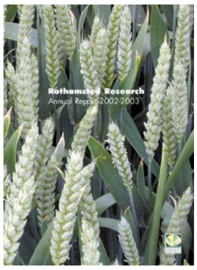
Rothamsted Research Annual Report 2002-2003



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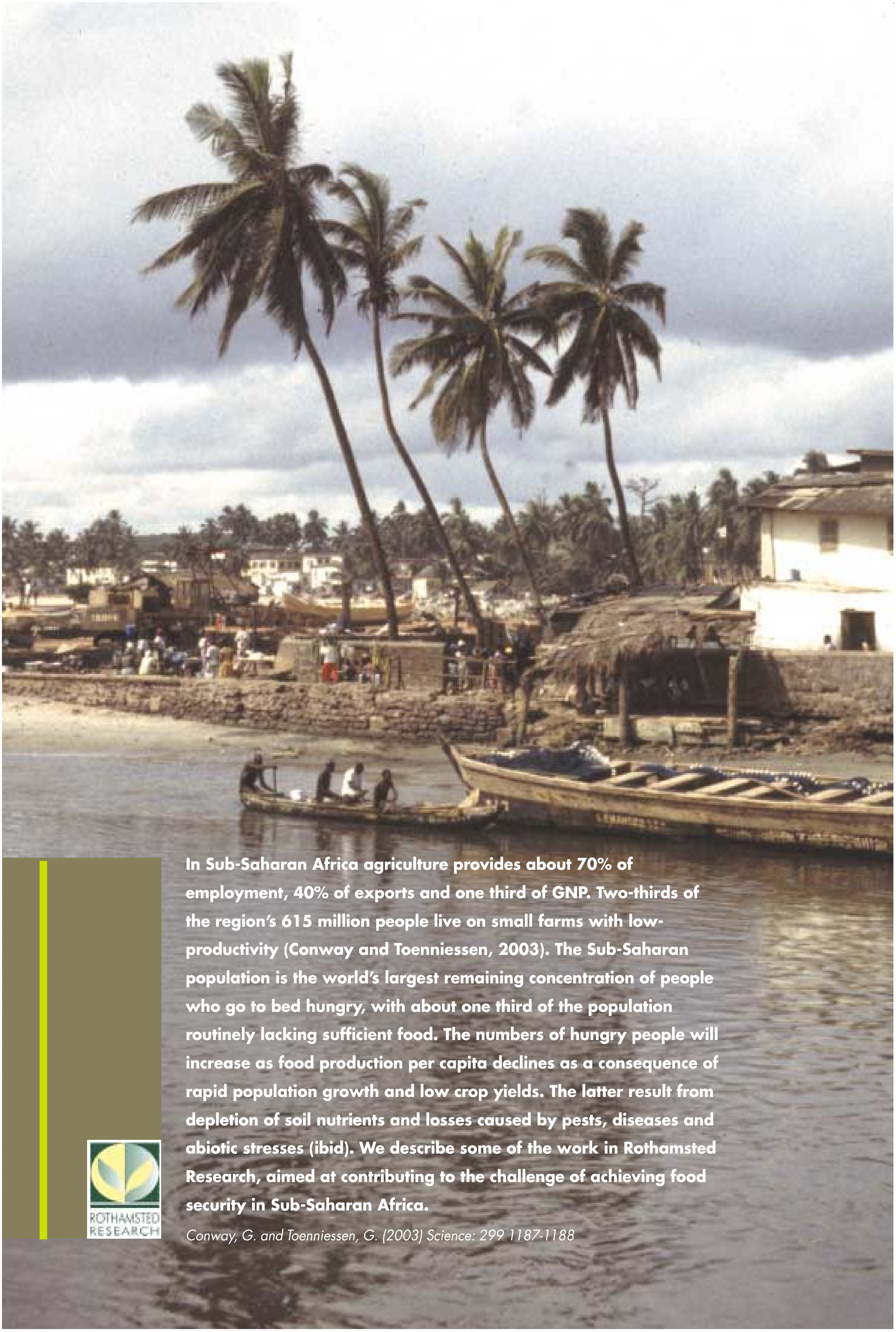
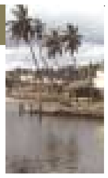


In Sub-Saharan Africa agriculture provides about 70% of employment, 40% of exports and one third of GNP. Two-thirds of the region's 615 million people live on small farms with low-productivity (Conway and Toenniessen, 2003). The Sub-Saharan population is the world's largest remaining concentration of people who go to bed hungry, with about one third of the population routinely lacking sufficient food. The numbers of hungry people will increase as food production per capita declines as a consequence of rapid population growth and low crop yields. The latter result from depletion of soil nutrients and losses caused by pests, diseases and abiotic stresses (ibid). We describe some of the work in Rothamsted Research, aimed at contributing to the challenge of achieving food security in Sub-Saharan Africa.

ROTHAMSTED RESEARCH

Conway, G. and Toenniessen, G. (2003) Science: 299 1187-1188



Rothamsted Research in Africa – focus on phytoplasma diseases

Phil Jones

The African continent is characterised by its range of climate and ecosystems, including Mediterranean regions, dry sub Saharan scrub, tropical rainforests and savannah. The phytoplasmas are microscopic prokaryotic plant pathogens that can exploit crops in all these environments.

The most devastating phytoplasma diseases are observed in coconut growing regions. Cape St Paul Wilt disease destroys tens of thousands of coconut palms every year in Ghana. The same phytoplasma also causes Bronze Leaf Wilt or Awka disease in Nigeria. Rothamsted has been working with the Coconut Programme of the Council for Scientific and Industrial Research in their search for genetic resistance. In East Africa, Coconut Lethal Decline is caused by a phytoplasma with a slightly different genome to the Cape St Paul Wilt phytoplasma. This difference means that varieties of coconut resistant in West Africa are highly susceptible to the phytoplasma in east Africa. The use of molecular markers developed in Rothamsted Research should help speed up the selection of new coconut varieties for disease resistance.

Sugar Cane Yellow Leaf Disease results in a reduction of sugar content and an increase in other polysaccharides that can gum up processing plants. As sugarcane is largely a vegetatively propagated crop it is important that seed cane is not produced from plants infected by phytoplasmas. This disease was thought to be a nutritional disorder but Rothamsted investigations have shown that it is caused by at least two different phytoplasmas. Collaborating institutes include the South African Sugar Experiment Station and the Mauritius Sugar Industry Research Institute.

White Tip Die Back and Slow Decline are two lethal diseases of date palms in Sudan that Rothamsted studies, conducted in conjunction with FAO, have also associated with phytoplasmas. Ribosomal RNA sequence data have shown them to have a 99% similarity with the phytoplasma that causes White Leaf Disease of Bermuda grass, a common weed in date palm groves. As date palms are vegetatively propagated, growers must take care that only uninfected palms are selected for propagation.

In Kenya, Napier grass is grown extensively as a fodder crop and as a soil stabiliser. Recent work by Rothamsted Research and ICIPE has shown that this grass can also be used as a trap crop to control stem boring moth larvae. However, in the past year a serious yellowing and stunting disorder of Napier grass has spread through the Kitale region of Kenya. All eleven samples sent to Rothamsted tested positively for the presence of phytoplasma. Sequencing of the 16S

Phytoplasmas

The phytoplasmas are a group of prokaryotic, microscopic plant pathogens that cause over 700 diseases of food, fibre and ornamental plants. They are found mainly in the phloem sieve tubes of their plant hosts and in certain sucking insects, which can act as vectors. They can also be spread by grafting, by parasitic plants or by seed transmission. Detection of phytoplasmas is by grafting to susceptible host plants, microscopy, serology (ELISA), nucleic acid hybridisation or DNA amplification using the polymerase chain reaction (PCR). Symptoms displayed by plants infected with phytoplasmas include foliage yellowing, petal greening, shoot proliferation, stunting, little leaf formation, necrosis and a decline of vigour leading to death.

rDNA and comparison with other phytoplasma sequences has shown that the phytoplasma is related (86% similarity) to the Bermuda grass White Leaf phytoplasma. Work is continuing in conjunction with colleagues at KARI to ascertain whether spread is due to an insect vector or solely by vegetative propagation.

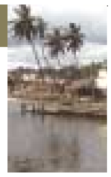
The phytoplasmas were once thought to be viruses but they are in fact members of the class Mollicutes, microscopic organisms that do not have a cell wall. Other members of the Mollicutes include spiroplasmas (helical motile organisms which infect plants and insects) and mycoplasmas (which infect animals). Phytoplasmas were originally classified according to their disease symptomatology but this has been replaced by phylogenetic analysis based on their 16S rDNA. Currently fourteen groups of phytoplasmas are recognised. Phytoplasma genomes range in size from c.500 to 1600Kb and several research groups world-wide are attempting to sequence complete genomes, a job made more difficult because these organisms cannot be grown in pure culture.

Rothamsted International in Africa

Stephen James

Rothamsted International (RI) Fellowships are entirely supported by the generosity of charitable donations from Rothamsted staff, Trusts and Foundations as well as companies, including the covenanted profit of Rothamsted International Consulting Limited.

The scheme gives excellent researchers from developing countries the chance to extend their scientific knowledge and skills by drawing on the facilities and resources at Rothamsted to address problems of their own country. In this way RI Fellows target the sorts of issues that are impeding the development of agriculture, assist in the development of research capacity where it is needed and so help in the fight to provide food security and alleviate poverty. Now celebrating its 10th anniversary, the RI



fellowship scheme has provided such opportunities for over 90 visiting Fellows, the vast majority of whom have returned home (a condition of the Scheme) to transfer technology through university teaching, extension services and commercial exploitation. A particularly important feature of the scheme is the extended period of preparation between the researcher in the host laboratory and the visitor. This allows both parties to get maximum benefit from the typical 12 month Fellowship period.

Rothamsted International team

Coming from Ghana, Kenya, Nigeria and South Africa, African RI Fellows have participated in a wide range of the Institute's work.

Integrated crop management relies on the understanding of how insecticides can have undesirable impact upon the natural enemies that act to limit pest numbers in natural situations. Insecticides can affect foraging and performance as well as having directly lethal effects. Understanding this can ensure that insecticides are only applied at optimum periods to minimise undesirable effects. Other studies have included those designed to enhance the reservoir populations of natural enemies by providing appropriate food (host) sources. This may require using a small area of land for this purpose and this is not an easy decision when land is limited and crop losses are high. Fellows have also been involved in understanding the chemical cues that determine behaviour of pests such as the Sorghum Midge (*Astylus atromaculatus*), a major problem on an important staple crop in Africa.

Statistical methods for analysing and describing the movement of pests in space and time have to be rigorous and robust. A Fellowship in this area was supported through donations made by staff at Rothamsted. In an article elsewhere in this Annual Report, Janet Riley describes how research in statistics has much to contribute to improved experimentation allowing the maximum amount of information to be extracted from carefully designed experiments.

A Fellow from Nigeria was able to undertake an extensive study of reports of herbicide resistance in grass weeds affecting cereal crops in her country. Careful work revealed that the problem was not in fact one of resistance, but poor responsiveness to the chemical was due to incorrect application both in timing and methodology. As a result the Fellowship was re-targeted to understanding pesticide use, so helping to avoid abuse of these, sometimes expensive, chemicals.

Over half of the sugar cane in South Africa is grown by small holders and one of our RI Fellowship projects was aimed at contributing to the global effort to control phytoplasma disease in this important crop.

Despite the success of the RI Fellowships, it is of concern that of our 90 Fellows, only eight have come from Africa. Rothamsted International wishes to increase the proportion of Fellows from this region of the world that particularly needs to harness agriculture as an engine for growth.

If you share this aim and could contribute to the support of Rothamsted International please make contact with the office. Similarly, get in touch if you are a researcher working in Africa and believe you or a colleague could benefit from the experience of 6-12 months at Rothamsted. http://www.rothamsted.bbsrc.ac.uk/ri/ri.htm

Sunday Ekesi inoculating aphids with a fungal pathogen