

Study: Trees Can Be Genetically Engineered Not to Spread

By Steve Lundeberg

The largest field-based study of genetically modified forest trees ever conducted has demonstrated that genetic engineering can prevent new seedlings from establishing. The “containment traits” that Oregon State University (OSU) researchers used in the study are important because of societal concerns over gene flow, the spread of genetically engineered or exotic and invasive trees or their reproductive cells beyond the boundaries of plantations.

“There’s still more to know and more research to be done, but this looks really good,” said corresponding author Steve Strauss, a professor of forest biotechnology at OSU. “It’s very exciting.”

Findings from the study, which involved 3,300 poplar trees in a nine-acre tract over seven growing seasons, were recently published in *Frontiers in Bioengineering and Biotechnology* (<https://tinyurl.com/ycsgv2c6>).

Poplars are fast-growing and the source of many products, from paper to pallets to plywood to frames for upholstered furniture. In trees like poplars that have female and male individuals, female flowers produce the seeds and male flowers make the pollen needed for fertilization. Strauss and colleagues in OSU’s Department of Forest Ecosystems and Society assessed a variety of approaches for making both genders of trees sterile, focusing on 13 genes involved in the making of flowers or controlling the onset of reproduction. Individually and in combination, the genes had their protein function or RNA expression modified, with the goal of obtaining sterile flowers or a lack of flowering.

The upshot: Scientists discovered modifications that prevented the trees from producing viable sexual propagules without affecting other traits, and did so reliably year after year. The studies focused on a female, early-flowering poplar that facilitates research, but the genes scientists targeted are known to affect both pollen and seed and thus should provide general approaches to containment.

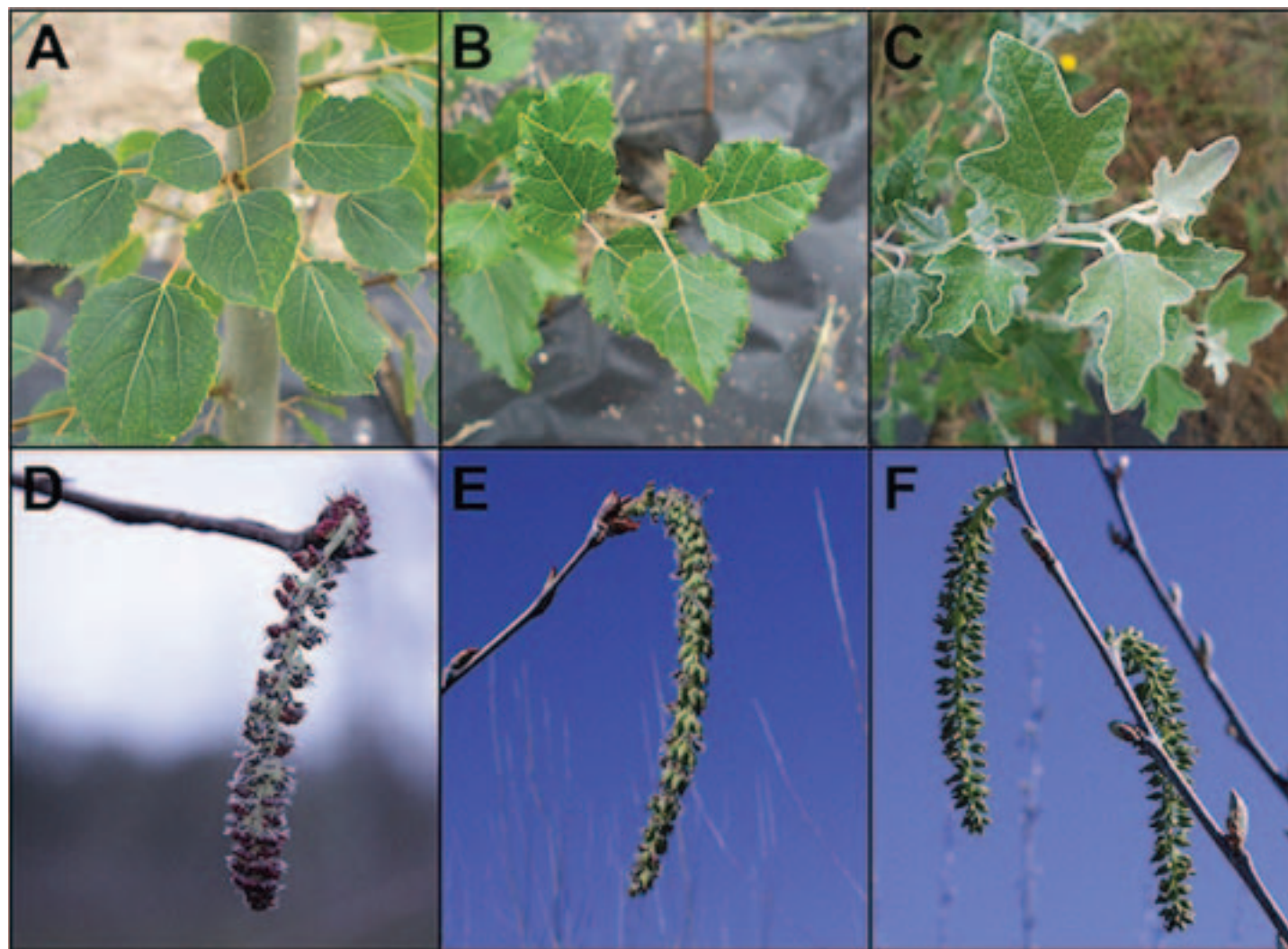
“People have this fear that GMO trees will take over the world, but these are containment genes that make taking over the world essentially impossible,” Strauss said. “If something is GMO, people assume it’s dangerous—it’s guilty until proven safe in the minds of many and in our regulations today. In contrast, scientists say the focus should be on the trait and its value and safety, not the method used.”

At the start of the research, Strauss wondered if the trees would look normal or survive or express their new traits stably and reliably. All the answers were a strong yes.

“Will our trees be OK? Will they be variable or unpredictable? The trees were fine,” he said. “Year after year, the containment traits reliably worked where we got the genetics right. Not all of the constructs worked, but that’s why you do the research.”



Summer worker Thomas Howe amid a nine-acre stand of genetically modified poplars in their sixth growing season. Photo courtesy of Steve Strauss.



Features of the three clones of hybrid poplar studied. Male clone 353 *Populus tremula x tremuloides* had (A) heart-shaped leaves with fine serrations and (D) staminate flowers with red anthers. Female clone 717 *Populus tremula x alba* had (B) triangular leaves with larger serrations and (E) pistillate flowers. Female clone 6K10 *Populus alba* had (C) lobed leaves with a tomentous abaxial surface, giving a silvery appearance, and (F) pistillate flowers. Source: *Frontiers in Bioengineering and Biotechnology* (<https://tinyurl.com/ycsgv2c6>).

What's the timeline for the project?

Ellering: We will be continuing with analysis and chapter development for at least the next 10 months, and after that the draft HCP will undergo the NEPA [National Environmental Policy Act] process and probably additional coordination with USFWS [US Fish and Wildlife Service] in finalizing the plan and applying for the permit. There's some uncertainty in the timeline, but we're just going to keep doing the work.

Is writing a multistate HCP a model that would work elsewhere in the United States?

Baker: We're in a unique position in the Upper Midwest because we work closely in all kinds of ways and have similar natural environments. These multiple-state efforts are pretty challenging, and I don't think it would fit easily elsewhere.

Is it bittersweet that this interest in bats is because the numbers are declining, in part due to WNS?

Baker: The status of bats is a real tragedy. The numbers have declined over 90 percent in certain circumstances. WNS has only been in Minnesota for a couple of years, but we've seen similar declines at least for the NLEB in the largest hibernacula in our state. **FS**

NO SPREAD

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Strauss also noted that newer genetic approaches in his laboratory, especially clustered regularly interspaced short palindromic repeats gene editing (CRISPR), are making the production of reliably contained and improved trees even easier and more efficient. He pointed out that "the work focused on pollen and seeds, but poplar can also spread vegetatively, for example, by root sprouts. But those are far slower, much narrower in distance, and far easier to control in and around plantations."

Strauss's collaborators included Amy Klocko, now of the University of Colorado; Amy Brunner, now at Virginia Tech; and Haiwei Lu, Anna Magnuson, and Cathleen Ma of OSU. The US Department of Agriculture, the US Department of Energy, the National Science Foundation, the J. Frank Schmidt Charitable Foundation, the Biotechnology Risk Assessment Grant Program, and the Tree Biosafety Genomics Research Cooperative of Oregon State University supported this research. **FS**

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Science & Tech

The *Forestry Source* welcomes contributions for the Science & Technology section, which focuses on recent research, technologies, and techniques for forestry and natural resources management. Information: Steve Wilent, 503-622-3033, wilents@safnet.org.

FOREST PRODUCTS INDUSTRY NEWS**MIT's Mass Timber Longhouse**

An architecture class at the Massachusetts Institute of Technology (MIT) has designed a longhouse made primarily of laminated veneer lumber (LVL) made into panels 50 feet long, 10 feet wide, and more than six inches thick (see tinyurl.com/y7fu6k4p). The panels would be cut to size and used to make a series of large arches, 40 feet tall to the central peak and spanning 50 feet across; sections of the arches would be strengthened with triangular cross-sections. A series of such arches would be assembled to create a large enclosed space with no need for internal structural supports. According to MIT, the "pleated" design of the roof is designed to accommodate solar panels and windows for natural lighting and passive solar heating.

John Klein, a research scientist in MIT's Architecture Department who taught a workshop called Mass Timber Design that came up with the new design, explains that "in North America, we have an abundance of forest resources, and a lot of it is overgrown. There's an effort to find ways to use forest products sustainably, and the forests are actively undergoing thinning processes to prevent forest fires and beetle infestations."

GAO Report on Federal Log Exports

The Government Accountability Office (GAO) recently issued a report entitled, *Federal Timber Sales: Forest Service and Bureau of Land Management (BLM) Should Review Their Regulations and Policies Related to Timber Export and Substitution*. The GAO noted that for about 50 years Congress has restricted the export and substitution of federal logs from the western US. (Substitution occurs when forest-products companies use timber harvested from federal lands in their US processing facilities while exporting non-federal unprocessed logs that could have

been used in those facilities.

"Since the restrictions were put in place, substantial changes to the timber economy have occurred, and agency officials and stakeholders view the likelihood of illegal timber export and substitution as low," the report states. "The Forest Service and BLM have various regulations, policies, and procedures to carry out the ban. However, the agencies did not issue new regulations as required by the Forest Resources Conservation and Shortage Relief Act of 1997 and have not obtained legislative relief from this requirement. As a result, the agencies are relying on regulations issued before 1995. Without issuing new coordinated and consistent regulations or obtaining legislative relief, the Forest Service and BLM will continue to be out of compliance with the regulation provisions of the 1997 act."

The GAO recommended that the Forest Service and BLM should determine whether new regulations governing timber export and substitution are needed, and if they determine that new regulations are appropriate, they should issue them in accordance with the 1997 act. Otherwise, the agencies should seek legislative relief from the act's requirement. The full report is available at gao.gov/products/GAO-18-593.

Caterpillar Sheds Forestry Division

Caterpillar Inc. recently announced a preliminary agreement to sell its "purpose-built forestry business" to Weiler Inc., a manufacturer of equipment for the asphalt paving market since 2005. Weiler will manufacture wheel skidders, track feller bunchers, wheel feller bunchers, and other machines, and sell them through Caterpillar and Prentice dealer networks. Caterpillar will continue to provide forestry excavators designed for log loading, processing, and other forestry applications. Weiler will acquire Caterpil-



Caterpillar Inc. recently announced a preliminary agreement to sell its "purpose-built forestry business" to Weiler Inc. Photo: Caterpillar

lar's manufacturing plant and warehouse in LaGrange, Georgia; a demonstration and training center in Auburn, Alabama; and Prentice parts distribution center in Smithfield, North Carolina.

Weiler said that it anticipates retaining about 270 Caterpillar employees; the company currently employs nearly 500 employees at its Knoxville, Iowa, corporate office and manufacturing facility. "Utilizing the capabilities of both the LaGrange and Knoxville facilities, we have plans in place to expand the existing forestry product line to further meet customer demands", said a Weiler press release. The sale is expected to close by early 2019.

No Tariff on Canadian Newsprint

The United States International Trade Commission (USITC) recently determined that the US paper industry is not materially injured or threatened with material injury by imports of uncoated groundwood paper (newsprint) from Canada. As a result of the USITC's determinations, no antidumping or countervailing duty orders will be issued on imports of this product from Canada. Earlier this year, the US Department of Commerce determined that such products are subsidized by the Canadian government and sold in the United States at less than fair value. **FS**



An architecture class at the Massachusetts Institute of Technology (MIT) has designed a longhouse made primarily of laminated veneer lumber. Image: MIT