Gryphon

Michael J. Carson, Ph.D.

BForSc (Hons – 1st Class), University of Canterbury, 1976
Ph.D., Forestry Genetics, North Carolina State University, 1982,
Apptd. Honorary Lecturer, School of Forestry, University of Canterbury, 1993

Professional Background

With Ph.D. in forestry genetics, Dr. Carson is an experienced forestry geneticist and tree breeder. He is a world-wide authority in the application of innovative forest biotechnologies for advanced genetic development of the quality and value of future forests. Experienced in tissue culture, DNA markers and genetic engineering he has successfully developed faster and better growing trees with more desirable characteristics and higher market potential, all while sustaining gains made through classical tree improvement. Dr. Carson has managed and led forestry research organizations in New Zealand, and provided extensive consultancy services to forest industry and institutional clients in Australia, United States, Canada, Malaysia, Chile, New Zealand, Brazil, and Argentina, including a number of forestry research cooperatives. Mike has been involved in managing the New Zealand Radiata Pine Breeding Cooperative (which recently became the Radiata Pine Breeding Company) since 1989.

Areas of Specialization

- Tree Improvement and Breeding Strategies
- Prediction of Genetic Gain
- Genetic Testing Design, Clonal Trials and Clonal Forestry
- Genetic Data Analysis and Interpretation
- Disease Resistance Breeding Strategies in Forestry
- Integration of Molecular Genetics with Tree Breeding
- Impact of Improved Genotypes on Forest Yield and Quality
- Breeding and Biotechnology Research for Increased Disease Resistance
- Molecular Markers & Marker-aided Selection
- Risk analysis in Tree Improvement Operations
- Design of tree improvement research projects and project management
- Genetic Engineering

Awards and Fellowships

- Schlich Memorial Prize, 1976 – for "best all-round forestry student" at University of Canterbury, School of Forestry
- National Research and Advisory Council (NZ) Scholarship, 1978 – for PhD study (under Professor Bruce Zobel)
- Fulbright Travel Award, 1978 – for PhD study
- NZFP Jubilee Fellowship, 1988 – for technical exchanges with Australian tree breeders

Selected Experience

Current Activities

♦ Preparing research and development plans for GenFor, Chile, covering forest biotechnology applications aimed at provision of clonal production for improved Radiata pine.

♦ Implementing clonal forestry trials with forest companies, and assisting CellFor, Canada, with clonal forestry planning and strategies.

♦ Designing and marketing applications of DNA genotyping to major N.Z. and international forest growers.

♦ Facilitating contract research proposals for applications of gene transformation technologies, including current contracts with New Zealand and Chilean organisations.

♦ Acting as co-ordinator and strategic planner for the New Zealand Radiata Pine Breeding Cooperative.

♦ Designing strategies for identifying new forest tree species with commercial potential for New Zealand and international forestry clients.

♦ Provision of tree breeding and biotechnology consultancies to forest companies in the U.S.A., Canada, Chile, Argentina, Brazil, Australia and New Zealand.

Recent Achievements

♦ Managed and led a $6,000,000/year biotechnology research programme at Forest Research, with 85 research staff, from 1992 –98.

♦ Co-ordinated the reformation of the N.Z. Radiata Pine Breeding Cooperative into the Radiata Pine Breeding Company, during 2000/01.

♦ Published (with Keith Jayawickrama) 'A Breeding Strategy for the N.Z. Radiata Pine Breeding Cooperative', Silvae Genetica 49 (2000).

♦ Successfully facilitated development of the DNA marker services venture (SignaGen) with the joint venture partner, Celera.

♦ Coordinated successful FRST and GEENZ reviews of all major forest biotechnology programmes at Forest Research

♦ Coordinated research implementation projects funded by the FRST Technology for Business Growth fund.

♦ Planned and organised a major IUFRO Conference on Genetics of Radiata Pine (December, 1997), with 120 participants and published Proceedings.

♦ Chaired the 5-year research programme review for the Hobart-based Cooperative Research Centre for temperate eucalypt species, acted as external reviewer of the new CRC research programme for Sustainable Production Forestry, and as panel member for their 2nd year review, November, 1999.

♦ Managed the Forest Research liaison with ERMA regarding trialing of genetically-modified-organisms, including presentations at the November, 2000 ERMA hearing on field trials of transgenic (flowering and herbicide resistance genes) Radiata pine and spruce.

♦ Presented specialist evidence to the Royal Commission on GMOs, Wellington, N.Z. in October, 2000.

♦ Since 1997, have reviewed the tree breeding/biotechnology programmes for 3 Australian, and 4 N.Z. plantation owners.

Major Career Achievements

♦ 1986-90: Initiated and coordinated establishment of a New Zealand-wide series of approximately 30 large replicated field trials examining the growth and yield performance of genetically-improved commercial seedlots of *Pinus radiata* under varying stocking density and forest site conditions. These, and subsequent trials established under Dr Sue Carson's management are providing the basis for growth and yield modelling and prediction for New Zealand's genetically-improved pine plantations.

♦ In 1989: Published (with Dr S.D. Carson) "Breeding for disease resistance in forest trees – a quantitative genetic approach" in the Annual Review of Phytopathology 27: 373-95, being the first paper to fully address this approach. I have published six other articles on the subject of breeding for disease resistance.

♦ 1986-89: Undertook and coordinated research in quantifying the effects of genetic improvement in growth rate and log quality on the profitability of radiata pine plantation forestry and published nine related articles. This work led to the initiation of the FRI/Industry Management of Improved Breeds Cooperative (now Plantation Management Cooperative). During the same period, I assisted in initiating and managing two other FRI/Industry Research Cooperatives.

♦ Since 1982: Carried out research on breeding strategies, and published more than 15 scientific articles on advanced breeding strategies for radiata pine.

♦ 1988-1992: Organised and chaired annual joint technical meetings of APPITA and the NZ Institute of Forestry.

♦ In 1989: Organised a Clonal Forestry Workshop with 70 NZ and overseas participants.

♦ Since 1989, have managed and led the Radiata Pine Breeding Cooperative, which comprises members with ownership of over 80% of the NZ *P.*

radiata estate and includes three Australian member organisations. Annual funding for the Cooperative research programme is approximately $1,000,000.

♦ In 1990: Initiated the Eucalypt Breeding Cooperative with eight forest industry members.

♦ Since 1990: Carried out tree improvement consultancies for the British Columbia Ministry of Forests, APM Forests Ltd, Forestry Commission of NSW, Conservation and Land Management Department, WA, Tasmanian Forestry Commission, an Argentinean tree improvement cooperative (CIEF), and Comfloresta (S.C. State, Brazil).

♦ 1990-1995: Coordinated research into breeding for improved wood properties, including initiation of several collaborative research projects between the Forest Technology Division, the Wood Technology Division, and the Pulp and Paper Research Organisation (PAPRO) of the FRI.

♦ In 1992: Initiated a "Seed Orchard Research Group" (SORG) comprising FRI, School of Forestry, PROSEED, Tasman Forestry Ltd, and Carter Holt Harvey Forests Ltd.

♦ In 1992: Prepared a prospectus, and coordinated the inaugural meeting and establishment of GEENZ Ltd, for 6 years a limited liability company consisting of 8-10 industry partners, with an annual research budget of $700,000, for funding forest biotechnology research.

♦ Since 1993: Established and led research programmes in Genomics, Molecular Breeding and Gene Transformation & Expression, now with approximately 20 scientific staff. Together, these programmes represent the development of a comprehensive research capability for the application of new gene technologies to forest tree improvement.

♦ 1995-99: Supervised thesis development for three PhD students, and two MSc students.

Conferences & Speaking Engagements

♦ Invited speaker in the IUFRO Workshop on Douglas fir, Lodgepole pine, Sitka and Abies spp., Olympia, Washington, USA, 1990

♦ 11th Research Working Group 1 meeting of Australian Forestry Council, Coonawarra, S.A., including presentation of three papers, 1991

♦ Invited speaker in IUFRO Conference on Mass Production of Genetically-Improved Trees, Bordeaux, France, 1992

♦ Invited speaker at NZ Institute of Forestry Conference, Napier, N.Z., 1993

♦ Invited speaker in Western Forest Genetics Conference, Hawaii, 1993

♦ Invited speaker in the Chilean Tree Breeding Workshop, Concepción, Chile, 1994

♦ Invited speaker in CRC-IUFRO Conference, Hobart, “Eucalypt Plantations: Improving fibre yield and quality”, 1995

♦ Invited speaker to sum-up WFG-CTIA Conference, Victoria, B.C., “Evolution and tree breeding”, 1995

♦ Invited speaker at NZ Institute of Forestry Conference, Invercargill, New Zealand, 1996

♦ Invited speaker in QFRI-IUFRO Conference, Caloundra, Queensland: “Tree improvement for sustainable tropical forestry”, 1996

♦ Invited speaker in Royal Society of N.Z. Conference, Wellington, “Gene Technology: Benefits and Risks”, 1997

♦ Organised, chaired, and participated as invited speaker of FRI-IUFRO Conference, Rotorua: “Genetics of Radiata Pine”, 1997

♦ Invited speaker and chairman of 2nd Annual Asia Pacific Conference on plantation forestry, Kuala Lumpur, Malaysia, 1998

♦ Invited speaker at XI Silvotecna, Applied Biotechnologies in the Silviculture of Fast Growing Forest Species, Concepción, Chile, 1998

♦ Invited speaker at IMPACT workshop (pine pitch canker), Monterey, USA, 1998

♦ Invited speaker (summing-up) for CRC-SPF Hybrid Symposium, Noosa, Australia, 2000

Employment History

Carson Associates Ltd. (CAL), Rotorua, New Zealand,
1999 – Present. President, and
Forest Genetics Ltd. (CAL subsidiary), Rotorua, New Zealand,
2004 – Present. Director

Radiata Pine Breeding Company Ltd., Rotorua, New Zealand,
2003 – Present, Managing Director & Strategic Planner

Radiata Pine Breeding Company Ltd., Rotorua, New Zealand,
2003 – Present, Managing Director & Strategic Planner

Forest Research (ex New Zealand Forest Research Institute), Rotorua, New Zealand,
1998 Portfolio Manager, Future Forests

NZ Forest Research Institute, Rotorua, New Zealand,
1992 – 1997. Science Manager

NZ Forest Research Institute, Rotorua, New Zealand
1989 – 1993. Programme Manager, Genetics & Tree Improvement

Radiata Pine Tree Breeding Cooperative, Rotorua, New Zealand
1989 – 1998 Programme Manager

Eucalypt Tree Breeding Cooperative, Rotorua, New Zealand,
1989 – 1992. Programme Manger

NZ Forest Research Institute, Rotorua, New Zealand,
1986 – 1988. Scientist, Exotic Forest Management

Management of Improved Radiata Breeds Cooperative, Rotorua New Zealand
1988 – 1991. Programme Manager

NZ Forest Research Institute, Rotorua, New Zealand,
1982 – 1986. Scientist, Genetics & Tree Improvement

North Carolina State University, Raleigh, NC, USA,
1978 – 1982. Ph.D. study leave – Ph.D. thesis on "Breeding for Resistance of Loblolly Pine to the Fusiform Rust Disease"

NZ Forest Research Institute, Rotorua, New Zealand,
1976 – 1978. Research Forester, Genetics & Tree Improvement

NZ Forest Service, Kaingaroa, New Zealand,
1976. Forester, Kaingaroa Forest

Technical Publications

Carson, M.J. 1982: Breeding for fusiform rust resistance in loblolly pine. PhD thesis. NC State University.

Carson, M.J. 1986: Control-pollinated seed orchards of best general combiners - a new strategy for radiata pine improvement. Agronomy Soc. of New Zealand, Special Publication No. 5: 144-1480.

Carson, M.J. 1986: Advantages of clonal forestry for *Pinus radiata* - real or imagined? *New Zealand Journal of Forestry Science 16(3)*: 403-15.

Carson, M.J. 1987: Improving log and wood quality: the role of the radiata pine improvement programme. *New Zealand Forestry*, February 1987.

Carson, M.J.; Wilcox, P.L.; Parsons, J.; Tombleson J.D. 1988: Managing forests to realise genetic gains from improved breeds of radiata pine. Proceedings Ninth Australian Plant Breeding Conference, Wagga Wagga, NSW, June 1988.

Carson, M.J. 1988: Long-internode or multinodal radiata pine - a financial analysis. *Ministry of Forestry, Forest Research Institute, FRI Bulletin No. 115*.

Carson, M.J.; Inglis, C.S. 1989: Genotype and location effects on internode length of *Pinus radiata* in New Zealand. *New Zealand Journal of Forestry Science 18(3)*: 267-79 (1988).

Carson, M.J. 1989: Comparison of improved radiata pine breeds using STANDPAK. New approaches to spacing and thinning in plantation forestry. FRI Bulletin No. 151. Proc. IUFRO Symposium, Rotorua, New Zealand.

Carson, M.J. 1989: From improved breeds to clonal ideotypes? Proceedings Clonal Forestry Workshop, FRI, Rotorua, May 1989.

Carson, M.J. 1993: Beyond 2000 - New opportunities for radiata pine in New Zealand. Proceedings NZ Institute of Forestry Conference, Napier, May 1993.

Carson, M.J. 1995: Current Issues in Tree Breeding: summing-up. Proceedings IUFRO Conference "Evolution and Tree Breeding", Victoria, BC.

Carson, M.J. 1997: FRI research on genetic diversity, as a component of biodiversity of forests. *New Zealand Forestry*. Nov. 1997.

Carson, M.J. 1998: Forest biotechnology Challenges for the 21st Century. Presented at XI Silvotecna - Applied Biotechnologies in the Silviculture of fast growing forest species.

Carson, M.J. 2000: Symposium on Hybrid Breeding and Genetics: summing-up. Noosa, Australia. 9-14 April, 2000.

Carson, M.J.; Lindgren, D. 1995: Full-sib forestry in plantation conifers. Proceedings CTIA/WFG Conference, Victoria, B.C. (Abstract).

Carson, M.J.; Carson, S.D. 1983: Breeding for disease resistance in pine plantations. Proc. Fourth Intl. Cong. Plant Path., Melbourne, Australia, Abs. No. 78.

Carson, M.J.; Haines, R.J. 1998: Biotechnology systems for increasing timber production from plantation forests. Proceedings, 2nd Annual Asia Pacific Conference on Plantation Forestry, Kuala Lumpur, Malaysia, and Asian Timber, Oct.1998. 25-32.

Carson, M.J.; Tombleson, J.D.; Wilcox, P.L. 1989: Research for stand management of clones. Proceedings Clonal Forestry Workshop, FRI, Rotorua, May 1989.

Carson, M.J.; Burdon, R.D. 1989: Relative advantages of clonal forestry and vegetative multiplication. Proceedings Clonal Forestry Workshop, FRI, Rotorua, May 1989.

Carson, M.J.; Burdon, R.D.; Carson, S.D.; Firth, A.; Shelbourne, C.J.A.; Vincent, T.G. 1990: Realising genetic gain in production forests. Proceedings IUFRO Working Parties on Douglas fir, Lodgepole pine, Sitka and Abies spp. Olympia, Washington, Sept 1990.

Carson, M.J.; Carson, S.D.; Richardson, T.; Donnison, H.; Connett, M.B.; Wilcox, P.L. 1993: Application of molecular genetics to radiata pine improvement. Proc. Western Genetics Conference, Honolulu, Hawaii, October 1993 (abstr).

Carson, M.J.; Vincent, T.G.; Firth, A. 1992: Control-pollinated and meadow seed orchards of radiata pine. Proceedings IUFRO Conference on Mass Production of Genetically-Improved Trees. Bordeaux, France, Sept. 1992.

Carson, M.J.; Carson, S.D.; Richardson, T.E.; Walter, C.; Wilcox, P.; Burdon, R.D.; Gardner, R.C. 1996: Molecular biology applications to forest trees - fact, or fiction? Proceedings QFRI-IUFRO Conference "Tree improvement for sustainable tropical forestry", Caloundra, Queensland, Australia, 27 October-1 Carson, M.J. November 1996.

Carson, M.J.; Walter, C.; Grace, L.; Menzies, M.I.; Richardson, T.E.; Burdon, R.D. 1997: Genetic modification of forest trees in New Zealand - science and public perception. Proceedings Royal Society of New Zealand Conference "Gene technology: benefits and risks", Wellington, N.Z., 21 August 1997.

Carson, S.D. and Carson, M.J. 1983: Geographic variation in the fusiform rust fungus. Proc. Fourth Intl. Cong. Plant Path., Melbourne, Australia Abs. No. 794.

Carson, S.D. and Carson, M.J. 1986: A breed of radiata pine resistant to Dothistroma needle blight. Agronomy Society of New Zealand, Special Publication No. 5: 202-207.

Carson, S.D. and Carson, M.J. 1987: New pine strains enter the war on needle blight. *Commercial Horticulture*, February 1987.

Carson, S.D. and Carson, M.J. 1989: Breeding for resistance in forest trees – a quantitative genetic approach. *Ann. Review of Phytopathology 27*: 373-95 (1989).

Carson, S.D. and Carson, M.J. 1989: Clonal forestry and durability of disease resistance. Proceedings FRI-NZFP Forests Ltd Clonal Forestry Workshop, FRI Bulletin No. 160. Pp. 134-138.

Carson, S.D. and Carson, M.J. 1991: Realising gains in resistance to *Dothistroma* for *P. radiata* in New Zealand. Proc. 11th Research Working Group 1 of the Australian Forestry Council, Coonawarra, S.A. March 1991. 5 pp.

Carson, S.D. and Carson, M.J. 1992: Breeding for durable resistance to red band needle blight caused by *Dothistroma pini* assuming quantitative inheritance. Symposium on Breeding for Durable Resistance, Wageningen, The Netherlands (Abstract).

Carson, S.D. and Carson, M.J. 1995: Quantifying genetic gains in growth from tree improvement. Reprinted from: "Eucalypt Plantations: Improving Fibre Yield and Quality" (Eds B.M. Potts, N.M.G. Borralho, J.B. Reid, R.N. Cromer, W.N. Tibbits and C.A. Raymond). Pp 459-462. Proceedings CRC-IUFRO Conference, Hobart, 19-24 Feb. 1995.

Carson, S.D.; Kimberley, M.O.; Hayes, J.D.; Carson, M.J. 1999: The effect of silviculture on genetic gain in growth of *Pinus radiata* at one-third rotation. Can. Jour. For. Res. 29: 1979-1984.

Carson, S.D.; Richardson, T.E.; Carson, M.J.; Wilcox, P.L.; Dodds, K.G. 1994: Integrating conventional tree breeding methods with marker aided selection using RAPD markers linked to quantitative trait loci. Proceedings Plant Genome II. San Diego, CA, 24-27 Jan, 1994. Abstract No. P175 (FRI Project Record No. 3937).

Carson, S.D.; Richardson, T.E.; Dodds, K.G.; Carson, M.J.; Wilcox, P.L. 1994: Using RAPD markers found to be linked to quantitative trait loci in one cross to find markers useful in other crosses. Proceedings 4th Queenstown Molecular Biology Meeting. Queenstown, N.Z., 14-19 August. Abstract, p. 177.

Carson, S.D.; Richardson, T.E. and Carson, M.J. 1995: The use of molecular markers in tree breeding. Proceedings CTIA/WFG Conference, Victoria, B.C. (Abstract).

Concheyro, S.C.; Carson, M.J.; Garrick, D.J.; Jefferson, P.A. 1997: Evolution of variance components in a *Pinus radiata* clonal trial planted over two sites in New Zealand.- some preliminary results. Proceedings IUFRO Conference on Silviculture and Improvement of Eucalypts. Salvador, Brazil, 1997.Vol.1, 193-1999

Devey, M., Matheson, C.I. and Carson M.J. The IMPACT project –screening for pitch canker resistance in radiata pine. N.Z.J. For. (Submitted).

Franich, R.A.; Carson, S.D. and Carson, M.J. 1983: Dothistroma blight lesion induction with dothistromin: First step for use for screening *Pinus radiata* for Dothistroma resistance. Proc. Fourth Intl. Cong. Plant Path., Melbourne, Australia, Abs. No. 951.

Franich, R.A.; Carson, M.J. and Carson, S.D. 1986: Synthesis and accumulation of benzoic acid in *Pinus radiata* needles in response to tissue injury by dothistromin, and correlation with resistance of *P. radiata* families to *Dothistroma pini*. *Physio. Plant Pathology (1986) 28*: 267-286.

Grace, J.C.; Carson, M.J. and Carson, S.D. 1991: Climate change - implications for radiata pine improvement. NZ J. For Sci. 21(2/3): 123-134 (1991).

Grace, J.C. and Carson, M.J. 1993: Prediction of internode length in *Pinus radiata* stands. N.Z. J. For. Sci.

Hosking, G.P.; Carson, M.J.; Dick M. 1998: Pitch canker as a potential threat to New Zealand's plantation forest biosecurity. IMPACT - An international workshop on pine pitch canker, Monterey, USA.

Burdon, R.D.; Carson, M.J. 2000: Conservation and Management of Genetic Resources of Commercial Forests in New Zealand: Challenges of Institutional Changes and New Technology. Forest Genetics and Sustainability, Vol. 63, 235-246, Kluwer Academic Publishers.

Jayawickrama, K.J.S. and Carson M.J. 2000: A breeding strategy for New Zealand radiata pine. Silvae Genetica 49 (2000), pp. 82-90.

Jayawickrama, K.J.S.; Carson, M.J.; Jefferson, P.A.; Firth, A. 1997: Development of the New Zealand radiata pine breeding population. Paper submitted to the IUFRO Conference "Genetics of Radiata Pine", 1-4 December 1997, Rotorua, New Zealand.

Jayawickrama, K.J.S.; Shelbourne, C.J.A.; Carson, M.J. 1997: New Zealand's long-internode breed of *Pinus radiata*. N.Z.J. For.Sci. 27(2):126-141

Jefferson, P.A.; Burger, F.C.; CARSON, M.J.; VINCENT, T.G. and Firth, A. 1992: Comparison of delivery of genetic gains from clonal and meadow seed orchards. IUFRO, Bordeaux.

King, J.N.; Carson, M.J. and Johnson, G.R. 1998: Analysis of disconnected diallel mating designs II – Results from a third generation progeny test of the New Zealand Radiata Pine Improvement Programme. Silvae Genetica 47, Heft 2-3, 61-176.

Manley, B.R.; Will, G.D. and Carson, M.J. 1987: Improving productivity in New Zealand pine plantations. *Sanrin* (Japanese Journal of Forestry) No. 1243(12).

Menzies, M.I. and Carson, M.J. 1989: The potential for early selection. Proceedings Clonal Forestry Workshop, FRI, Rotorua, May 1989.

Shelbourne, C.J.A.; Carson, M.J. and Wilcox, M.D. 1989: New techniques in the genetic improvement of radiata pine. *Commonw. For. Rev. 68(3)*, 1989.

Stovold, G.M.; Jefferson, P.A. and Carson, M.J. 1995: Farm-field testing for early selection of *Pinus radiata*. CTIA/WFG Conference, Victoria, B.C. (Abstract).

Tombleson, J.D. and Carson, M.J. 1989: Family forestry versus clonal forestry - a case study. Proceedings Clonal Forestry Workshop, FRI, Rotorua, May 1989.

Walter, C.; Carson, S.D.; Menzies, M.I.; Richardson, T.E.; Carson, M. 1997a: Review: Application of biotechnology to forestry - molecular biology of conifers. *World Journal of Microbiology and Biotechnology,* 14, 321-330.

Wilcox, P.L. and Carson, M.J. 1989: Reduced spacings using improved radiata pine. New approaches to spacing and thinning in plantation forestry. FRI Bulletin No. 151. Proc. IUFRO Symposium, Rotorua, New Zealand.

Wilcox, P.L. and Carson, M.J. 1989: Implications of tree improvement for stand establishment in New Zealand. Proceedings IUFRO Stand Establishment Conference, Sept, 1989.

Wilcox, P.L.; Amerson, H.V.; Sederoff, R.R.; O'Malley, D.; Kuhlam, E.G.; Carson, M.J. 1992: Dissection of fusiform rust resistance in loblolly pine. Proceedings Plant Genome 1, New York (Abstract).

Wilcox, P.L.; Amerson, H.V.; O'Malley, D.; Carson, S.D..; Carson, M.J.; Kuhlam, G.; Sederoff, R.R. 1993: Fusiform rust - a model for marker assisted selection in loblolly pine? Proceedings 22nd Southern Forest Tree Improvement Conference. 14-17 June. Atlanta, GA, pp. 174-182.