The 2017 MWP Award – Full motivation

Citation

The 2017 Marcus Wallenberg Prize is awarded to Distinguished Professor Ronald R. Sederoff for his breakthroughs in developing methods for gene discovery in conifer species and further exploiting molecular methods in breeding of trees with improved properties. The methods developed have been extensively exploited in research and in practical applications. Improvements in forest tree breeding for enhanced productivity resulting in a more rapid genetic gain are among the most obvious benefits of the work by Professor Sederoff and his group.

Background and Prize Motivation

Ronald R. Sederoff is regarded as one of the most influential scientists in the field of forest molecular genetics and has successfully combined basic science with applications in forest tree breeding.

Ronald Sederoff's work has had a major impact on the field of forest genetics, under various themes, such as: lignin biosynthesis, methodological innovations in markers, identification of genes, inheritance of plastids, and QTL* mapping. The tree species/genera he has studied include pines (e.g., *Pinus taeda*), eucalypts, American chestnut, poplars, spruces, and peach. In addition to scientific impact, his work has produced important innovations for the forestry sector, including several patents, new methods and applications for practical tree breeding, and valuable information to be used in the restoration of the American chestnut.

He was one of the first in the field of forest biotechnology. He started his career in *Drosophila* and maize genetics after which he changed to work with forest trees. The "transfer" from skilful geneticist using model organisms (*Drosophila*, *Zea*) to forest researcher taming wild conifers with complex genomes seems quite rapid; a crucial point in his career was likely a sabbatical visit to the USDA Forest Genetics Group in Pacific Southwest Forest and Range Experimental Station in Berkeley, California in 1985. Together with Tom Ledig, he started to envision the role of biotechnology in increasing forest productivity – by 1986 he had already published an article showing that biotechnology was feasible for conifers.[1]

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* From Wikipedia.org:
A **quantitative trait locus** (**QTL**) is a section of DNA (the locus) that correlates with variation in a phenotype (the quantitative trait). Usually the QTL is linked to, or contains, the genes that control that phenotype. QTLs are mapped by identifying which molecular markers (such as SNPs or AFLPs) correlate with an observed trait. This is often an early step in identifying and sequencing the actual genes that cause the trait variation.
Quantitative traits are phenotypes (characteristics) that vary in degree and can be attributed to polygenic effects, i.e., the product of two or more genes, and their environment.
A **phenotype** is the composite of an organism's observable characteristics or traits, such as its morphology, development, biochemical or physiological properties, behavior, and products of behavior (such as ease of pulping). A phenotype results from the expression of an organism's genetic code, its genotype, as well as the influence of environmental factors and the interactions between the two.

At North Carolina State University in 1988 he established the Forest Biotechnology Group that focused on the genetic basis of quantitative traits in trees, using molecular genetics to advance tree improvement, and on the molecular basis of wood formation, particularly lignin biosynthesis. Trees of particular interest have been pines, eucalypts and chestnuts.

Research themes and methods used in studies by Ronald Sederoff and his group are diverse and lie at the heart of forest genetics and biotechnology. He studied organelle DNA in trees and, together with his post-doc of that time, Prof. David Neale, elucidated their unique paternal and maternal inheritance in conifers. He applied expertise obtained with model species to develop methods for gene discovery and gene transfer in conifers[1.] The genetic basis of wood formation has been a major research theme, and he has identified important genes in cell wall formation such as phenylalanine ammonia-lyase, cinnamyl alcohol dehydrogenase and laccase. Sederoff was one of the first to conduct genetic mapping in forest trees, using the newest markers available at that time (RAPDs). Quantitative trait loci (QTL[*]) were mapped using contemporary molecular markers, for important traits like rust resistance,[2] growth and quality. High-throughput sequencing enabled projects on genomics, and Prof. Sederoff's group has been actively working on sequencing pine and American chestnut genomes, for example.

Forest biotechnology is a rapidly developing field with many bright investigators, new innovations, and highly interesting publications. Recent advances in genomics and gene editing technologies will make the field even more important in the future.

Ronald R. Sederoff

Ronald R. Sederoff, born in 1939, received a Bachelor of Arts in Zoology at the University of California, LA, CA (UCLA) in 1961, a Master of Arts in Zoology at UCLA (Genetics) in 1963, and a Doctor of Philosophy in Zoology, UCLA (Genetics) in 1966. His post-doctoral training, from 1967-1969, was as a Post-doctoral Fellow at the Institute of Molecular Biology at the University of Geneva, Geneva, Switzerland and 1969-1975 Assistant Professor at Columbia University, New York, NY. From 1975-1978, he was an Associate Professor/Assistant Professor, in the Department of Genetics at the University of Oregon, Eugene, OR. In 1978 and until 1985, he was an Associate Professor in the Department of Genetics at North Carolina State University, Raleigh, NC after which he held, until 1987, a Senior Scientist and Plant Molecular Geneticist position at the USDA Forest Service, Berkeley, CA. Since then, he has been a Professor in the Department of Forestry and

Environmental Resources at North Carolina State University, where he also holds associated departmental memberships in the Department of Genetics and the Department of Molecular and Structural Biochemistry. He is currently Emeritus Distinguished University Professor and Edwin F. Conger Professor of Forestry and Environmental Resources at North Carolina State University, Raleigh, NC.

Professor Sederoff has received numerous awards, including the following: Elected to the National Academy of Sciences, USA in 1995; Appointed the Edwin F. Conger Professor of Forestry in 1995; Appointed Adjunct Professor Nanjing Forestry University in 1997; Appointed Distinguished University Professor of Forestry, NC State University in 1997; Appointed as an Honorary Research Professor, Chinese Academy of Forestry in 1998; Elected as a Fellow of the International Academy of Wood Science in 2000; Became a Fellow of the American Association for the Advancement of Science in 2003; was awarded an Honorary Doctorate (Doctor Honoris Causa) from the Swedish University of Agricultural Sciences in 2004; and Named “2011 Forest Biotechnologist of the Year” by the Institute of Forest Biotechnology (IFB).

References

1. Sederoff, R.; Stomp, A.-M.; Chilton, W.S.; Moore, L.W., Gene Transfer into Loblolly Pine by *Agrobacterium tumefaciens*. *Nature Biotechnology* (1986), **4**, 647-649.
2. Wilcox, P.L.; Amerson, H.V.; Kuhlman, E.G.; Liu, B.H.; O’Malley, D.M.; Sederoff, R.R., Detection of a major gene for resistance to fusiform rust disease in loblolly pine by genomic mapping. *Proceedings of the National Academies of Sciences* (1996), **93**(9), 3859-3864.