# Introduction

**Peter J. Gregory**

What a difference a year makes! After many years in which talk about the production of food crops has been considered by many economists and environmentalists in government as of low priority, the subject is now very much back on the agenda. The diversion of about one quarter of the US maize crop into bioethanol production, coupled with poor harvests in Australia and parts of Asia, increased demand for grain in China and India for meat production and reduced stocks of stored food grains have resulted in substantially higher food prices around the world. Recent articles in the financial press herald the end of an era of cheap food and point out that the political desire for fuel security through increased biofuel production has inevitably linked food prices more closely to that for oil. Moreover, the publication during the year of the Fourth Assessment of the Intergovernmental Panel on Climate Change has focused public attention on a more uncertain future and on the potential effects of various environmental changes on food security especially in the developing world.

SCRI is responding to these challenges in several ways. First, we have increased our research activity of direct relevance to mitigating and adapting to climate change. We have started work on plant mediated transfer of carbon to soils as our contribution to the Scottish Alliance for Geosciences, Environment and Society (SAGES). Our newly created sub-programme on Resource Capture is examining ways to improve water and nutrient use efficiency by crops which will reduce gaseous and leaching losses. Both of these research activities will lead to outcomes that mitigate climate change. Research on means of adapting to climate change includes work on identifying mechanisms and sources of durable disease resistance, and development of germplasm that has enhanced resistance/resilience to abiotic stresses such as drought and cold funded by our major customer the Rural and Environmental Research and Analysis Division (RERAD) of the Scottish Government.

Another means of both mitigating climate change and adapting to other environmental changes is to develop new crops that will take advantage of more favorable growing conditions in some regions (including eastern Scotland). So, a second change this year has been to refocus parts of our research and develop a programme of Plant Products and Food Quality. This new programme will research the place of non-food crops in Scottish agriculture focusing on plants producing molecules of high value, and also act as a focus for our growing research portfolio on energy crops. A third response has been to build upon our excellent relationship with the University of Dundee to form a joint Division of Plant Sciences containing three joint appointments alongside five university appointments, and to start discussions with several other university schools about a joint research centre with a focus on environmental change and human resilience. These latter discussions are at an early stage but have the potential to significantly enhance the social and policy relevance of SCRI's research while simultaneously examining issues of international significance.

Closer to home, SCRI is delivering to most of

Welcoming Professor Anne Glover, the Scottish Government's Chief Scientific Advisor.

the national aspirations outlined by the Scottish Government. Our contributions to the "Greener" aim are many but particularly noteworthy during 2007 have been the production of a major synthesis of experimental data on cross pollination, seed persistence and movement, and ecological impacts in relation to the introductions of new crops (including GM crops). These outputs from the EU Sigmea project provide the scientific evidence on geneflow underpinning the policies on coexistence of the EU member states. Simultaneously, the EU ECOGEN project, investigating the ecological and economic consequences of GM crops, was successfully completed and published. Highlights of our research contributing to a "Healthier" community include unraveling the complexities of how vitamin C accumulates in fruit and determining the role of bioactive compounds in fruits. We have demonstrated four potential pathways for vitamin C accumulation in blackcurrant by *in situ* synthesis via the L-galactose pathway, together with the potential for long-distance transport via the phloem. We have also found that polyphenolic compounds in blueberry killed cells of the intestinal parasite *Giardia duodenalis* and increased the encystation of *Cryptosporidium parvum* oocysts. These protozoan parasites are common causes of diarrhea across the world for which there are currently no, or only limited, chemotherapeutic interventions.

Basic and strategic research across the institute contributes to the "Smarter" agenda leading to both knowledge and better practical ways of doing things. We have discovered a translocation signal (the RXLR motif) in virulence proteins of late blight (*Phytophthora infestans*) which facilitates delivery of these proteins

into plant cells and explains how blight establishes itself in potato crops. Interestingly, the finding has broader significance because the signal is also conserved in other, similar pathogens and in distantly related organisms such as the malaria parasite. Through field studies of late blight outbreaks, we have shown that the marked increase in the A2 mating type of *P. infestans* observed across Great Britain in recent years is due to the predominance of a single clonal lineage of the pathogen. This opens the way to a reassessment of current disease management strategies based on host resistance, fungicide application, and minimization of primary inoculum sources.

Improved plant varieties that are resistant to pests and pathogens, use nutrients efficiently and effectively while maintaining or enhancing yield and quality are globally recognized as the most sustainable route to food and environmental security. We have developed a genetic analysis platform for barley that is similar to that used in human genetics and is revolutionizing the way we derive data for genetic analysis. Using an emerging population genetics-based approach termed 'association genetics', we have used this platform to locate versions (alleles) of genes that breeders select for, often inadvertently, within their elite breeding populations. In parallel we have developed software (GERMINATE) that stores, displays and facilitates analysis of this genetic information. With these resources and the forging of a strong and productive collaboration with all of the commercial barley breeders in the UK, we shall develop practical strategies to increase the predictability of plant breeding.

SCRI and Mylnefield Research Services Ltd commissioned DTZ to undertake an assessment of the economic impact of our research. Their market-based survey showed that we contribute £165 million to the UK economy annually representing a 14-fold return on the investment of public money. In addition to the readily quantifiable benefits such as new and superior plant varieties (3 new potato and 1 new raspberry varieties were registered for commercialisation during 2007), there were many other non-quantified benefits such as those resulting from reduced pesticide applications as a consequence of enhanced disease resistance, and promotion of good land stewardship resulting in less pollution and the protection of soils and landscapes. These contributions to a "Wealthier" community demonstrate the value of institutes such as SCRI in working with businesses with commercial skills that can translate our research into products of value to society.

Our research for RERAD has brought us into daily working contact with the Scottish Agricultural College (SAC). During 2007 we signed an agreement to work more closely together across our shared interests in crop and soil research and knowledge exchange. The first fruits of this closer relationship are evident in joint plans and applications for grants detailed later in this report. Our science strategy places particular emphasis on our international links. During the year we strengthened our relationship with the Norwegian institute BIOFORSK. Scientists from several science programmes (especially Environment–Plant Interactions and Plant Pathology) have good interactions already, but we look forward to closer working on a range of issues common to land use systems in northern latitudes. Our scientific links with institutes in China continue to evolve, and I visited the International Centre for Research in the Dry Areas (ICARDA), Syria to renew our association with a major centre for barley research. We already have funding from the Global Challenge Fund to study the drought resistance and associated genetics of landrace barley, and anticipate a growing level of interaction.

The Director's Award for 2007 went to Phil Taylor for his outstanding contribution in assisting us to communicate our work to diverse audiences. 2008, is the UN Year of the Potato so there will be many opportunities for us to bring our important work to the attention of a wider audience.

I hope that you enjoy reading the details of our current activities in this report.

P J Gregory
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