

Ten lessons from 15 years of transgenic *Populus* research

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Summary

Based on extensive experience with transgenic poplars in laboratory and field environments, we have found that transformation is an extremely useful tool for research in biotechnology and functional genomics. The key lessons from our experience are: (1) stable gene expression is the rule in vegetatively propagated transgenic poplars; (2) somaclonal variation is modest and manageable; (3) transformation and field tests are extraordinary functional genomics methods; (4) there are many social and technical motivations for transformation centres; (5) regulations may choke biotechnology without scientist involvement; (6) the value of transgenic traits look high, but await careful, broad evaluation; (7) public-sector scientists need to play a serious, free role in value studies; (8) gene flow is complex and needs careful consideration; (9) sterility systems can be developed via diverse means; and (10) domestication transgenes can provide new avenues to promote biosafety. In short, transformation in poplar is extremely reliable and there are diverse and promising means for improving biosafety, but considerable time, institutional commitments and public-private partnerships are required to deliver them to society.

Our system and perspective

The goal of this paper is to describe the diverse kinds of research and interactions with the private and public sectors we have had while creating and field-testing many different kinds of transgenic poplars (genus *Populus*, aspens and cottonwoods) over the last ~15 years. [We use 'transgenic' to refer to any trees produced using asexual gene transfer, regardless of the origin of the genes.] Our laboratory has generated more than 6500 independent gene-transfer events in 17

different genotypes of *Populus*, and field-tested more than 1600 of these lines. This has given us extensive experience with how transformation affects the behaviour of trees grown on a moderately large scale. It has also given us a different perspective about the reliability of transformation than seems to be common in most academic laboratories that study transgenic plants for basic research purposes.

We have benefited from excellent growing conditions for poplars in the Pacific Northwestern USA, where trees grow in the order of 3 m in height

