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**Andrew M Gordon**

University of Guelph, Canada

The ecology of tree intercropping systems in Southern Ontario, Canada: Thirty-two years of research

Tree-based intercropping is a high-value, environmentally-beneficial agroforestry practice, well-suited to the climates and soils found in southern Ontario, Canada. Since 1984, researchers at the University of Guelph, Guelph, ON have been investigating ecological processes, crop responses and management protocols on a 30 ha intercropping research site, where a number of commercially-important tree species were intercropped at variable width with a variety of agricultural crops. This paper reports on the collective research conducted on-site over an approximately 30-year period. Results are presented for studies on row orientation, tree and crop physiology, tree-crop root interactions, economics and aspects of nutrient cycling and carbon-related processes. In addition, data is presented on the population dynamics of insects, birds, earthworms, mycorrhizae and crop weeds and diseases. Initially, the productivity of C3 agricultural crops intercropped with trees did not differ from those in corresponding sole-stand (conventional) systems of crops. But soil organic carbon content and bird and insect diversity increased in the intercropped area. The abundance and distribution of earthworms was higher closer to the tree rows indicating improved soil health. The C sequestration potential in tree-based intercropping systems varied from 2.5 to 3.7 times more than that reported for conventional agricultural fields in the region, depending upon the tree species. With reduced fertilizer use and more efficient N-cycling, tree intercropping could also lead to the reduction of nitrous oxide emissions from agricultural fields by about 0.7 kg ha⁻¹ yr⁻¹. With respect to water-quality enhancement, carbon sequestration, and biodiversity conservation, intercropping can be placed above conventional agriculture in terms of long term-productivity and sustainability.

Biography

Andrew M. Gordon received his B.Sc.F. (Forest Environment) from the University of New Brunswick in 1978 and a Ph.D. (Forest Ecosystem Ecology) from the University of Alaska in 1984. From then until his retirement in 2017, he was a faculty member in the Department of Environmental Biology (1984-2009) and then in the School of Environmental Sciences (2009-2017) at the University of Guelph, Canada. He attained the rank of full professor, and was the first Director of the Agroforestry Research and Development Program. His research interests lie in the investigation of ecosystem-level processes in both agricultural and temperate/boreal forest systems. He has worked in the boreal forest since 1978, and has directed a number of research projects looking at long-term plantation productivity. He has spent considerable time developing and promoting agroforestry systems in temperate regions for their ameliorative and restorative properties, including both intercropping and riparian systems to investigate reduced nutrient loadings to streams and other water systems. He has a strong interest in the interaction of terrestrial and aquatic systems, stemming from his senior undergraduate research on Narrows Mountain Brook in central New Brunswick. Dr. Gordon has a strong appreciation for the utilization of trees, forests and vegetation within the context of landscape level restoration of ecological processes. He is a licensed professional forester in the province of Ontario and a member of numerous professional organizations. He has also served as the Canadian representative to the International Energy Association (Short Rotation Biomass Fuels), was a Theme Director of CRESTech's (a former Ontario Centre of Excellence) Controlled Environments Research program, currently in collaboration with NASA to develop biological plant systems for extended space missions, and a former co-director of C.A.A.R.N. (the Canadian Afforestation and Agroforestry Research Network), at one-time, an emerging BIOCAP network. Dr. Gordon is the author and co-author of over 200 research Publications in both refereed and non-refereed journals, book chapters, technical communications, etc. He has advised over 50 M.Sc. and Ph.D. students, and is particularly proud of the fact that 19 of his former students hold professorial appointments at universities around the world. He has served on a multitude of University of Guelph academic and administrative committees, and has been involved in a number of provincial forest research initiatives. Dr. Gordon has considerable international experience in research, development, education and curriculum development in many countries (e.g. Nepal, Ghana, Chile, Bolivia, Indonesia, Vietnam, etc.) and currently has just finished directing a long-term CIDA Tier 1 project in Ghana entitled: "Agroforestry practices to enhance resource-poor livelihoods in Ghana". He is the President and CEO of Forest Environments Universal, a small consulting company specializing in many of the above topics.

agordon@uoguelph.ca