BIOTECHNOLOGY AND FOREST HEALTH
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EVOLUTIONARY BIOLOGY AND ENVIRONMENTAL ACTIVISM
SCIENCE IN A SOCIAL ECONOMIC AND POLITICAL CONTEXT
CAN/SHOULD BIOTECH BE USED TO PROTECT AND CONSERVE FORESTS?

NO!
FIRST QUESTION: WHAT IS A FOREST?

MONOCULTURE PLANTATION: WOOD FARM

“REAL” FOREST
“For decades, the World Rainforest Movement (and many allies) have demanded that the United Nation’s Food and Agriculture Organization (FAO) urgently review its forest definition, which mainly benefits the interests of industrial monoculture tree plantations companies. **FAO’s definition reduces a forest to any area covered by trees. In doing so, the FAO definition discards other life-forms as well as the biological, cyclical and cultural diversity that define a forest in its continuous interconnection with forest-dependent communities.**

Statement on International Day of Forests, March 21, 2018
WHAT IS A HEALTHY FOREST?
OR WHAT IS AN UNHEALTHY FOREST?
SCIENCE CANNOT BE IN A VACUUM!
MOS'T TREE BIOTECH IS FOR PULP OR BIOENERGY NOT CONSERVATION!

ARBORGEN’S FREEZE TOLERANT EUCALYPTUS- A RESOUNDING NO!

UNREGULATED: GE LOBLOLLY PINE – WHO KNEW?

The International Campaign to STOP GE Trees & Dogwood Alliance
FOR IMMEDIATE RELEASE
Outrage Over US Secret Approval of Genetically Engineered Trees
Groups Condemn US for Bowing to Industry, Ignoring Widespread Public Opposition

New York (29 Jan, 2015) — Groups from around the world [1] today joined together to denounce the US government for allowing the first genetically engineered tree, a loblolly pine, to be legalized with no government or public oversight, with no assessment of their risks to the public or the environment, and without regard to overwhelming public opposition to GE trees.

A secret letter from the USDA to GE tree company ArborGen [2], dated last August, was recently exposed by scientist Doug Gurian-Sherman of the Center for Food Safety [3]. In this letter, the USDA made the unprecedented decision to allow ArborGen to pursue unregulated commercial cultivation of a loblolly pine genetically engineered for altered wood composition. These trees could be planted anywhere in the US, without public knowledge or access to information about them.

Gurian-Sherman argues the USDA “is deliberately thumbing its nose at the public” with this decision, pointing out that this is probably the biggest environmental regulatory change in the US since the early 1980s [4].

Loblolly pines are native across 14 states throughout the US Southeast, and are grown in plantations around the world. Their pollen is known to travel for hundreds of miles.
Stability of Herbicide Resistance over 8 Years of Coppice in Field-Grown, Genetically Engineered Poplars

Abstract  Forest trees produce an important feedstock, wood. Forest tree breeding programs have been traditionally carried out by selecting elite trees to enhance productivity and processability. Recently, however, a biotechnological approach has attracted much attention because it enables efficient and versatile improvement of forest trees. In the last decade, forest tree biotechnology has considerably progressed: genomic sequences of several forest tree species have been decoded, efficient Agrobacterium-mediated genetic transformation and regeneration systems have been established in a number of forest tree species, and many reports have been published on the metabolic engineering of a major wood component, lignin, in forest trees. However, in contrast to the metabolic engineering of lignin, the metabolic engineering of cellulose and hemicelluloses in forest trees awaits further development. The detrimental effects on tree growth are often concomitant with the metabolic engineering of wood components. To mitigate such effects, fine-tuned regulation of transgene expression, and tactics may be targeted in future forest tree biotechnology.

Designer lignins: harnessing the plasticity of lignification

Yaseen Mottiar, Ruben Vanholme, Wout Boerjan, John Ralph, and Shawn D Mansfield

Recent advances in forest tree biotechnology

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POPLAR FOR AVIATION FUEL?

WOOD TO WING
PLANT RESEARCH

Bioplastic Production by Transgenic Poplar

David A. Dalton, Cathleen Ma, Ganti S. Murthy, Steven H. Strauss

Plants have long been the source of biopolymers of great economic importance to humans. Starch and cellulose—both biopolymers—have obvious roles as major sources of food and fiber, respectively. It is increasingly likely that biotechnology can develop plant-based methods for the production of non-traditional biopolymers with profound benefit to humans. Bioplastics such as polyhydroxybutyrate (PHB) are particularly intriguing in this regard. Although plants do not produce PHB, many bacteria do, and plants can be engineered to produce PHB by transfer of the relevant bacterial genes. The ability of transgenic plants to produce PHB was first demonstrated 20 years ago, but this innovation has not yet resulted in plant systems that show commercial feasibility for production of PHB. The major underlying impediment is the lack of an efficient pathway for the production of acetate that could be used by plants for PHB synthesis in the plastid organelle. PHB is synthesized in the plastid organelle because this organelle is the site of fatty acid synthesis, which also requires acetyl CoA as the precursor. For several years, the general strategy for creating plants capable of making PHB has used a strong constitutive promoter (usually the cauliflower mosaic virus 35S promoter) along with plastid targeting sequences for each of the three genes of PHB biosynthesis (phbABC) derived from Ralstonia eutropha (formerly Alcaligenes eutrophus). While this approach has created plants capable of producing PHB, it has not yet resulted in plant systems that show commercial feasibility for production of PHB. The major underlying impediment is the lack of an efficient pathway for the production of acetate that could be used by plants for PHB synthesis in the plastid organelle.
Redesigned crops could produce far more fuel

19:00 03 April 2014 by Hal Hodson

The very compound that keeps plants standing tall has been redesigned to make them easier to break down. This genetic tweak has made it far easier to unlock the valuable chemicals held inside plants.

If it scales up, the method could be used to make more environmentally friendly biofuels, and more products extracted from wood.

Traditionally, getting at the chemicals in plants is tricky. The paper industry boils wood pulp in caustic soda at 170 °C for hours just to break it down. The stumbling block is a chemical called lignin, a chain-like molecule that gives woody plants their rigidity.

John Ralph at the University of Wisconsin-Madison and colleagues found a gene from a herb called Chinese Angelica that changes lignin production, making it easier to break down.

They introduced the gene to poplars, and found that they could extract nearly all the lignin from the wood, rather than just 20%.
GE CHESTNUT AND FOREST PROTECTION AS TROJAN HORSE

WHO OWNS PATENTS?

“JUST A COMMON GENE FROM SOMETHING YOU EAT: WHEAT”
“There is opposition to commercial application of trees, engineered specifically for fast growth and increased yields, by those whose stance is that the value accrues only to ‘big companies’. It will remain for traits that have broad societal benefits, such as conservation of threatened and endangered species and biofuels, for acceptance to be gained. Even then some countries will benefit before others, not because of the science, which is universal, but because of organized resistance.

In this treatise, I’ve addressed conservation of threatened and endangered species and bioenergy as the two disciplines that will most rapidly get public support. Engineered trees for faster growth and greater yields per unit area of time will, in the short run, continue to get negative publicity because of the perception that the benefits will accrue to ‘big companies’. Following acceptance of specialty crops for the good of the whole will set the stage for acceptance of value-added products such as trees engineered for fast growth, tolerance to adverse sites, and exotic plantations. The application of forest technology will first accrue to the owners of large industrial tracts of land, then to the REITs and TIMOs, and lastly to the non-industrial private landowners.”
Growth performance and chestnut blight incidence (Cryphonectria parasitica) of backcrossed chestnut seedlings in surface mine restoration

Jenise M. Bauman · Carolyn Howes Keiffer · Brian C. McCarthy

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HERBICIDE, PEST AND PESTICIDE RESISTANCE:

“THE SINGLE MOST COMMON TRANSFORMATION FOR PEST RESISTANCE INVOLVES THE INTRODUCTION OF EXOGENOUS BT GENES, ENABLING THE PLANT TO PRODUCE CRY TOXINS LETHAL TO CERTAIN TARGETED INSECT PESTS.”

GM trees with increased resistance to herbivores: trait efficiency and their potential to promote tree growth

Jonathan Latham, Madeleine Love and Angelika Hilbeck

Climate change, as well as a more intensive forestry, is expected to increase the risk of damage by pests and pathogens on trees, which can already be a severe problem in tree plantations. Recent development of biotechnology theoretically allows for resistance enhancement that could help reduce these risks but we still lack a comprehensive understanding of benefits and tradeoffs with pest resistant GM genetically modified trees. We synthesized the current knowledge on the effectiveness of GM trees with increased resistance to herbivores. There is ample evidence that induction of exogenous Bacillus thuringiensis genes lowers performance of target pests whereas upregulation of endogenous resistance traits e.g., phenolics, generates variable results. Our review identified very few studies estimating the realized benefits in tree growth of GM trees in the field. This is concerning as the realized benefit with insect resistant GM plants seems to be context-dependent and likely, manifested only if herbicide pressure is sufficiently high. Future studies of secondary pest species and resistance-evolution in pest to GM trees should be prioritized. But most importantly we need more long-term field trials to evaluate the benefits and risks with pest resistant GM trees.

The distinct properties of natural and GM cry insecticidal proteins

Jonathan R. Latham, Madeleine Love and Angelika Hilbeck

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NEW BREEDING TECHNIQUES:

JUST BECAUSE WE CAN, DOES NOT MEAN WE SHOULD!
"We are walking forwards blind…We are opening boxes without thinking about consequences. We are going to fall off the tightrope and lose the trust of public….We haven't seriously screwed up in the laboratory yet. Sometimes that surprises me.” (Kevin Esvelt)
WILL THEY BE REGULATED AND DO WE TRUST THE REGULATORY PROCESS?

Urgent international action on new GM techniques

It's looking as if Australia might have the dubious distinction of being the first country in the world to deregulate the use of new GM techniques such as CRISPR and RNA interference in animals, crops and microbes.

If we allow this to happen, products from these new GM techniques will enter our food chain and our environment with no safety testing and no labelling. The risks are enormous and the results could be catastrophic.

Please send an email demanding that risky new GM techniques are regulated under GMO laws.
WHAT ARE THE THREATS TO FORESTS?
WHAT ARE UNDERLYING DRIVERS OF LOSS AND DEGRADATION?

- Climate Change
- Unsustainable demand for wood/pulp and now bioenergy
- Trade: introduced pests and diseases.
- Agriculture and sprawl

GENETIC ENGINEERING CANNOT ADDRESS THESE EFFECTIVELY. NEW THREATS AND NEW DEMANDS WILL CONTINUE TO EMERGE, AND MUCH FASTER THAN GE “SOLUTIONS” CAN BE DEVELOPED.
Salvage logging is often a pretext for harvesting wood

Bia³owie³a Forest in Eastern Poland is one of the last remaining primeval forests in Europe. For the time being. In 2017, the Polish government had 100,000 more trees logged than previously, despite the fact that large areas of the Natural World Heritage site are under strict protection. They did this under the pretense of preventing the bark beetle from spreading further. The motor saws are quiet now after protests from environmental activists, Europe-wide criticism in the media and concerns by the European Commission. The case has been

HOW EUROPE'S TISSUE GIANT IS
WIPING AWAY THE BOREAL
Invasive Forest Pests in the United States
COMMUNITY IMPACTS AND OPPORTUNITIES FOR TREE-SMART TRADE

PROBLEM: Increased risk from pests due to global trade.

IMPACTS:
- Trees become infested causing damage or death.
- Changes the character of neighborhoods.
- High costs and damages borne disproportionately by homeowners and municipalities.

SMART 5 policy actions that will help prevent new forest pests:

S - Switch to pest-free packaging materials for international shipments to the US.
M - Minimize new pest outbreaks by expanding early detection and rapid response programs.
A - Augment international pest prevention programs with key trade partners.
R - Restrict the importation of live plants in the same genera as native woody plants in the US.
T - Tighten enforcement of penalties for non-compliant shipments.
GENETICS AND REDUCTIONISM:
LIFE IS NOT COMPUTER CODE AND WIDGETS!
GENETICS AND REDUCTIONISM:

WIDGETS AND COMPUTER CODE...
SO MUCH WE DO NOT KNOW!

Soil microbiota
How trees “communicate”
Impacts on hydrology
Interaction with climate

THE SECRETS OF THE WOOD WIDE WEB

In London’s Epping Forest, a scientist named Merlin eavesdrops on trees’ underground conversations.

By Robert Macfarlane  August 7, 2016
“THE PLANT MICROBIOTA EMERGES AS A FUNDAMENTAL TRAIT THAT INCLUDES MUTUALISM ENABLED THROUGH DIVERSE BIOCHEMICAL MECHANISMS, AS REVEALED BY STUDIES ON PLANT GROWTH–PROMOTING AND PLANT HEALTH–PROMOTING BACTERIA.”

Structure and Functions of the Bacterial Microbiota of Plants

Annual Review of Plant Biology
Vol. 64:807-838 (Volume publication date April 2013)
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https://doi.org/10.1146/annurev-arplant-050312-120106

Davide Bulgarelli,¹ Klaus Schlaeppi,¹ Stijn Spaepen,¹,² Emiel Ver Loren van Themaat,¹ and Paul Schulze-Lefert¹
CONCLUSION: REJECT THE MYTH OF BIOTECHNOLOGY FOR “FOREST HEALTH”

• Given we are still learning basic fundamental aspects of how forest systems function within earth systems
• Given so many unknowns and unknowables about GE trees and irreversibility of potential impacts if released
• Given the multitude and ever changing nature of threats to forests, at a pace and on a scale that biotech cannot address
• Given we know the primary root cause of many of these threats lies in bad policies governing forest “management”, trade practices, and land use which biotech does not and can not address
• Given that the tree biotech industry and vested interests are using “conservation” as cover for greasing the skids of deregulation and winning over a reticent public.
• Given we need a fundamental shift away from the misguided reductionist view of genetics and life - and towards recognition of forests as infinitely complex and variable systems.
• Given very many people – most people - not only indigenous peoples - consider GE to be a violation of the natural world and our relationship to it, an assault on the global commons, and have demonstrated their resistance.
• We should REJECT genetic modification of forest trees - for conservation or any other application. It won’t work, and only opens a pandora’s box that will worsen the problems!