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Tackling CBSD, Cassava's Foremost Enemy

PHOTO: Gates Foundation

The Cassava Brown Streak Disease (CBSD), a viral disease ravaging Africa's second most important food crop, has come up against a formidable force - two consortia of experts, two advanced approaches and some funding set aside to develop varieties resistant to the virus.

One group, headed by the Donald Danforth Center, is spearheading work on CBSD resistance using RNA interference technology (RNAi). RNAi is a natural defense mechanism of plants and other organisms, the technique works by "teaching" the plant to recognise virus sequences in advance, so that it is ready to act when the real virus attacks. The other group comprising the International Institute of Tropical Agriculture (IITA) and its partners - the Agricultural Research Institute (ARI), in Tanzania and Uganda's National Agricultural Research Organisation (NARO) – are using molecular markers for faster and more accurate breeding of cassava varieties resistant to CBSD.

Cassava is a primary staple in Sub-Saharan Africa; it is an important source of calories for over 200 million people on the continent. It's a hardy crop – able to thrive across various agro-ecological zones and in poor soils, tolerating severe water stress and producing its edible roots even under and the poorest farm management practices. Besides high-carb tubers, its leaves are used as a vegetable and provide a cheap but rich source of proteins; vitamins A, B and C; and other minerals. Because of this, cassava is an important food security crop - serving as a reserve against famine for Africa's farmers who now experience longer and more frequent droughts.

But this hardy crop is increasingly being threatened by the re-emergence of Cassava Brown Streak Disease (CBSD). Though CBSD was first noted in the 1930s in Tanzania, it has only recently become a major concern for farmers and researchers. The disease, once thought to be found only in low-lying cassava-growing regions, is now spreading to other regions in Eastern Africa, causing a food-security panic.

According to Dr. Claude Fauquet, who heads the Danforth Center initiative, "This disease is unprecedented on cassava, and is spreading very quickly in East Africa, large numbers of farmers around the Lake Victoria are out of cassava material to plant for the next season and the international community has to respond immediately to help these farmers to avoid a human catastrophe."

Scientists have distinguished two different viruses causing the disease; Cassava Brown Streak Virus, present mainly in the coastal lowlands of Tanzania and Mozambique, and the Cassava Brown Streak Uganda Virus, which is behind the spread of the disease in the highlands of East Africa.

CBSD produces yellow-brown 'streaks' of decay along the stem which eventually spread from the shoots down to the roots. The disease results in a dry rot in the roots giving them an unpalatable corky texture. It can lead to crop losses anywhere from 70 to 100 percent.

Though researchers have been developing disease-tolerant varieties for distribution, Cassava Brown Streak Virus (CBSV) mutates and over time the resistance in varieties breaks down. Keeping the virus in check requires sustained breeding programmes able to keep up with new emerging strains.

> This will dramatically reduce the time taken to develop improved varieties."

However, conventional breeding takes 8 – 12 years to produce improved varieties. According to Dr. Morag Ferguson, IITA Plant Molecular Geneticist and team project leader, "The use of molecular markers can reduce the time taken to develop improved varieties by allowing selection earlier on in the breeding cycle and by increasing the accuracy of selection. It is like using a magnet in a game of 'find the needle in the haystack'!"

IITA and ARI have identified a few varieties with some level of resistance to the disease. Marker-assisted breeding will enable the breeders determine whether or not the desired genes of CBSD resistance have been successfully transferred from the parents to the offspring at the seedling stage using DNA testing. The four-year project, funded by the Bill & Melinda Gates Foundation, seeks to integrate marker-assisted selection into cassava breeding programs.

The group working with RNAi technology have, so far, managed to develop resistance to Cassava brown streak virus as well as the second virus causing the disease. They have been working with *Nicotiana benthamiana*, a close relative of tobacco, as a model host since production of transgenic cassava is time consuming and hard to screen for CBSD resistance. The plan is to replicate these tests with cassava, after which they shall do several trials - first in the greenhouse, then on the field.

If all goes well, both teams may have improved varieties ready for farmers to grow in the next 5-6 years.

(IITA, March 2010. Donald Danforth Center,July 2010.)

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UNCTAD Proposes Uniquely African 'Green Revolution'

Africa needs to embrace a uniquely African 'Green Revolution' if it is to meet the challenge of declining per capita food production by small scale farmers; this is the strong recommendation of the 2010 Technology and Innovation Report by the United Nations Conference on Trade and Development (UNCTAD).

Released in mid-May, 'Enhancing Food Security in Africa through Science, Technology and Innovation' focuses on the challenges of improving agricultural performance in Africa and the role of technology and innovation in raising agricultural production and incomes of all farmers, including smallholder farms.

Since the early 1970s, agricultural production in Africa has been on a continuous decline. Between 2003 - 2005 production was one-fifth lower than it was in the early 70s. The report says ineffective farming techniques and wasteful post-harvest practices mean that Sub-Sahara Africa is the region most likely to miss the first Millennium Development Goal of halving extreme hunger and poverty by 2015.

Unlike Asia and Latin America, who were also food insecure in the 1960s, Africa missed out on the Green Revolution. This Revolution was, in essence, agricultural innovation that involved a mix of high yielding varieties, chemical fertilizers and irrigation. Besides averting the looming spectre of hunger, the Green Revolution has also been credited with transforming traditional farming systems and the socio-economic conditions of farming communities where it took place.

With the recent food crises in many regions of the world, many have been quick to propose that Africa rehashes 'Green Revolution' principles that brought food sufficiency to many regions in Asia and Latin America. But according to UNCTAD experts, replicating this for Africa is setting the continent up for failure.

Though acknowledging the need for technology and innovation it notes that Africa's unique situation does not allow for the replication of an Asia-styled Green Revolution because of "…the heterogeneity of staple crops, farming systems and the paucity of rural infrastructure."

Instead, it recommends improving the mix of agricultural technologies used by African smallholders, and strengthening the innovation capabilities of African agricultural systems but says that "the technology package behind a genuinely African Green Revolution must be crafted with the continent's tremendously varied human, ecological, and economic circumstances firmly in mind."

On the ground, the continent's farming system is largely made up of smallholder farmers; they account for about 96 percent of all African farming. Therefore African governments wanting to improve agricultural productivity would do well by not only investing more in agriculture but also ensuring that resources are put into areas that are likely to have a large impact on smallholder productivity. Yet, today only a handful of African countries devote the agreed target of 10 percent of their GDP in public expenditure to agriculture.

> "No intervention can hope to succeed unless African Smallholder farmers are brought into the process."

Triggering a uniquely African Green Revolution, says the report, would require:

1. Working with African farmers and other stakeholders to redesign and modernize the complex African subsistence farming systems
2. Applying modern science and technology to produce robust technologies tested at farm-level and adapted to the respective agro-ecological zones in Africa
3. Reducing crop losses by applying post-harvest technologies and innovative management systems

For Africa success rests on a case-by-case approach that looks at the continent's diverse human, ecological, and economic circumstances bearing in mind suitability and adaptability of the technology to a particular situation. On the whole, no intervention can hope to succeed unless African smallholder farmers are brought into the process.

(UNCTAD, May 2010)

Biotech Crops Worthwhile *for farmers and Environment*

US farmers who adopted Genetically Engineered (GE) crops over conventional ones experienced significant economic and environmental benefits, these are the conclusions made in a recent report on farm-level impact of biotech crops.

The report by the National Research Council is the first comprehensive assessment of how GE crops are affecting all U.S. farmers, including those who grow conventional or organic crops. Previous reports by the Council, though addressing the effects of GE crops on the environment and human health, have never before looked at the effect of agricultural biotechnology at farm-level and from the farmers' point of view.

GE crops - more commonly referred to as biotech or GM crops - have been on the US market for the past 13 years. During this period the number of farmers' planting these novel crops has continued to steadily rise owing to their growing popularity in the farming community.

The current stable of biotech crops on offer target pest control; both insect and weed pests. Resulting from their use, farmers cited lower production costs, fewer pest problems, reduced pesticide use and better yields as the benefits they experienced as compared to farming conventional crops.

In many cases, farmers who have adopted the use of GE crops have either lower production costs or higher yields or both, due to more cost-effective weed and insect control and fewer losses from insect damage says the report.

"Many American farmers are enjoying higher profits due to the widespread use of certain genetically engineered crops and are reducing environmental impacts on and off the farm," says David Ervin, a professor of environmental management and economics, at Portland State University who also chairs the committee that wrote the report.

Insecticide use

Since biotech maize was first introduced for the control of European corn borer, insecticide use per acre has reduced as more and more farmers turn to Bt maize. Now, biotech maize offers even better pest control qualities, protecting against both the corn borer and corn rootworm- the result has been even more substantial savings on insecticides.

With cotton, which traditionally has the highest use of insecticides per acre, a drastic drop in insecticide use has been seen in farms that adopted biotech cotton. Owing to its success at insect control, adoption rates for Bt cotton have been the higher than any other biotech crop.

Besides the more obvious on-farm benefits of reduced insecticide use such as; fuel savings, reduced water use (for mixing insecticides) and less plastic container waste. Less insecticide spraying also means that farmers, their families and employees are protected from exposure to harsh chemicals.

Soil health & Water quality

The report cites improvement of water quality as one of the most significant positive impacts of biotech crops. Especially since agiculture is traditionally the largest source surface water pollution.

Bt crops contain in-built insect resistance which translates to a reduction in insecticide use, in turn reducing the need for harmful pest control products which are usually the biggest culprits in surface water pollution.

Biotech crops with their herbicide resistance technology promote the use of conservation tillage, a farming method that emphasizes minimal disturbance to the soil through tillage preferring instead, to control weeds using chemical as opposed to mechanical means. This promotes soil health by reducing erosion and the impaction caused by tillage.

Since their introduction in 1996, the use of GE crops in the United States has grown rapidly accounting for over 80 percent of soybean, corn, and cotton acreage in the United States in 2009. Despite all the benefits, the report warns of the growing cases of herbicide resistance and cautions farmers to on the need to adopt better management practices to ensure that they continue to reap the beneficial environmental effects of GE crops.

GE crops have not exhausted their scope says the report. The current biotech traits are concentrated on pest control; genetic engineering technology could do more in terms of mitigating food insecurity through Research and Development into traits that could for instance protect yield by conferring drought tolerance.

(National Research Council, April 2010)

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Uganda: Confined Field Trials for 3 crops

Confined field trials for Cassava Brown Streak Disease, sweet potato weevil, and Water Efficient Maize for Africa (WEMA) have been approved by the Ugandan National Biosafety Committee. The application was filed by the Ugandan National Agricultural Research Organization (NARO) to allow the National Crops Resources Research Institute (NaCRRI) to undertake research on these crops.

Tracking Agriculture Research across the Globe

An interactive new "Agricultural Science and Technology Indicators (ASTI)" website collects, analyzes, and shares data on agricultural research & development (R&D) in developing countries. The ASTI website is facilitated by the International Food Policy Research Institute (IFPRI). It tracks investment in agricultural research, sources of R&D funding, and the allocation of the investment across institutional categories, as well as numbers agricultural scientists,

contd on pg 4....

German Hot-Potato Finally Gets Planting Go-ahead

After more than 13 years of waiting, Amflora, BASF's genetically optimized starch potato, finally received approval for commercial cultivation by the European Commission on March 2nd.

According to a statement by the European Food Safety Authority (EFSA), Amflora is as safe as any other potato for humans, animals and the environment. However, Amflora is not intended for food use; the potato was developed purely for industrial purposes, providing a quality of starch that has long been desired for several technical applications.

Europe produces around two million metric tons of potato starch each year, a large part of which is used for industrial applications. The extraction of starch from conventional potatoes produces a mixture of two starches amylopectin and amylase. For many technical applications, pure amylopectin is advantageous, but separating these two starch components is uneconomical.

With the aid of biotechnology researchers have succeeded in "deactivating" the gene responsible for synthesizing amylose. The result is Amflora - a starch potato tailor-made for industrial use that produces pure amylopectin. Amflora starch can be used in many different ways. It makes yarn stronger and paper glossier, it also makes spray concrete adhere better to walls and keeps glue liquid for longer.

The Amflora approval process was initiated in August 1996 with the submission of request for authorisation, but owing to a moratorium on genetically modified products between 1998 and 2004, no approvals for genetically modified plants were granted in the EU.

Only plants deemed safe are approved by the national and European authorities. EFSA's passing of a positive opinion on the use of antibiotic resistance marker genes in June 2009 paved way for Amflora's approval on March 2, 2010.

"We hope that this decision is a milestone for further innovative products that will promote a competitive and sustainable agriculture in Europe," said Stefan Marcinowski, who serves on the Board of Executive Directors at BASF.

.....from pg 3.

their degree levels, their distribution among major commodities and themes, and the participation of female scientists. IFPRI hopes this information will be useful to policymakers and other stakeholders in designing agricultural development strategies to reduce hunger and poverty. ASTI is currently updating data for more than 30 sub-Saharan African countries. In the coming months, it expects to make available a large number of country, regional, and sub-regional reports on its website. visit the site at www.asti.cgiar.org

(IFPRI, August 2010)

Colombia: GM Soybeans for Planting

Colombia has approved the commercial planting of Monsanto's genetically modified glyphosate-tolerant Roundup Ready (MON04032-6) soybeans. The Ministry of Agriculture's plant and animal health biotechnology corporation, the ICA, issued the approval in July. The Roundup Ready Soya will now be commercially planted along with GM cotton which was previously the only GM crop officially grown in Colombia.

China: Weighing the Benefits of GM rice

Chinese researchers have found that three varieties of insect resistant genetically modified (GM) rice produced much higher yields than their non-GM equivalents under conditions of high insect pressure but that a "cryptic yield loss" resulted when insect pressure was "extremely low". This finding was based on a field trial of the three GM rice varieties and of their non-GM equivalents. Given that the GM rice varieties were outperformed by non-GM varieties under conditions of very low insect pressure, the researchers recommend that, when commercialized, GM rice should be deployed strategically so as to avoid any unnecessary losses. This is probably true for other insect resistant GM crops, the researchers say. They also recommend the employment of "effective biotechnology and breeding measures" to try to minimize the yield costs associated with the use of insect resistant GM rice under low-insect-pressure conditions. The results are contained in the September issue of the 'Field Crops Research' journal.

Burkina Faso: Biosafety Law in Local Languages

Joseph Paré, Burkina Faso's minister of secondary and higher education, science and technology, has launched a new program to create awareness of the country's National Biosafety Law. The law has been translated into the three most commonly spoken languages (Mooré, Jula, and Gulmacema) in the cotton growing areas. So far, 2,000 copies have been printed in each language, to be distributed to farmers through agricultural extension services. Burkina Faso's National Biosafety Authority is planning to reach out to farmers with the documents and to train them on the existing provisions regarding the use and management of genetically modified (GM) crops. Burkinabe farmers have been growing Bt cotton since 2008. Around two to four million of the country's farmers now grow the crop. Most of these producers have low literacy levels, especially when it comes to reading French, the actual language in which the biosafety law is written.

(Crop Biotech Update)

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