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biotechnology and biological sciences research council

DFID Department for International Development

Sustainable Agriculture Research for International Development

Improving agricultural productivity and food security in developing countries

Three out of four poor people in developing countries live in rural areas and most depend on agriculture for their livelihoods. Increasing agricultural productivity has benefited millions through higher incomes, more plentiful and cheaper food, and by generating patterns of development that are employment-intensive and benefit both rural and urban areas.

More importantly, it has provided the spur to economic development outside agriculture where growth and job creation are faster and wages higher. Research on agriculture and better natural resource management has led to significant improvements and reduction in poverty. The World Bank's 2008 World Development Report "Agriculture for Development" called for more research and innovation to achieve the productivity revolution needed, especially in Sub Saharan Africa. Responding to this challenge the Biotechnology and Biological Sciences Research Council (BBSRC) and the Department for International Development (DFID) have joined forces to announce £7M of new research to harness the UK's world-class bioscience research base to address the challenges facing agriculture and food security in developing countries.

Under this flagship initiative - Sustainable Agriculture Research for International Development (SARID) - 12 grants have been awarded to projects which will utilise cutting edge technologies to develop sustainable agriculture solutions for farmers and communities in the developing world.

The newly funded projects are collaborations between UK scientists and scientists from institutions and Universities across Africa, Asia and South America.

Facts

- £7M investment for sustainable agriculture research for Africa and South Asia
- 12 cutting-edge research projects being conducted over the next 4 years
- 32 collaborations between UK universities and institutions across the globe
- 1 billion people live on less than $1 a day

Saving staple foods from witchweed attack

Maize is the staple food for half of the population of sub-Saharan Africa, but unfortunately it is also susceptible to damage from pests and parasitic weeds, which can result in total yield loss. Parasitic witchweed is a major culprit.

Researchers from the UK and Kenya are looking at new ways of tackling witchweed. Research has shown that when desmodium, a nitrogen-rich legume, is grown amongst maize, it can increase the yield from less than one tonne per hectare to over five tonnes by preventing witchweed from growing. A chemical in desmodium has been identified which interferes with the development of witchweed, the big question is 'how?'

In this new study, the international team of researchers will look to identify the enzyme responsible for creating the chemical that disrupts growth of witchweed. With this information they will then be able to breed edible crop legumes, which when intercropped with maize, not only prevents witchweed from attacking the valuable maize but also provide another human food source.

Collaborations
Rothamsted Research, UK; and International Centre of Insect Physiology and Ecology, Kenya

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WILFRED MUSHOBOZI

Halting armyworm rampage with biological pesticide

Like locusts, the African armyworm is a major migratory insect pest in Africa. Eggs laid by African armyworm moths hatch into extremely dense swarms of caterpillars which feed voraciously on cereal crops. Up to 70% of farmers across Africa suffer from crop damage and loss caused by armyworms.

Outbreaks occur in most years and spread across much of Africa. Currently the only way to control these outbreaks is by spraying with chemical insecticides, but these are too expensive for most farmers and can damage the environment. Using a radical new solution, researchers from the UK, Canada and Tanzania will investigate the use of a naturally occurring virus in armyworms - armyworm nucleopolyhedrovirus (NPV). NPV is a highly specific virus, harmless to humans and other wildlife, but in most years the virus appears too late to prevent armyworms from causing serious crop damage.

This new project funded by SARID will study the detailed biology of NPV with a plan to harness it as a biological pesticide to prevent the early spread of armyworms and the resulting loss in crops.

Collaborations

University of Lancaster; Natural Resources Institute, Greenwich UK; Laurentian University, Canada; and Sokoine University of Agriculture, Tanzania

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Rice security for billions of people

Rice is the staple food for over two billion people, but lack of water and disease limit its production across the developing world. There is an urgent need for new breeds of rice that can cope with changing climate conditions and to improve yield to feed growing populations. It is an issue central to future global food security.

Researchers from the National Institute of Agricultural Botany in the UK and the International Rice Research Institute in the Philippines will look at the genetic make up of rice as well as its genetic expression to identify genes which may be crucial in developing new types of rice resilient to climate change and diseases.

The inherited make-up of rice is well understood, but using a four-year SARID grant, the researchers will use new techniques, usually used in human and animal studies, to look at gene expression in rice in response to different conditions. By doing this they hope to identify genes which are naturally tolerant to climate extremes and diseases and go onto use this knowledge to develop rice breeding programmes for Africa and Asia.

Collaborations

National Institute of Agricultural Botany, UK; and International Rice Research Institute, Philippines

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Improving food security for 500M people

Pearl millet can produce grain and fodder under hot, dry conditions in infertile soils where other crops fail completely. It provides food security to over 500 million people predominantly in Africa and Asia. Although compared to other cereals, pearl millet is better adapted to cope without much water, low and unpredictable rainfall severely reduces its yield stability. This does not bode well as climate change scenarios predict that reduced and more variable rainfall are likely in much of the dry tropics, threatening the food security of millions of the world's poorest people.

Improving pearl millet's genetic tolerance to drought offers a sustainable route to alleviating this problem. Using funding from SARID, this is exactly what researchers from the UK, India and Ghana are set to do. Over the next four years, this international collaboration of scientists will look at genes and gene behaviour in different conditions to develop tools to simplify and increase the precision of breeding for increased drought tolerance in pearl millet. Their findings will play a significant role in increasing crop production in water-stressed environments globally.

Collaborations

Institute of Grassland and Environmental Research, UK; International Crops Research Institute for the Semi Arid Tropics, All India Coordinated RP on Pearl Millet, India; and University of Cape Coast, Ghana

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Breeding tolerant coconuts

A lethal disease has devastated coconut plantations in tropical regions of Africa, causing severe economic hardship and environmental damage. UK and African scientists are joining forces to understand the disease and to develop new varieties of coconuts that are able to resist infection. The Coconut palm is a vital crop in coastal tropical regions of Africa and is the main source of livelihood for several disadvantaged groups, providing food, fuel, building materials and income. Coconuts help sustain the environment and grow in poor soils that are unsuitable for other crops. However, Lethal-yellowing diseases caused by phytoplasma bacteria have devastated plantations.

Coconut breeders have identified some palm varieties which show resistance or tolerance to the diseases. Researchers from the UK and Ghana want to study these coconuts and exploit their resistance to produce improved varieties for future plantations. International researchers are now joining forces to examine how phytoplasmas are transmitted between coconuts and to look more closely at the molecular and genetic basis of disease resistance and tolerance in coconuts. This information will then be used in breeding programmes and replanting programmes to minimise the risk of future coconut harvests being destroyed by disease.

Collaborations

University of Nottingham UK; and Oil Palm Research Institute, Ghana

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WARWICK HRI

Kale and Cabbages to beat Black Rot

Kale and cabbage are two of the most important vegetables for the local economy in Kenya and other East African countries, but often, entire harvests are wiped out by Black Rot - a seed-borne disease which penetrates the leaves and causes spreading yellow lesions. Affected leaves drop prematurely and the plants can die.

Researchers from the UK and Kenya are joining forces to provide a sustainable solution to the black-rot problem. They are looking to discover the genes necessary to breed kale, cabbages and other brassicas with resistance to Black Rot. Currently little is known about this type of resistance.

In this new project funded under SARID, the researchers will exploit exciting new developments in Brassica genomics to characterise the resistance shown in some varieties and identify the genes involved.

Key practical outcomes of this work will be resistant plant material with tightly linked molecular markers, candidate resistance genes and information on the natural variation for resistance in Brassica genomes that could be exploited in plant breeding to provide durable resistance to a disease which currently wreaks havoc for small scale farmers.

Collaborations

University of Warwick, Central Science Laboratory, UK; and CABI and KARI, Kenya

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Putting more sweet potato on the table in Africa

Producing crops by cuttings or other means of vegetative propagation is common for many tropical staple foods including sweet potato. In sub-Saharan Africa, about half of all plant-derived calories are grown in this way.

The use of cuttings gives such crops a head start over ones grown from small seeds but the downside is that viruses are often transferred within the cuttings. In developed countries, certified virus-free schemes protect commercial planting materials but these schemes are not financially or logistically viable for staple crops and farming systems in developing countries.

Some local varieties of sweet potato have been found to be highly resistant to a broad range of viruses. With funding under SARID, a team of researchers from the UK, Peru and Uganda will study this resistance further, seek markers for the responsible genes and use this knowledge to speed up breeding virus resistant crops, particularly orange-fleshed sweet potatoes, as they contain pro-vitamin A to combat blindness in African children.

Collaborations

Natural Resources Institute, University of Cambridge, and Central Science Laboratory, UK; The International Potato Centre, Peru; Makerere University, and National Agricultural Research Organisation, Uganda.

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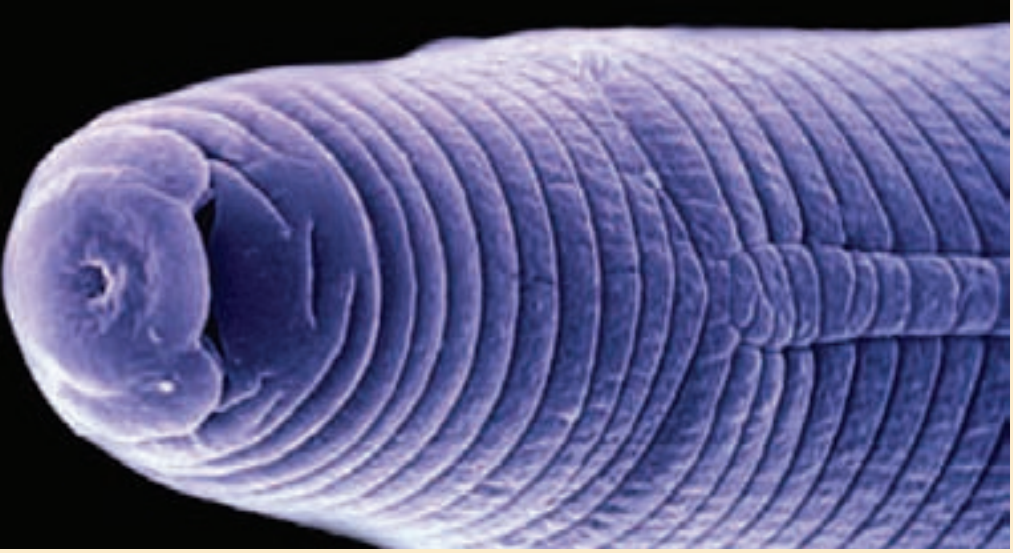

ROTHAMSTED RESEARCH

Fighting nematode worms with fungus

Root-knot nematodes are microscopic worms that feed on plant roots, stunting their growth and causing yield losses of US$70 billion each year. UK scientists and their Kenyan colleagues are harnessing a natural soil fungus to destroy the worms' eggs reducing damage to crops.

Nematodes destroy a wide range of crops worldwide, particularly those growing in tropical soils. In sub-Saharan Africa the devastation caused by nematode worms is set to worsen as a result of climate change.

Scientists from Rothamsted Research have been working with the naturally occurring soil fungus *Pochonia chlamydosporia*, which kills the eggs of nematodes. This fungus has been registered as a bio control agent. But in order to maximise the nematode-destroying potential of this fungus the researchers are now looking at how to create optimal soil conditions for it. If farmers try to encourage the fungus with extra organic material to improve soil structure and nutrients they can increase the abundance of the fungus - but counterintuitively the fungus seems to become less effective against the worms, eating the extra organic material instead of the nematode eggs.

Collaborations

Rothamsted Research, UK; and University of Nairobi, Kenya

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Reducing arsenic levels in rice

Arsenic contamination of rice paddies is a major problem across South East Asia. It is caused by irrigation with arsenic contaminated groundwater, pollution resulting from base and precious metal mining and the use of municipal solid waste as fertilizer.

Arsenic is a chronic carcinogen. In Bangladesh alone there has been a three-fold increase of inorganic arsenic in rice. As a result, across the South East Asian region people are being exposed to dangerous levels of inorganic arsenic in their diet.

Preliminary experiments have identified genetic variation rice that affects the amount of arsenic that can accumulate. With funding under SARID, researchers from the UK, India, Bangladesh and China will look at types of rice which have lower take-up levels of inorganic arsenic to unravel the genetic basis for this. Field experiments will be carried out in India, Bangladesh and China on arsenic contaminated soils with the ultimate aim of breeding genes for local rice which will have lower uptake levels of inorganic arsenic for use in areas with high arsenic in the soil.

Collaborations

University of Aberdeen, UK; and University of Calcutta, India

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More bananas for Africa

Nearly one third of the sub-Saharan African population is severely under-nourished.

Plantain and other types of cooking banana provide 27% of the daily calorie intake of Ugandans and many people in several African countries. But up to 70% of plantains are often damaged or destroyed by nematode worms, which feed on the roots of plantains.

To stop the devastating impact of nematode worms, breeding plantains resistant to the worms is vital. This is just what researchers from the UK and Uganda plan to do with funding to harness biotechnology.

Plantains are sterile crops that produce no seeds, this hampers their improvement by conventional plant breeding but not by plant biotechnology. Creating the new biosafe plants will build on previous work carried out in both the UK and Uganda.

A major part of the project is ensuring the new resistant plantains can be produced in Africa and made widely available to subsistence growers to improve their yield and ultimately the dietary intake of millions.

Collaborations

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Defeating the witchweed famine threat

Many important subsistence crops, relied on by billions of people, are at risk of attack from a noxious parasitic plant - witchweed. Over 40% of the cereal-producing areas of sub-Saharan Africa are infested with the parasite and the livelihoods of some of the world's poorest farmers are threatened. Researchers from the UK, India and Senegal are using SARID funding to find ways to produce crops resistant to witchweed.

Currently, the most commonly used strategies to reduce the impact of witchweed are hand weeding, improving soil fertility and growing some crops which are not attacked by the parasite, but these methods are costly and largely ineffective. Producing crops resistant to witchweed would improve the stability of food supply for people who rely on crops such as sorghum, maize, millet and rice.

Researchers from the University of Sheffield have already identified some rice varieties that are resistant to attack by witchweed. The next step for the international team of researchers is to identify what makes these varieties resistant and which genes play a role. Once this is known, they will look for similar genes in other cereals and explore the possibility of breeding cereals with increased resistance to witchweed.

Collaborations

University of Sheffield, National Institute of Agricultural Botany, UK; International Crops Research Institute for the Semi Arid Tropics, India; and African Rice Centre, Senegal.

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New strain of wheat disease threatens African crops

A new strain of stem rust, a major fungal disease of wheat, has emerged in East Africa. With the ability to spread thousands of miles and the potential to wipe out 40-70% of wheat yields an outbreak has already caused a painful spike in wheat prices in the region. UK and South African scientists are now working together to identify genetic resistance to the disease and protect vital crops.

In the past, stem rust was effectively controlled using cultivated wheat resistant to the disease. However, in 1999 a new virulent strain of stem rust emerged in Uganda - Ug99 - infecting many previously resistant wheat cultivars. Ug99 presents a new threat across the developing world, not least because of its ability to spread thousands of miles. Most farmers cannot afford to use expensive fungicides to control the disease so breeding new resistant varieties of wheat is crucial. SARID funding is making this possible. Scientists from the John Innes Centre (JIC) in the UK and the University of the Free State in South Africa will spend the next four years looking at the genetic make up of over 300 types of African wheat varieties for resistance to both stem rust and a related fungal disease, stripe rust. DNA markers will be used to define the extent of the variation between these different varieties. One wheat of particular interest to the scientists is Cappelle Desprez, a n old European variety which has so far proved resistant to stripe rust in both Europe and South Africa. A genetic mapping study will look specifically at this wheat to identify the genes contributing to the resistance.

Collaborations

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Details of DFID supported research can be found on: www.research&development.info
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