impossible. This would seem to be ample reason to not move forward with genetic manipulation. Potential profits seem to have replaced sense, and so the bio-engineers are attempting to create sterile trees. Trees that could not flower would eliminate the threat of transgenic cross-pollination with natural plants, and address concerns about potentially allergenic pollen. At the same time, growth rates would likely increase. Replacing forests with sterile plantations, where no food exists for wildlife, could hasten the loss of biodiversity.

Flowering is a complex process, and while it may be delayed or stunted, there are no guarantees that it can be stopped. One of the complications is the press to patent these processes and bring these transgenic species to market as quickly as possible. This puts particular pressure on tree research, since their life processes take place over extended time frames, and many tree species do not flower for many years or decades.

Environmental stresses can also alter the normal development, and trigger flowering in an immature tree. Precocious flowering has been reported in American elm, likely in response to Dutch elm disease, and in transgenic poplar. This would seem to complicate the problem. Trees are not machines, they are living beings. Thwarting their normal life processes is not likely to succeed, but if it was possible, would we really want to create "Terminator" trees?

Product Uniformity

The industry would realize cost-savings if all trees were the same size and shape. This would facilitate handling in the pulp and paper industry, but would be especially appealing in shapes that would maximize the amount of dimensional lumber that could be cut from each log. ForBio promises that they "can change the number of branches, the angle that they

(continued on next page)

Altered Life (cont'd from prev. page)

grow at, and even their diameter." This may be true in theory, but since shaping involves the interaction of hundreds of genes, this is unlikely to occur in the forseeable future. The shape a tree takes is also in response to the environment in which it grows, so even genetically identical individuals may have different shapes.

Disease Resistance

Movement between countries of raw logs or even unprocessed wood (as in shipping containers) has brought exotic insect pests and pathogens. This is not just a recent phenomenon, although rapid corporate globalization has increased the number and scale of problems.

Elms were once the most common shade tree in nearly every city in America. The last century has seen them succumb to a fungal infection referred to as Dutch elm disease. Massive chestnut trees once dominated eastern North American forests, and now exist primarily as root sprouts from dead trees. Beech are also in serious decline from an exotic fungal infection which gains access to the tree on a minute bark beetle.

Biotechnology promises a solution. Researchers in New Zealand have developed elm with anti-fungal genes. Should these trees be successful, they are most likely destined for commercial use where elm's strong wood would be valuable.

The question has been asked if opponents of rampant biotechnology would find a moral quandary in a solution to a problem like Dutch elm disease. A response could be another question. Could a different solution be found? Elms continue to survive and even propagate in the wild, although only isolated individuals seem to avoid the disease. As long as elms are able to breed, there is every likelihood that the gene for resistance would ultimately occur. That gene might take some time for nature to develop, and would not be patented. Another solution is one that has many hopeful about the return of American chestnut. Resistant individuals have been found and there are crosses with the resistant Chinese chestnut that are surviving exposure to the pathogen. Resistant trees are now being planted from Kentucky to the Green Mountains of Vermont.

Bioremediation

There has been discussion about trees designed for bioremediation, trees that could take up and store contaminants. Imagine PCB-loving trees planted in former industrial wastelands that are able to remove these deadly toxins from the soil. Now imagine disposing of these toxic trees. If trees like this do not exist now, they are likely to in the future. More could be accomplished to reduce our toxic legacy by banning all organo-chlorines.

Carbon Sequestration

Trees, through part of their respiration cycle, take in carbon dioxide and release oxygen. A percentage of the carbon is sequestered (stored) and is not released until the tree decomposes or is burned. Because carbon dioxide is the greenhouse gas most responsible for global warming, planting trees would seem to be an obvious solution to climate change.

This has led, inexorably, to the idea of tradable carbon credits. Carbon credits would allow businesses to choose not to reduce carbon emissions from dirty industries, but rather find additional profits in cutting down forests and installing plantations. This promise has prompted companies like Shell and Toyota to become involved in the genetic engineering of trees. Their hope is a supertree that would be more valuable in tradable credits because it could sequester more carbon. Not taken into account is the carbon released by the removal of original forest for the intended supertree plantation, the fact that these trees are designed for short-rotation for pulp, and their low lignin content which would accelerate decomposition. Carbon sequestration is important, and that is a key reason to leave the world's remaining original forest in place, and to increase protections for recovering forest landscapes.^

Native rainforest in SE Mexico.
Photo: Petermann/ NFN

Who's Guarding the Henhouse?

In the United States, all engineered plant releases must have a permit issued by the Animal and Plant Health Inspection Service (APHIS), a part of the US Department of Agriculture. The USDA has been genetic engineering's biggest proponent, fighting all requests for labeling, and using threats of trade sanctions to force GM products on unwilling countries.

The USDA regulations were designed for genetically modified annual food crops, and do not have specific regulations regarding trees, in spite of very different biosafety concerns. APHIS may set conditions on the release, and requires annual renewal of permits. They reportedly have a complete database of all releases of GE trees in the U.S. and, because APHIS is a government agency, they should be responsive to requests from the public for information under the Freedom of Information Act (FOIA).

When the modified traits have environmental impact, the Environmental Protection Agency (EPA) also has responsibility. This has been interpreted to cover pesticide production and herbicide tolerance. The EPA has responded by increasing the amount of herbicide residue allowed on some crops.

The relationship between Monsanto and the government agencies that supposedly regulate the giant corporation have been described as a "revolving door". Former Monsanto employees are often in key government jobs, promoting GE products and limiting any restrictions on biotechnology.

References

Brown, Lester, et.al., State of the World 2000, W.W.Norton, New York, 2000.

Ferrara, Jennifer, "Revolving Doors: Monsanto and the Regulators", The Ecologist, vol.28 no.5, 1998

Johnstone, Bob, "Supertrees", Forbes Global Business and Finance, August 10, 1998.

Langelle, Orin, "From Native Forest to Frankenforest", from the upcoming book edited by Brian Tokar published by Zed Press, London, 2000.

Lappe, Marc, Ph.D. and Britt Bailey, Against the Grain, Common Courage Press, Maine, 1998.

Owusu, Rachel Asante, "GM Technology in the Forest Sector", WWF, 1999.

Wallach, Lori and Michelle Sforza, Whose Trade Organization, Public Citizen, 1999.

Warwick, Hugh, "AReport for Green-peace from Forest Biotechnology '99", Oxford, England, 1999.

"The Next GM Threat: Frankenstein Forests", The Ecologist, vol.29 no.4, July 1999.

Wilson, E.O., The Diversity of Life, W.W.Norton, N.Y., 1999.

Trade Treaties and Trees

While many in the activist community see the regulatory requirements in the U.S. as too lax, industry finds any control intrusive. Many U.S.-based transnational corporations are therefore drawn to take advantage of the less demanding or non-existent regulations in the South. For this reason, the forest products industry has been increasing pressure to eliminate all tariffs on wood traded internationally.

The first meeting of the Free Trade Areas of the Americas was held in Toronto in November 1999. The goal is to expand the North American Free Trade Agreement (NAFTA) to include all countries in Central America, South America, and the Caribbean Basin with the exception of Cuba. This is clearly in the interests of forest products giants like International Paper, Champion, and Boise-Cascade, all with land in Central and South America. Additional meetings are planned for the FTAA with the intent of completing the treaty by 2005. The effect will be to eliminate all tariff and non-tariff barriers to trade. Non-tariff barriers include environmental, health, and safety regulations. Under NAFTA, and presumably under the FTAA,

Native Forest Network and ACERCA hung a 600 square foot banner on the Toronto Convention Center where Ministers of the Free Trade Area of the Americas were meeting. Photo: Langelle/ ACERCA

corporations have the right to sue governments that impede their ability to generate profits. Attempting to limit the spread of genetically modified life forms could be challenged as a non-tariff barrier to trade.

A Global Free Logging Agreement (GFLA) was scheduled for consideration at the World Trade Organization (WTO) ministerial in Seattle. The Clinton Administration referred to this with the more innocuous label of Advanced Tariff Liberalization (ATL). The ministerial was not successful, and the ATL did not come up for consideration. The US Trade Representative released a study showing that this treaty would "only" increase the rate of forest loss by 4-5% annually. With forests already disappearing at the alarming rate of 35 million acres every year, all efforts should be on stemming, not increasing the loss.

The WTO's side Treaty on Intellectual Property Rights (TRIPS) has allowed the patenting of life forms, which has made genetic engineering profitable. The WTO has ruled against distinguishing a product based on how it was produced. This is likely to prevent labeling of GE products. There is also a WTO challenge against so-called "eco-labeling" by the European Community. Eco-labeling would designate products that were produced with less impact on the environment (e.g. chlorine-free paper). Efforts to certify forests for sustainable forestry practices are likely to fall before WTO challenges, especially if genetically engineered trees are not approved. FSC, the leading certifier, does not currently accept GE trees.^

Final Thoughts

The solutions to many of the world's problems are within our grasp, and, in most cases, solutions tend toward the simple, not the complex.

Life forms should not be patentable. While this would not prevent scientific research, it would reduce commercial incentive to rush these technologies to market.

Adhere to the precautionary principal. Under free trade globalization, individuals have had the responsibility of proving products harmful. This can be difficult and costly. The responsibility should be on the corporations to prove beyond all doubt that their product causes no harm. Because this could be extremely difficult with an engineered life form released into the environment, the most prudent step would be to not create these new life forms.

Since the primary focus of GE trees is the cheaper production of pulp for paper, let us look briefly at alternatives. Cleaner production methods have already been described, and these methods should be instituted immediately. The pulp and paper industry is the major source of dioxin, one of the deadliest substances ever created, which is dumped in the water by most pulp mills. Current EPA guidelines allow the continued discharge of this toxin. Closed loop systems, oxygen delignification, and alternatives to chlorine would provide a clean environment without the need for GE trees.

Pressure on primary forests can be answered by using alternatives to virgin wood. Since more than 40% of industrial wood goes to paper production, aggressive efforts to convert to recycled paper could have dramatic effects on the need to convert forests to products. Recycling will benefit from improved methods of using shorter fibers to make strong paper. This is especially true for second and third generation recycled.

Nearly half of all paper used goes into packaging. The demand for cheap paper for packaging is what is driving the conversion of land for pulp plantations in Mexico. Advertising and junk mail also contribute substantially to the waste stream, especially in affluent countries. The annual use of paper worldwide is just over 100 lbs. per person. Industrial countries use 360 lbs., and the United States uses more than 800 lbs. Clearly there is room for improvement. These unwanted and unnecessary uses could be reduced to eliminate the need to destroy the world's last remaining forests.

To contact NFN ENA:

PO Box 57, Burlington, VT 05402
(802) 863-0571 (802) 864-8203 fax
nfnena@sover.net
www.nativeforest.org

Become A Member!

__ I want to support the NFN's campaign against Genetic modification of trees.

__$10-25 low income **__$35 regular**
__$50 supporting **__$100+ sponsor**

Name______________________________
Address____________________________
____
Phone______________fax______________
email_______________________________

Make check payable to NFN and send to POBox 57, Burlington, VT 05402