Researchers demonstrate way to control tree height

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Forest scientists at Oregon State University have used genetic modification to successfully manipulate the growth in height of trees, showing that it's possible to create miniature trees that look similar to normal trees – but after several years of growth may range anywhere from 50 feet tall to a few inches.

This is a "proof of concept" that tree height can be readily controlled by genetic engineering techniques. It opens the door to a wide variety of new products for the ornamental and nursery industries, experts say, if regulatory hurdles can be overcome – a big "if."

The findings were recently published in the journal *Landscape Plant News*.

"From a science perspective, this is a very interesting accomplishment and there's no doubt it could be made to work," said Steven Strauss, a professor of forest science at OSU.

"But further development may be precluded by social, legal and regulatory obstacles," he said. "Clearly there would be concerns whether the market for specialty tree products such as this would be strong enough to make it worth the large investments of time, money and testing that current regulation of genetically modified organisms would require, at least in the U.S."

That aside, he said, it appears that with further research and

development programs, it would indeed be possible to create an elm tree – which ordinarily would grow to 100 feet or more – that is only five feet tall at maturity, a charming addition that would fit nicely on a backyard deck. Or a 30-foot version that might be a better fit on urban streets. Or, in fact, just about any height in between. Other changes can also affect foliage shapes or color in very attractive ways, and some might have value in cleaning up environmental pollution.

In their studies, OSU scientists were able to create young poplar trees, which grow rapidly and can reach a mature height of 150 feet or more, that were anywhere from about 15 feet to a few inches tall after two years of growth. The smallest of them could be difficult to even find, tiny little “shrublets” among the flowers in the field site.

The manipulation of height growth was achieved by insertion of certain genes, mostly taken from the model plant Arabidopsis, which inhibited the action of a class of plant-specific hormones known as gibberellic acids. These compounds are also used as sprays to control the size and fruiting of orchard trees. In trees, the compounds promote the elongation of plant cells – when they are inhibited, the cells do not fully elongate, and plants remain short and stocky.

“It’s really interesting that these genes from Arabidopsis, which is a small plant in the mustard family, have been conserved through 50-100 million years of evolution and can perform more or less the same function in poplar trees,” Strauss said. “The modified trees themselves look pretty much normal, just a lot smaller, and a little more compact or bushy.”

Altogether, the researchers used seven distinct kinds of genes and more than 160 different types of genetic insertions to create about 600 genetically modified trees. All caused decreased signaling by gibberellic acids. They were grown in the field with USDA approval, and assessed

several times for variation in size and appearance.

Other than reduced size, there appeared to be striking variation in foliage color and leaf shape, some of which might have significant ornamental value. Root development also appeared to be very strong, which might provide increased stress tolerance and have value where extensive root development is needed, such as in bioremediation of polluted soils or in very windy, limited soil moisture situations.

From an environmental viewpoint, the researchers said, dwarfed trees such as this are unlikely to be any kind of threat to spread, because they would compete very poorly with normal or wild trees. In virtually all tree species, low height is a disadvantage as trees compete for sunshine. Another possible value, from that perspective, is that this trait might be used to help control the spread of exotic and potentially invasive trees that are commonly sold by nurseries.

The initial studies were done with poplar, Strauss said. Similar results should be possible in any tree species, but are limited by the lack of research into gene transfer methods for most ornamental and forest trees. However, usable methods are already available for sweet gum, elm, black locust and pines. The current successful modification with poplar could be just “the tip of the iceberg,” the researchers said in their report.

Dwarf trees and crop plants created with traditional cross-breeding or horticultural techniques are already widely used in fruit trees, the ornamental tree industry and agriculture.

The advances for cereals have been part of the “Green Revolution,” in which plants such as rice or wheat were created that directed less energy to height growth and more to development of stout stems and plentiful seed. In orchards, semi-dwarf fruit trees produce more fruit that is easier

to harvest. The improvements in cereal yields have been credited with preventing the starvation of millions.

Source: Oregon State University