## Management of genes and organisms in the environment

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The year was dominated by the reporting and discussion of scientific results on GM crops and cropped ecosystems. Colleagues were authors in the first refereed papers from the UK's Farm Scale Evaluations of GM herbicide-tolerant crops. Several high-profile reports of our research were published by government on geneflow and persistence in the environment. EU-wide studies were consolidated on the effect of GM plants on soil ecology. Our GM research was recognised internationally to the extent that staff were in demand to advise governmental committees in several EU member states on the potential for coexistence of GM and non-GM crops. Further afield, we ran international working groups through the GMO-Guidelines Project, whose job is to work with national scientists in developing countries to consider whether and how to introduce GM cropping to their production systems. The first two such international workshops were held in Kenya and Brazil. A third is planned for Vietnam in 2004. These varied contributions exhibit the integrative and multi-disciplinary approaches that the Environment Theme can now bring to bear on complex areas of science and its applications.

Firm foundations laid in basic science also brought success in another of the Theme's main specialisms – the effect of plant roots on soil structure and function. A joint initiative in *soil bioengineering* combines expertise in civil engineering at the University of Dundee with SCRI's biology and biophysics of roots. The partnership has successful widened the range of science-funding bodies to which SCRI can apply. The award of a one-year 'discipline hopper' grant by the Medical Research Council allows us to apply the principles of geotechnical engineering to the biomechanical properties of roots. This was quickly followed by a three-year grant from the Engineering and Physical Science Research Council for more fundamental work on the relations between plant roots and the stability of soil. *Soil bioengineering*'s potential was also recognised by industrial concerns, who have commissioned scoping studies on slope stability, potentially the forerunner of major research funding. The Theme has also been gearing up for major trans-EU activity in 2004 and beyond. Staff coordinate two EU funded projects on the late blight, Phytophthora infestans, one of the most pernicious pests in world agriculture. EUCABLIGHT draws together all European work on the integrated control of late blight; the aim is to reduce the inputs of fungicide by introducing durable blight resistance more widely among commercial potato cultivars. ECOPAPA aims to incorporate durable resistance to late blight into germplasm of the breeding programmes of participating countries, and notably extends operations beyond the EU to Bolivia, Argentina, Uruguay and other parts of Latin America. ECOGEN - the study of ecological and economic impacts of GM crops - is an 8partner project which examines the integration of GM and conventional varieties in cropping systems, and particularly the effect of GMOs on soil ecology. And most recently, SIGMEA, a >40-partner EU project in which SCRI will manage a major workpackage, aims to draw together all European research on gene flow and persistence in oilseed rape, beet, maize and other crops, then to construct workable predictive models of GM coexistence. This increased networking by Theme 3 in Europe - we now liaise with over 100 groups through these EU projects - enables our science to influence, and be influenced by, researchers in other environments and production systems. We are demonstrating through this work that basic science can be scaled from plant to region to provide sound recommendations that influence the policy of the EU and the care of its managed ecosystems.

Outreach and education Towards the end of 2003, the Theme formed a Systems Research Group to expand and exploit its expertise in ecological and environmental research. The Group will apply knowledge of soils, plants, microbes and invertebrates to resolving problems in crop ecology and crop production. Its remit is the 'lowland' or arable production systems of northern Europe, dominated by barley and wheat, and including potato, legumes, brassica crops and soft fruit. The Group will provide a systems context for SCRI's Product Innovation Centre for potato, barley and soft fruit. High in its remit is to ensure that SCRI's activities in systems research are fully integrated with complementary studies at related organisations, particularly the Macaulay Institute, SAC and SNH. The first tasks of the Group will combine and apply existing knowledge in four specific, linked subjects sustaining crop production while enhancing arable food webs, coexistence between conventional, organic and GM cropping , whole-system carbon balance and the recycling of carbon 'wastes', and local impacts on regional processes in epidemiology. The hub of the Group's work is modelling the cropped ecosystem, based on the conceptual and biometrical approaches that were the basis of the MAPP, the *Management Advisory Package for Potato*. Several generic elements of MAPP will form the basis of a flexible framework, notably active influence diagrams that are used in design, development and documentation and a rule-based broker-agent model for flexible, context-specific querying. The *Systems Research Group* is forming links with end-users specialising in plant breeding, farmland wildlife, agronomy, crop protection and land use policy. Together we shall develop a flexible and complementary network of research and advisory functions to tackle emerging environmental issues.

An important part of the Theme's outreach is the Living Field Project, which transfers ecological and crop science to schools and the lay public. We have concentrated this year on material aligned with schools' requirements and completed three stages that cover ages 5-11 (A to D/E) of the science curriculum. Staff from the Theme have been much involved in the conception and execution of this resource along with members of SCRI's Scientific Liaison and Information Service (SLIS) and a Primary School teacher who has worked closely with staff to ensure that the CD is relevant, easy to use and fun for pupils. All three stages are being discussed with national and regional education offices and trialled in various schools before launch through digital (web, CD) media by mid-2004. The Living Field Project is also being extended to a community garden in the SCRI farm, which also will be ready for visits in 2004 (organised through SLIS); and will be extended to cover the full secondary curriculum.

None of these developments in science, outreach and education would have occurred without the Theme's integrative philosophy that combines disciplines and methodologies linking science to tangible applications at scales of the organism and the landscape. Our approach to GM plants in the environment, for example, combines genetics, whole-plant physiology, community dynamics, molecular diagnostics, seedbanks, entomology, soil-plant relations, modelling and statistics - all of which are in-house and which together inform issues of scientific, public and economic significance. Finally, the turnover of staff through retirements, notably in Host-Parasite Co-evolution, provides an opportunity to concentrate and strengthen our science in areas of epidemiology and disease resistance in crops and other vegetation. A challenging year ahead.