

Poplars in biotechnology research

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Populus is the most widely used forest tree genus in genetic modification studies and the second most used in biotechnology research overall.

Biotechnology encompasses a wide range of scientific techniques that use living organisms or parts of them. Modern biotechnologies currently used in forestry fall broadly into three categories:

- those based on molecular markers, used, for example, to quantify genetic diversity between populations and individual trees, to identify parts of the genetic material that are unique to each individual (“fingerprinting”) and to locate genes responsible for traits of economic importance;
- those that enhance vegetative propagation and support large-scale production of uniform materials (micropropagation and tissue culture);
- genetic modification of forest trees.

Poplar is regarded as a model tree in forest genetics and biotechnology studies in temperate and boreal regions because of its rapid growth, its vegetative propagation capacities (many varieties can be reproduced easily by cloning), experience gained in conventional poplar breeding and cultivation, and its known genomic structure

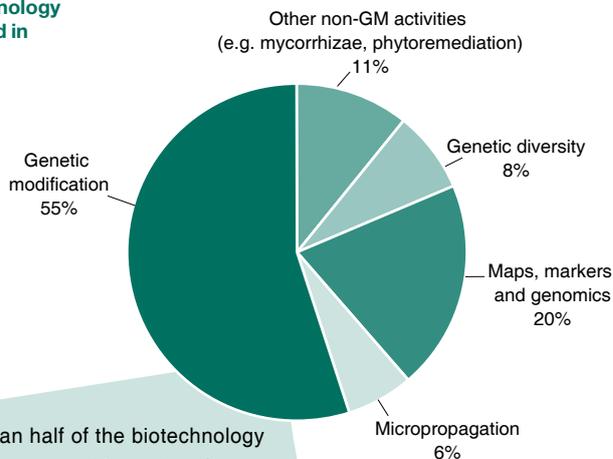
which offers genetic engineering opportunities. The first forest tree species for which the complete genome was sequenced was a poplar; this work was completed in 2004 (Oak Ridge National Laboratory, 2004; JGI, 2004).

Between 1994 and 2004 *Populus* was the second most used tree genus in biotechnology studies in general (after *Pinus*) and by far the most used in genetic modification worldwide.

Poplar is the only genetically modified (GM) forest tree that has been commercially deployed; the State Forestry Administration of China approved commercial plantation of GM poplars in 2002, and by the end of that year more than 1.4 million insect-resistant GM poplars had reportedly been planted in China.

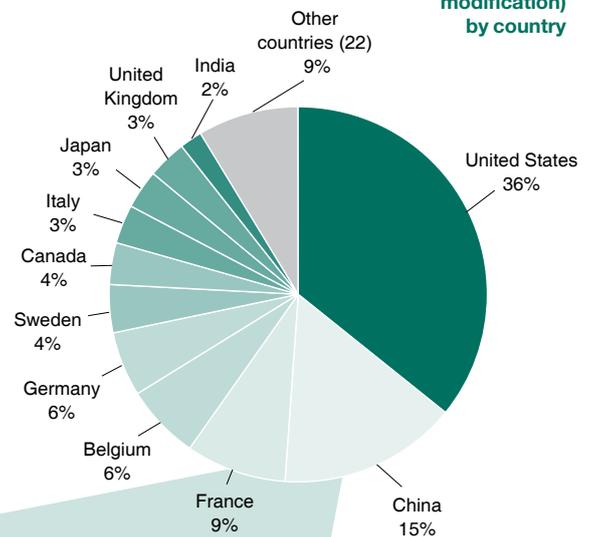
The graphics and statistics in this article are all based on the number of activities (ongoing or concluded, and irrespective of cost, project size or area of trials) reported in the international scientific literature, including data sets, published from 1994 to 2004 (FAO, 2004).

Categories of biotechnology reported in poplars



More than half of the biotechnology activities reported in poplars from 1994 to 2004 concerned genetic modification (GM).

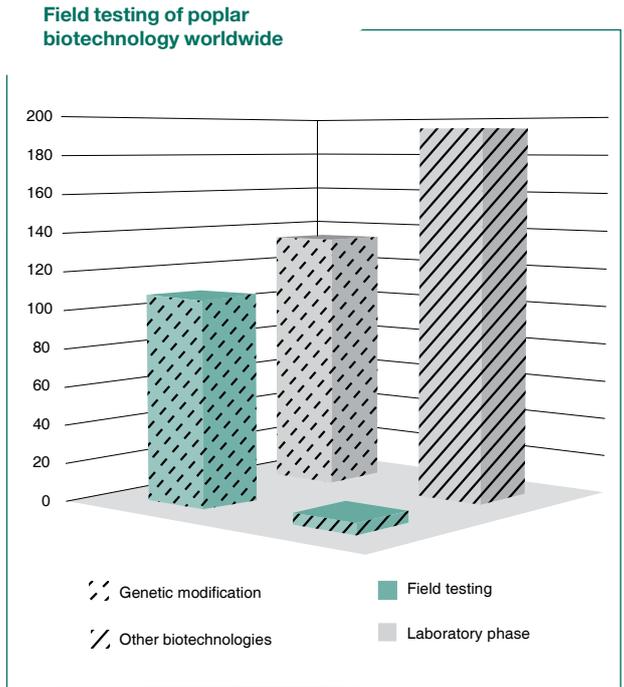
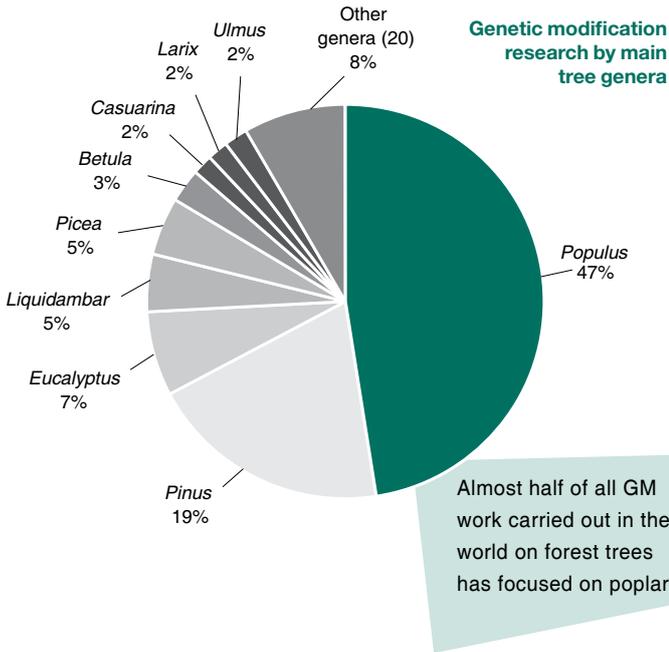
Poplar research in biotechnology (including genetic modification) by country



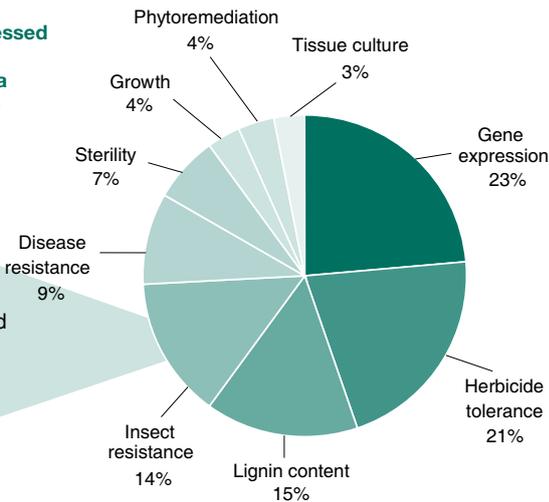
At least 33 countries and territories were reported to be working on poplar biotechnologies, with the United States and China dominating the field. Although most of the research was in developed countries, activities were also reported in 13 developing countries or countries with economies in transition; 24 percent of these activities concerned genetic modification, nearly all of it in China.

Héliette Marchadier, a recent university graduate, prepared this contribution while volunteering for six months in the Forest Resources Development Service, FAO Forestry Department, Rome, prior to continuing her studies.

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Main traits addressed when genes are transformed for a specific purpose



The main areas studied include modification of tree biology and of agronomic traits.

Field testing of poplar has been reported much more often for genetic modification than for other biotechnologies. However, it is possible that field testing of non-GM biotechnologies is often unreported because it does not require authorization. Most (if not all) countries where GM technologies are tested require authorization of GM field tests prior to establishment.



Bibliography

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