Ending *Striga*'s reign with IR maize

Key fact:

The collaborative development of herbicide-resistant maize promises effective integrated management of the *Striga* weed in Sub-Saharan Africa, increasing crop yields by up to four times and offering millions of farmers a solution to combating this noxious parasitic weed.

Summary:

Spreading through masses of tiny seeds, *Striga* infestation can cause yield losses of 20-100 per cent in maize, driving some farmers to give up cultivating the crop entirely. The persistence of the weed presents a serious challenge. However, a major step forward has been achieved by a private-public collaborative *Striga* control project to facilitate the release and utilisation of Imazapyr-resistant (IR) maize technology for *Striga* control in Sub-Saharan Africa. The new IR technology has two components: (i) herbicide resistant maize and (ii) herbicide (Imazapyr) coating. As the maize seeds germinate, they take in the herbicide. The germinated maize then produces a chemical which induces germination of the *Striga* weed, but as the *Striga* seedlings attach to the roots of the maize to withdraw nutrients, they are killed by the herbicide.

***Striga* infested maize farm in western Kenya** *(Peter Werehire)*

During pilot work in Kenya, Uganda and Tanzania, maize yields have increased from an average yield of 0.5 tonnes/ha to about 2 tonnes, thanks to the IR technology. Four hybrids and two open pollinated varieties are being produced as certified seed in Kenya, where about 30 tonnes have been made available to about 15,000 farmers in 2010. One variety has been released in Tanzania, and pre-release trials are underway in Uganda. Meanwhile, more than 60,000 farmers and 40 agrodealers have been trained to use the technology safely and effectively thanks to the combined effort of the partner seed companies, NGOs, farmer organisations and Ministry of Agriculture extension services.

Facts & figures[1]

- *Striga* seriously constrains the productivity of staples such as maize, sorghum, millet and upland rice. It is estimated that over 300 million people are adversely affected by *Striga* across sub-Saharan Africa (Ejeta, 2007).
- *Striga* infests as much as 40 million hectares of smallholder farmland in the region and causes yield losses ranging from 20–80% and even total crop failure in severe infestations. The AATF IR maize partnership is launching in the heart of Africa's Eastern *Striga* Belt, which extends across Ethiopia, Kenya, Uganda, Tanzania, Zambia, Zimbabwe, Malawi and Mozambique.
- 30g of Imazapyr herbicide, coated onto IR maize seeds, is enough to protect a hectare of maize from *Striga* for 6-8 weeks (Diallo *et al.,* 2007).
- IR maize seed retails at US$2 per kg (or US$40-50/ha), similar to other improved varieties. Higher yields and ability to reduce *Striga* seeds in the soil are some of the benefits that make IR maize more attractive to farmers than their own seed.
- IR maize seed is marketed through a network of agrodealers located in rural areas close to farmers, facilitating accessibility to the technology.
- Alongside IR maize, AATF's *Striga* project is promoting other control methods for effective weed management, such as legume rotations that release compounds to smother the weed, and intercrops that induce *Striga* to germinate suicidally.

Ending *Striga*'s reign with IR maize

Striga is a parasitic weed which infects tens of millions of hectares of farmland in Sub-Saharan Africa, making it the greatest plant threat to agricultural livelihoods on the continent. The weed is devastatingly prolific, with a single plant producing up to 200,000 tiny, sticky seeds, which can remain viable in the soil for over 20 years or be spread by wind, water, humans, animals and farm implements. *Striga* seeds germinate only when they sense germination stimulants from a potential host crop, after which the parasite sucks nourishment from the host plant.

Maize cobs: IR maize (left) and non-IR maize harvested from the same *Striga* infested farm *(Gospel Omanya)*

Striga in a field can reduce maize grain yield by 20-100 per cent, replacing a productive crop with pretty but useless purple flowers. *Striga* has persistently denied farmers harvests for decades, leading some farmers to abandon maize cultivation entirely. In addition, according to the World Health Organization, around 15 per cent of the population living in *Striga* infested regions are infected with HIV, thus depriving farm households of labour and leading to a further decline in crop yields. Labour cost and drudgery, especially for women associated with weeding prolific weeds such as *Striga,* only compounds an already serious situation for poor farming households.

Striga's spread and persistence has proved to be one of the most difficult challenges in modern pest management. During the last decade, the International Centre for Maize and Wheat Improvement (CIMMYT), in collaboration with the chemical company BASF and the Weizmann Institute of Science, have developed and evaluated a technology utilising herbicide-resistant maize to control *Striga.* The researchers employed conventional breeding to develop Imazapyr-resistant (IR) maize varieties, the seed of which can be coated with the Imazapyr herbicide without affecting the growth of the maize plant. The herbicide coat kills sprouting *Striga* seedlings as they attempt to attach themselves to the maize roots, protecting the crop and reducing the weed's seed bank in the soil.

Launched in 2004, the African Agricultural Technology Foundation (AATF) is a DFID-supported non-profit organisation designed to facilitate and promote public-private partnerships to enhance access to appropriate proprietary agricultural technologies. In 2005, as part of its flagship acitivities, AATF fostered a partnership with the IR maize developers to deploy the technology in *Striga*-oppressed areas of Sub-Saharan Africa. International research organisations, national research systems, government extension services, local NGOs and community-based organisations and seed companies in Kenya, Tanzania and Uganda have all been brought into the partnership. The partnership has been pivotal in the successful deployment and commercialisation of the technology, due to its multifaceted nature, which demands expertise in plant breeding, agronomy, agro-chemical coating, socio-economics, stewardship and seeds systems.

Green maize harvested from an IR maize demonstration plot *(Gospel Omanya)*

The sharing of responsibilities and effective team work between the partners has been a key factor in promoting and disseminating the technology, which has been commercialised under the trade name StrigAway®. Despite the challenges posed by such an adaptable adversary,

progress has been encouraging in pilot work in Kenya, Uganda and Tanzania. Maize yield in infested fields has grown from a dismal average of 0.5 tonnes/ha to about 2 tonnes. The results have brought renewed hope to farmers living under the perceived curse of *Striga* and farmers have begun to open up previously abandoned land as, within a few years of using StrigAway®, the *Striga* seed bank in the soil drops significantly, greatly reducing the threat posed by the weed to maize farming and farmers' livelihoods.

The achievements of the *Striga* partnership have resulted in four hybrids and two open pollinated varieties, which were released for certified seed production in Kenya between 2005 and 2009. Additionally, one variety was released in Tanzania in 2008 and several others are undergoing national performance trials towards commercial release. Farmers in Tanzania have not only demonstrated a distinct preference for the new hybrids, based on their higher yield potential, but also on the appealing white colour of the grain and the taste of flour when cooked. Pre-release trials are also underway in Uganda.

The release of varieties in Kenya and Tanzania has opened the doors for further commercialisation of the technology, with more private and public seed companies interested in commercial production of IR maize. This new era ushers in a new phase for the IR maize project as it works towards meeting farmers' demand of IR maize seed, stimulated by intensive technology promotion and awareness creation in the years preceding release, which has been a key part of the project in encouraging farmers' use of the technology and promoting sustainability.

In 2010, about 30 tonnes of certified seed will be made available to farmers. The partners have also trained more than 60,000 farmers (Kenya - 50,000; Tanzania - 5,000 and Uganda - 5,000) and 40 agrodealers in Kenya in the safe use and handling of the herbicide-coated seed. To sustain efforts to expand *Striga* control initiatives in other target countries across Sub-Saharan Africa, consultations are ongoing with private and public partners in Zimbabwe, Mozambique, South Africa, Nigeria and Ghana to develop StrigAway® maize deployment strategies.

Testimonials:

- **Kennedy Oure Okumu, Homa Bay District, Kenya:** "Maize is a very important crop for us. It is our main food at almost all of our meals, whether breakfast, lunch or dinner. However, my grandmother warned me not to plant maize. She told me that my land had been cursed by our ancestors and as a result a maize crop would not thrive on it. I did not heed her words and I planted maize, but to tell you the truth, my efforts have been largely futile. I've suffered on this land. It doesn't matter how many times I weed the farm, *Striga* always wins. I was therefore very happy to hear of a maize seed that doesn't get killed by the *Striga.* I asked for it just to try. What I've seen is nothing short of a miracle! My maize is very healthy now and my wife is happy to work on the farm, encouraged by the good crop. My grandmother is keenly watching to see if the seed will break the curse on our land."

- **Dick Morgan, Vihiga District, Kenya:** *"*In our village, the *Striga* weed poisons both maize and the soil. Farmers have named the new maize variety "*saviour".* We, the members of the Mwangaza Farmers Group from Vihiga District, have been planting IR maize in our *Striga*-infested fields for the past four years. We have been using an integrated approach to eliminate *Striga* infestation on our small farms. Our integrated approach has involved use of IR maize seed, application of animal manure, legume rotations and intercrops, digging trenches to prevent *Striga* dispersal and application of fertilisers. With this approach, we have been able to improve maize productivity from an average of 0.2 tonnes/ha to over 1.8 tonnes/ha."

Additional case study information

Costs and benefits:[2]

Striga is responsible for some US$1 billion of annual losses in maize production, perpetuating food insecurity and rural stagnation. A diverse, coordinated programme of management will be necessary to reverse these immense losses, and IR maize offers a key weapon in this arsenal. In comparison the price of development has been low, as the maize's herbicide resistance was unlocked through conventional plant breeding rather than through the more expensive genetic engineering. The use of IR-Maize technology to control *Striga* leads to yields 38–82 per cent higher than those currently obtained from traditional maize varieties. In Kenya, a conservative estimate indicates that when adopted, the proposed technology will lead to an extra 62,000 tonnes of maize in Western Province alone. This translates to US$5.3 million per year using the 2002 estimates of farm-gate price for maize in Kenya.

DFID contribution to research:

DFID has been a core donor of AATF since its establishment in 2004. Its funds have been pivotal in supporting both core and project activities, especially the *Striga* project, which is AATF's flagship project.

Research milestones:

- 2005 Certification and launch of IR maize technology in Kenya.
- 2005 Release of first IR maize varieties in Kenya.
- 2007 Wide-scale on-farm demonstration of IR maize technology in Uganda.
- 2008 Release of first certified IR maize variety StrigAway® in Tanzania by Tanseed International Ltd under the trade name *Komesha Kiduha*.
- 2005-2010 Capacity building of 40 agrodealers and over 60,000 farmers in handling and use of IR maize technology.
- 2010 Production of about 30 tonnes of certified IR maize seed in Kenya.

Photo credits:

AATF: For high resolution images contact AATF (aatf@aatf-africa.org)

Multi-media material:

Empowering African farmers against *Striga*
http://www.aatf-africa.org/striga/multimedia/striga_videos

Links:

African Agricultural Technology Foundation: www.aatf-africa.org
Striga project: www.aatf-africa.org/striga

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[1] Unless indicated otherwise, facts and figures sourced from: AATF *Striga* control in Maize project website http://www.aatf-africa.org/striga
[2] AATF, (no date) *Striga control in maize - managing a cereal killer*, AATF project brief

DFID Department for International Development

DFID, the Department of International Development, is the part of the UK government that manages Britain's aid to poor countries and works to get rid of extreme poverty.

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