



GET TREE RESEARCH

A country by country overview

WRM briefing - updated in August 2014

GE tree research

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WRM Briefing, November 2008 (updated in August 2014)

Since the late 1980s, research on Genetically Engineered (GE) or transgenic trees is being – or has been - carried out in a number of countries. Public awareness about this research remains scant, and the plantations industry and academia present the advances as a positive scientific development for the “improvement” of trees and increases in yield.

A survey from 2013 showed that there were about 750 reported field trials with transgenic non-fruit tree species taking place around the world. Most of these trials were reported in the USA (500), followed by China (78), Brazil (65), Canada (45), and countries in the European Union (44). The tree species most often used for genetic engineering are poplar, eucalyptus and pine (not including fruit trees, which we did not include in our assessment). (1) A survey among more than 100 scientists involved in GE tree research showed that each had carried out at least one field trial, and that the three most often mentioned research objectives were: disease resistance, bioenergy and wood quality. (2)

Industrial tree plantation companies want us to believe that using GE trees results in many benefits. One of the main benefits they mention is that using GE trees can result in an increase in wood production per hectare. The industry claim is that such an increase in

productivity could result in less land used by industrial tree plantations. However, the experience thus far with the plantation industry shows that the improved productivity already obtained without genetic engineering has not led to a global reduction in area occupied by tree plantations. On the contrary, in the past two decades industrial tree plantations - including eucalyptus, pine, rubber and acacia, as well as oil palm plantations - increased their land use fourfold in the global South.

Now, a new phase in GE tree research might be nearing with GE tree companies having submitted requests for commercial use of GE eucalyptus trees in countries like the USA and Brazil. This is a dangerous trend because of the potential environmental impacts reported in part of the available literature, including the fact that the “empirical data regarding the behavior of transgenic trees are largely lacking” (3)

People in those countries where GE tree research is taking place were never asked to give their free, prior and informed consent to such dangerous research. Access to adequate information is a first necessary step for people affected by GE research to provide or withhold consent, but such information has never been made available. Where authorities responsible for regulating such research eventually organize public hearings, these usually have a technical character. This in turn discourages participation by local communities affected by the plantations and others interested to discuss the issue. Moreover, it has been reported that in countries where some limited public participation in the approval process for field trials with GE trees is foreseen, promoters of GE trees have been lobbying to eliminate such participation. (2)

In order to try to reduce the existing information gap on the issue of GE trees in an understandable manner, WRM and Friends of the Earth in 2004 jointly published “**Genetically modified trees: the ultimate threat to forests**” (available at: <http://wrm.org.uy/books-and-briefings/genetically-modified-trees-the-ultimate-threat-to-forests/>). In 2007, WRM published the short briefing “**Transgenic trees**” that summarizes the main risks of applying the technology (available at: <http://wrm.org.uy/books-and-briefings/transgenic-trees/>)

As a follow up to these publications, WRM engaged organizations in countries where GE tree research is taking place in a collaborative effort to assess the status quo of ongoing GE tree research. The focus of this assessment has been on tree species eucalyptus, poplar, acacia, rubber – and more recently, oil palm, with the questions addressed including Where? What for? By who? With who’s support? Under what legal framework? ...is the GE tree research being undertaken, and who is opposing? The information was first published in 2008 in the form of 'information sheets' and a briefing that summarized the information from the different countries. Both, the information sheets and the briefing have been updated in August 2014.

This briefing thus provides an overview of the results of the collaborative investigation effort since 2008. It aims to provide sufficient information for concerned organizations and individuals in the relevant countries to involve themselves in the issue. With the latest update carried out in 2014, country information focusing on tree species has been updated whenever we succeeded in finding

new information. In this latest version we also included information on GE research on oil palm. Although not included as a "forest tree" in the figures on tree plantations or “planted forests” of the UN Food and Agriculture Organization (FAO), WRM considers oil palm as another tree used in the industrial monoculture plantation model, like eucalyptus, pine, acacia, rubber and others. Oil palm plantations have most of the characteristics of other industrial eucalyptus, pine, acacia and rubber plantations, including a rapid expansion in the global South. We intend to maintain the information sheets up-to-date by continuously adding relevant new country information. And whenever relevant, we will add information sheets on additional countries that make land available for GE tree research in the future. We therefore welcome any additional information that you might have and wish to share. Please contact wrm@wrm.org.uy for if you have any relevant information that you think should be included – or if you spot errors or omissions in the information sheets and the country sections of this briefing.

What follows now is a short summary of the situation in those countries where GE tree research is known to take place, with links to the information sheets on the WRM website that have been produced on all those countries for which the WRM Secretariat or organisations in the respective countries were able to find more information.

You can find all these information sheets here: <http://wrm.org.uy/all-campaigns/wrm-information-sheets-on-ge-tree-research/>

Australia

Little information is available on GE tree research in this country. One fact, however, is known: research is or has been carried out on GE eucalyptus, and the focus of the research was on faster growth, “improved” wood quality and sterility. CSIRO (Commonwealth Scientific and Industrial Research Organisation) discontinued its research in 2003, which included greenhouse eucalyptus trials. However, little is known about the work being carried out at two universities – Melbourne and Adelaide - and even less about research by Ensis (“a collaboration agreement between CSIRO and New Zealand’s Scion”). In any case, it is important to underscore that Australia is the most dangerous country for carrying out research on GE eucalyptus, given that eucalyptus trees are native to Australia. Any accidental release of pollen from GE eucalyptus – for instance, those manipulated for sterility - could easily contaminate and threaten the future of the country’s natural forest ecosystems.

Belgium

The world’s first release of genetically modified trees was a field trial of herbicide resistant GE poplars established in Belgium in 1988. Research is currently being carried out by the Flanders Institute for Biotechnology (VIB). For several years, VIB has been trying to modify the lignin content of poplars for easier ethanol production. The research team includes academics from the UK (Southampton University) and France. This research collaboration has more recently been transformed into a broader research consortium called EnergyPoplar, with a focus on bioenergy

purposes. This extended research consortium also includes Italian, Swedish and German research institutions. As a result of a strong campaign against GE research that was led by Greenpeace, authorization for another field trial was initially refused in May 2008. However, the trial was eventually approved in 2009. Because the results of this field trial were not considered satisfactory by VIB researchers, a permit for a new trial, again with poplar trees, was requested and approved in 2013 by the Belgian government. The approval was granted in spite of grave failures in the way the request was dealt with by the Belgian Biosafety Commission. These failings have been exposed by Belgian groups opposing GE trees. Also, hundreds of protest letters were sent to the Biosafety Commission.

Brazil

Research in this country is exclusively on eucalyptus, with the intention to manipulate for faster growth, for changing the wood quality for cellulose production through reduction and modification of lignin, for herbicide tolerance, resistance to pests and diseases and tolerance to water stress. The increased yields are expected to enable an increased pulp and paper production, enhance yields in wood pellet production, and make second generation energy production from biomass more economically viable. Those most directly involved in carrying out the research in the past years include corporations International Paper do Brasil, Suzano Papel e Celulose –through its fully owned company FuturaGene and in collaboration with industry association EMBRAPA -, Monsanto through Alellyx Applied Genomics, ArborGen, as well as the Universities of Viçosa, Santa Cruz and Rio Grande do Sul. Since research started, the

aforementioned entities but also other corporations have been providing support to GE tree research under the Project “Genolyptos”, funded by a consortium of pulp and paper companies including Aracruz Celulose (now Fibria), Celmar Indústrias de Celulose e Papel, Bahia Sul Celulose (now Suzano), International Papel do Brasil, Jarcel Celulose, Celulose Nipo-Brasileira, Klabin/Riocell, Veracel Celulose, Lwarcel Celulose e Papel, Rigesa Celulose, Papel e Embalagens, Votorantim Celulose e Papel and Zanini Florestal, among others. Another relevant consortium that promotes GE crops in general is the Biotechnology Information Council (*Conselho de Informações sobre Biotecnologia - CIB*), whose associates include – among many other - Arborgen, Monsanto and Suzano. A number of field trials have been approved and implemented over the years, mostly in the state of Sao Paulo (São Simão, Mogi Guaçú, Itararé, Itatinga, Brotas, Angatuba, Santa Cruz das Palmeiras, Borebi, Altinópolis, Luiz Antônio, Avaí, Guararema, Taquarivaí, Paranapanema), but also in Minas Gerais (Coimbra), in Rio Grande do Sul (Eldorado), and in the Northeastern states of Bahia, Piauí and Maranhão, the latter three exclusively by Suzano-owned company FuturaGene.

In 2014, FuturaGene was the first company in Brazil and in Latin America to apply for a permit for planting GE eucalyptus at a commercial scale to the Brazilian Biosafety Commission (CNTBio). The requested permit would cover both planting in their own plantation area, as well as in plantations linked to Suzano through outgrower schemes. More than 100 civil society groups and movements in Brazil and internationally are opposing this application.

Canada

Despite organized resistance to GE trees, the number of field trials has increased significantly in recent years in Canada, growing to 11 field experiments since 2011, all with poplar. The research institutes involved are the Laurentian Forestry Centre in Quebec and Queens University in Ontario. Past research also involved, white spruce (*Picea glauca*) and black spruce (*Picea mariana*) in addition to poplar species. The field trials carried out now focus on contributing to genetic research generally but also on two or three specific traits like herbicide tolerance, so-called modified secondary metabolites, selectable marker (gene introduced in a cell of, for example, a bacterium), fungal resistance, modified carbohydrate content and more digestible lignin for energy purposes.

Chile

Much research is being carried out in this country, but very little information is available on the results and even less on whether or not there are any field trials. Research is focused on manipulating radiata pine (resistance to pine shoot moth and to pitch canker fungus) and eucalyptus (faster growth, higher cellulose content in wood – including for second generation biofuels - , increased resistance to cold). Those carrying out the research include GenFor (a joint venture between Canada’s Silvagen, US’s Interlink and Fundación Chile) and Consorcio Genómico Forestal, which operates in the University of Concepción’s Biotechnology Centre in the Bio Bio Region. Research is supported by the main plantation companies (Forestal Arauco and Forestal Mininco), by the state’s

Forestry Institute INFOR and by the Universities of Concepción, Austral and Frontera.

China

China is the only country in the world to have commercially released GE trees and the country with the second highest number of field experiments worldwide. Well over one million insect resistant GM poplars have been planted in China since 2002. No records are known to be kept of where the trees are planted or how many have been planted. According to officials from the Chinese Academy of Forestry, “both commercialized species are female poplars with altered fertility”. However, in 2004, Xue Dayuan of the Nanjing Institute of Environmental Science told the *China Daily* that genes from the GM poplars had already appeared in natural varieties growing nearby. Also, new insect pests have emerged that were previously unknown in poplar trees not genetically engineered. Besides poplar, research is also being undertaken to develop GE eucalyptus and rubber trees.

Denmark

A Danish team led by Dr Jens Find has worked for a period of time on genetic manipulation of Nordmann Fir (*Abies nordmanniana*) to obtain Christmas trees resistant to insects and with needles that don't drop off as quickly. A test of these GE trees was established in Copenhagen's Botanical Gardens, with the support of the New Zealand Institute of Forest Research. In 2009, Find made a public announcement that he was giving up the research, explaining that

“People just don't want plants out of some laboratory standing in their living rooms”.

Finland

Tree species being genetically manipulated include hybrid aspen (*Populus*) and silver birch (*Betula pendula*). A field trial carried out in the name of the Finnish Forest Research Institute with silver birch was destroyed in June 2004. All of the nearly 400 seedlings planted in the fenced and locked site of 2000 square meters were broken off or ripped from the ground. In 2004, three Finnish environmental NGOs (the Union of Ecoforestry, the People's Biosafety Association, and Friends of the Earth Finland) launched an international campaign against GE trees. Helsinki University will carry out a new field trial in the period 2014-2017 with a focus on the wood formation and stomatal regulation in GE hybrid aspen.

France

Research is being carried out by government institutions. INRA (*Institut National de la Recherche Agronomique*) is genetically manipulating a hybrid poplar species focusing on producing trees with less lignin content for the production of ethanol and for the production of paper. INRA is part of an international consortium called EnergyPoplar with other research institutions from Europe involved and with a focus on research relevant for bioenergy purposes. There was one field trial of genetically modified poplars at Saint Cyr en Val (Loiret). An extension of this field experiment for

the period 2012-2017 was obtained, but INRA announced in 2013 that it had decided not to carry out the trial, apparently because of lack of funding. CIRAD (*Centre de coopération internationale en recherche agronomique pour le développement*) is focusing on GE rubber trees for enhancing the production of rubber, in collaboration with research organizations in Thailand.

Germany

In 1996, the Federal Research Centre for Forestry and Forest Products in Grosshansdorf started the first deliberate release trial of genetically modified aspen, which obtained approval for a further trial in 2000. Approval for deliberate release of poplar at two sites were granted to the University of Freiburg. They took place in Helbra (Saxony-Anhalt, 2002 – 2004) and in Helbra and Großörner (Saxony-Anhalt, 2003 – 2005). The University of Tübingen is also involved in GE research on poplar. Since 2005 no new field experiments have been reported although research continues, for example, two German universities participate in the international EnergyPoplar research consortium focusing on bioenergy purposes.

India

In India, research is carried out on GE rubber trees by the Rubber Research Institute of India. In 2012, field trials were approved by the federal government with GE rubber trees in the states of Kerala and Maharashtra. It was reported soon after this federal authorization that the state of Kerala wanted to maintain its status as state free of GMOs (Genetically Modified Organisms) while the

Maharashtra state government formed a commission to study the issue in all its aspects.

Indonesia

More than 10 years ago, it was reported that the Indonesian Institute of Sciences (LIPI) was working in partnership with the Japan Society for the Promotion of Sciences (JSPS) in genetic engineering of *Acacia mangium* and Sengon (*Paraserianthes falcataria*) for increased CO₂ fixation by trees. This Japanese-led joint project resulted in the production of 750 GE *Acacia mangium* and 400 GE Sengon trees in Indonesia. Some 130 Mangium and 30 Sengon trees were being kept at the Serpong Botanical Garden. The whereabouts of the other seedlings is unknown. No recent information has been found about these trials or about a follow-up trial.

Israel

A company called CBD Technologies was involved until 2006 in GE research on poplar, eucalyptus and pine (*Pinus halepensis*), when it merged with FuturaGene, which in turn was acquired by Brazilian pulp and paper company Suzano in 2010. The aims of FuturaGene are to genetically engineer non-fruit trees for faster growth, increased cellulose content and improved fiber properties. The company has field trials in the US (poplars), Israel (eucalyptus, poplar and pine) and Brazil (eucalyptus), and is planning to carry out a field trial in Thailand. In Brazil, FuturaGene is carrying out a project to increase the growth rate of eucalyptus trees. In early 2014, the company submitted a request for approval for planting GE

eucalyptus on a commercial scale in Brazil (see information on Brazil). Although no details are available, the Hebrew University, Institute of Plant Sciences and Agriculture is also involved in GE tree research.

Japan

Genetic manipulation has been performed on several tree species: eucalyptus, japanese cedar (*Cryptomeria japonica*), poplar, acacia mangium and sengon (*Paraserianthes falcataria*). The aims are diverse: salt-, acidic soil and cold- tolerant eucalyptus, male sterility in japanese cedar to avoid pollen-related allergies, reduced lignin content and increased CO₂ fixation by trees, as well as increased quality and quantity of biomass and increased disease resistance. A number of universities and research institutions have been jointly working with major pulp and paper corporations. The University of Tsukuba is working with Nippon Paper Industries on GE eucalyptus. Gifu University and also the RIKEN institute works in partnership with Oji Paper, also on eucalyptus. Research on GE Japanese cedar has been carried out by the Forest Experiment Station, Toyama Forestry and Forest Products Research Center. Until 2013, in Japan 9 field trials had been carried out, 7 with eucalyptus and 2 with poplar. Field trials of eucalyptus trees have been implemented at the University of Tsukuba's Gene Research Center and at Oji Paper's Forestry Research Institute in Kameyama, Mie Prefecture. According to a survey from 2013, the most recent field trial that is on-going (2013-2017) is carried out by the University of Tsukuba with cold-tolerant eucalyptus. According to the RIKEN research institute, new field tests will be carried out with Nanjing Forest

Institute of China and with the Forest Science Institute of Vietnam, the latter in collaboration again with Oji Paper.

Malaysia

Since the 1990s research is carried out in Malaysia on GE oil palm and rubber. The aim of having GE oil palm is to obtain more oil, improve oil quality, herbicide tolerance and insect and fungal resistance. With GE rubber trees, the focus is on production of specific, commercially valuable proteins. Research is mainly carried out by the Malaysian Palm Oil Board and by the Malaysian Rubber Board, respectively. In spite of the efforts by Malaysia since the 1990s to be one of the global leaders in biotechnology, commercial oil palm plantations are only expected from 2040 onwards. No information has been found on field trials. The slow process might be due to the existing opposition to GE crops in general in Europe, one of the major markets for Malaysian palm oil.

New Zealand

Research in New Zealand has focused on radiate pine and Norway spruce, aimed at herbicide tolerance, flowerless trees and wood that is easier to pulp. In June 2008, Scion cut down the last radiate pine trees of its field trial, when the trees were eight years old and thus had reached an age where they could reproduce and thus the manipulated genes could be reproduced and spread. Scion has also signed a research agreement with GE tree research company ArborGen, owned by International Paper, MeadWestvaco and Rubicon. This means that GE tree research will continue. However,

opposition is growing and is headed by two organizations: GE-Free New Zealand in food & environment (Rage Inc.), and the Soil and Health Association. The latter carried out a campaign for the Scion GE tree trial to be stopped and the trees to be removed. Following a different approach, in January 2008, someone got into Scion's GE tree experiment site and damaged 19 trees. A new Scion's field trial attempt with 375 pine trees, set up in 2013, was destroyed in a break-in action in 2014.

Poland

The Warsaw University of Life Sciences carries out research on GE poplar, aiming at increased biomass production and reduced water consumption. One field trial in the period of 2010-2014 was authorized to study a number of functions of GE poplar like biomass production while a second trial in the period 2015-2019 will study changed biomass production properties and water use efficiency.

Russia

Little is known about GE tree research in Russia and even less about field trials. However, a research article published in 2006 mentions that a transgenic poplar (*Populus tremula*) was grown "outside during 3 years", which means that there has been at least one open air field trial with GE trees in Russia. In 2009, press articles mentioned plans to plant some 300,000 genetically modified aspen and birch trees - in the open air near the cities of St. Petersburg and Nizhny Novgorod. According to those news reports, planting would take place in the autumn of 2009. Currently, there appears to be no

threat of GE trees in Russia and there are no known plans for large-scale trials for commercial release. In April and May 2014, under the influence of the clash with the European Union and the USA, Russian Prime Minister Medvedev announced that Russia is and will stay a country free of all GMOs. For the same reason, the parliament also opposes GMOs. With this announcement, at least for now, the period (2006-2013) when GM lobbyists in Russia were very aggressively trying to promote the introduction of GMOs seems to have come to an end.

Spain

The Universidad Politécnica de Madrid and the Universidad de Malaga are doing GE research on poplar, aiming to increase biomass yield. Both universities carried out field trials, with the collaboration of INRA (France) that provided poplars for field tests. The field trial of the Malaga University was carried out and concluded in 2011. The trial of the Madrid Politechnical University is being carried out in the period 2013-2016.

Sweden

Tree species being manipulated include poplar, eucalyptus and spruce and the aims are to obtain trees that flower earlier, grow faster, with increased fibre length, improved wood quality, wood that is easier to pulp (with more easily extracted lignin content) and easier breaking down of the sugar polymers for subsequent production of ethanol. Research has been carried out by the Swedish

University of Agricultural Sciences (SLU), Umeå Plant Science Centre and by SweTree Technologies (SweTree Technologies was formed in 1999 as a joint initiative of the Foundation of Technology Transfer – Innovationsbron - in Umeå and the company Woodheads AB. Innovationsbron aims to profit from commercialising Swedish research and innovation. Woodheads AB was formed to handle the intellectual property from 44 researchers at the Umeå Plant Science Centre and the Royal Institute of Technology in Stockholm). It is interesting to note that three Swedish forestry companies (Sveaskog, Bergvik Skog and Holmen) are part-owners of SweTree Technologies, and SweTree Technologies is also part of the international EnergyPoplar consortium with other research institutions in Europe focusing on bioenergy purposes. Several field trials have been undertaken with GE poplar in Sweden. Two trials are carried out by the SLU in the periods 2011-2016 and 2014-2019, to study modified wood properties and improved wood quality, respectively. SweTree Technologies also is carrying out two field trials in the periods 2011-2016 and 2012-2017, focusing on increasing knowledge about growth and drought stress properties, respectively, and also on increased production of woody biomass. Umea University has been carrying out a field experiment since 2013, focusing on basic research aims.

Taiwan

The only information publicly available is that the Taiwan Forestry Research Institute is collaborating with the North Carolina State University in the USA in genetically modifying eucalyptus to achieve more cellulose production and more CO₂ uptake by these

trees. In 2011, field testing of GE eucalyptus for pulp production was on-going.

Thailand

France's CIRAD (*Centre de coopération internationale en recherche agronomique pour le développement*) is jointly working with some Thai research institutions on rubber trees for higher latex production and to allow callus growth recovery, with reduced browning and sustained so-called GUS activity. A collaborative initiative between French and Thai research institutions was created in 2008, called the 'Hevea Research Platform in Partnership'. It is unknown if there are any field trials of GE rubber trees in Thailand. GE rubber tree research receives support from the Charoen Pokphand group, one of the country's largest business empires, which has stated that "it is confident that the government will give the go-ahead for the cultivation of GM rubber in the future."

United Kingdom

Research on GE trees in the past included field trials of herbicide-resistant eucalyptus (carried out by Shell and now discontinued) and poplar (destroyed by protesters in 1999), as well as a field trial - carried out by researchers from Abertay University in Dundee - composed of elm trees genetically engineered for resistance to Dutch Elm disease. The elm field trial was carried out in "a controlled environment" "somewhere in Dundee". The scientists developing them feared "terrorism" by protesters and did not disclose precisely where they were or gave details on the numbers of

trees planted. Southampton University researchers and Imperial College in London are involved in an international Consortium called EnergyPoplar with other European research institutions focusing on bioenergy purposes. No recent information has been reported on new field trials in the UK.

USA

The USA is the country with globally the largest number of registered field trials of non-fruit trees until now (500). The USA has almost 900 acres (360 hectares) of genetically engineered tree field trials across 20 states, mainly in the U.S. South, Upper Midwest and Pacific Northwest. The vast majority of these are in three species: 355 acres of field trials are in GE eucalyptus and 322 acres are in GE poplars. GE Loblolly pines are planted on more than 150 acres.

The USA also has the largest number of companies and universities carrying out research, as well as the largest number of traits being genetically modified and research institutions in the USA are almost certainly receiving the largest amount of funding for research on GE trees. On the other hand, opposition is growing stronger and a number of organizations are carrying out a coordinated campaign against GE trees. Another type of opposition expressed itself in March 2001, when Oregon State University (OSU) students and alumni targeted three GE test sites of poplar and cottonwood trees. They ringbarked or cut down 90% of the trees at OSU's site at the Peavey Arboretum. At OSU's tract near Half Moon Bend on the Willamette River they eliminated 60% of the trees. Every tree was

cut down in one test plot at OSU's Agricultural Experiment Station in Klamath Falls. In all, over 1200 GE research trees were destroyed.

The trees closest to commercial development are GE freeze tolerant, altered fertility eucalyptus for biomass energy production. The petitioner requesting approval for commercial release is ArborGen and the request was presented in 2011. Also in an advanced stage for commercial development are poplar and eucalyptus with altered wood composition, faster growth and altered fertility for biofuel use.

- (1) Haggman, A, et al. "Genetically engineered trees for plantation forests: key considerations for environmental risk assessment", 2013, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3823068/#b55>
- (2) Viswanath, Venkatesh, 2011. "Global regulatory burden for field testing of genetically modified trees", http://people.forestry.oregonstate.edu/steve-strauss/sites/default7.forestry.oregonstate.edu/steve-strauss/files/Viswanath_Survey_2012.pdf
- (3) Verwer, C.C. et al, 2010. "Genetically Modified Trees: status, trends and potential environmental risks". <http://edepot.wur.nl/146722>