CONTROLLING "WITCHWEED"

in Sub-Saharan Africa

Striga hermonthica – commonly known as "witchweed" – is an aggressive parasitic weed that seriously affects the production of cereals such as maize, pearl millet, sorghum, upland rice, sugarcane and Napier grass. *Striga* infests as much as 40 million hectares of farmland in the region and causes yield losses ranging from 20% to 100%. It affects the livelihoods of more than 100 million people causing annual crop losses estimated to be worth US$ 1 billion.

Striga weed attaches to the roots of growing host plants through the haustorium, siphoning off water and nutrients for its own growth. In addition during its subterranean phase, it initiates damage to its host through phytotoxins. Eventually, host plants that succeed to emerge above ground may wither culminating in total crop loss in severe infestation.

Emerged *Striga* produces characteristic "pretty" purple flowers that belie its devastating effects. At maturity the weed sheds its tiny seed (< 0.3mm in size), with a single plant producing about 50,000 – 200,000 seeds. This seed can remain dormant and viable in the soil for up to 20 years. With every planting season, some of the dormant seeds germinate, attach to host plants and regenerate profusely, escalating the *Striga* menace and threatening farmers' livelihoods.

Consolata Ogona is a 53 year-old mother of eight and a maize farmer in Busia District in Kenya. As a young girl, she recalls watching her father and his friends uproot the weed from their farms. The uprooted plants were thrown by the roadside as proof to government officials that they were controlling the weed's spread. They had no idea that by throwing the plants by the roadside they were actually helping to spread the weed. Another farmer, Salome Ken from Vihiga District, had to abandon part of her maize-growing land to the encroaching weed. "I had to start planting bananas instead of maize so that my land [did] not go to waste," she laments.

Bringing science to bear

For half a century, scientists have been looking for suitable methods to control *Striga,* including agronomic practices, host-plant resistance and herbicide application. While some of these control methods have reasonable potential, they are labour intensive and/or costly, limiting their use by resource-poor smallholder farmers. The best control measure is one that acts before the *Striga* seed germinates or shortly after the germinating *Striga* seed attaches to the roots of the host plant. To eliminate the threat of *Striga*, the soil must be depleted of all *Striga* seeds. On the other hand, the *Striga*

biology demands that its efficient control is done before or during the time it is attaching itself to its host. Thus, ideal technologies must both control the weed before crop yields are affected and deplete the amount of *Striga* seed left in the soil.

To address this challenge, AATF is collaborating with the International Maize and Wheat Improvement Center (CIMMYT), BASF – a multi-national producer and supplier of agro-chemicals, the Kenya Agricultural Research Institute (KARI), the Western Regional Alliance for Technology Evaluation (WeRATE) – a consortium of NGOs, and seed companies to disseminate a technology known as STRIGAWAY®, which kills *Striga* when it attaches to and starts feeding on the germinating maize plant. This enables the maize to grow normally and farmers to realise higher yields, as the maize plant is able to grow to its full potential.

The technology is based on a natural form of herbicide resistance that was originally found in maize lines owned by BASF. Using the BASF seed, CIMMYT worked with KARI to incorporate the natural herbicide resistance into maize varieties that are adapted to the climatic conditions of *Striga*-infested areas in eastern and southern Africa. The International Institute of Tropical Agriculture (IITA) is involved in a similar project in western Africa.

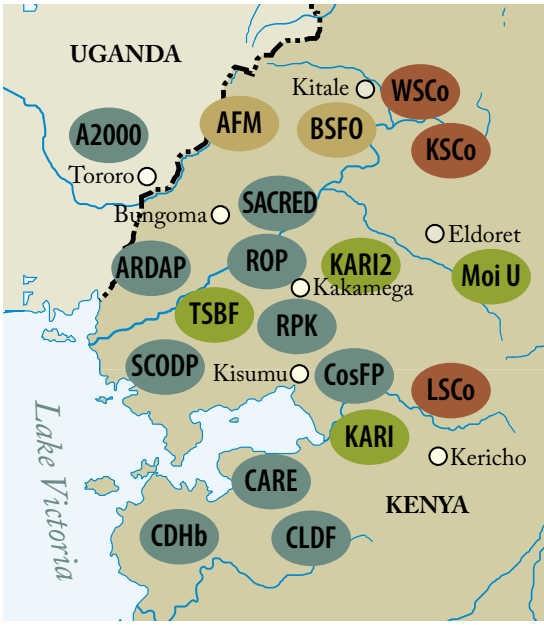
The Weizmann Institute of Science (Israel) and CIMMYT developed a herbicide coating formulation that does not harm the germinating maize seed but kills the *Striga* seedling that tries to attach to the maize roots.

In 2005, AATF and WeRATE collaborated on a project designed to assess recently developed *Striga* management technologies in farmers' fields in western Kenya and to promote stakeholder awareness of witchweed and how to effectively control it as a means of backstopping the efforts of CIMMYT and BASF. Known as the *Striga* Management Project, the partnership was later expanded to include 12 NGOs and 2 farmer associations, with individual NGOs responsible for different geographical areas.

Sustaining the use of STRIGAWAY® technology

With the assistance of NGOs and Kenya's Ministry of Agriculture extension services, the new technology has been tested in on-farm trials and demonstration plots and has been introduced to about 5,000 farmers in western Kenya. Data collected from on-farm trials and farmer fields indicate that maize yields have increased on average from 1.5tons/ha to over 3tons/ha. In fact, farmers are reporting that they can grow maize once again in fields that had been deemed unsuitable for maize production because of *Striga*. Preliminary data indicates that the amount of *Striga* seeds in the soil of fields planted with STRIGAWAY® maize dropped by about 30 percent over two cropping seasons. This reduction in the *Striga* seed bank may have been higher if the second season (short rains 2005/06) had not been affected by periods of severe drought that negatively impacted on maize growth.

Rose Katete, a member of the Apokos Women's Group in Teso District, has tried the new maize seed. "My fellow women farmers and neighbours



Top: *Striga hermonthica*. Its pretty appearance belies its devastating effects.
Middle: Farmer Onyango Baridi inspects his maize plantation.
Bottom: The AATF-WeRATE *Striga* network

have seen the results and are asking when the seed will be available," she said. The herbicide-coated and herbicide-resistant maize variety has been named *Ua Kayongo* meaning "Striga killer".

Dick Morgan, Chairman of Sabatia Smallholder Farmers Association in Vihiga District says, "In our village *oluyongo* (*Striga*) is equivalent to poison. It is believed that *Striga* weed poisons both maize and the soil. With the coming of *Ua Kayongo* maize, farmers have baptised this seed *mukombozi* (saviour). *Ua Kayongo* maize means saviour to the farmers."

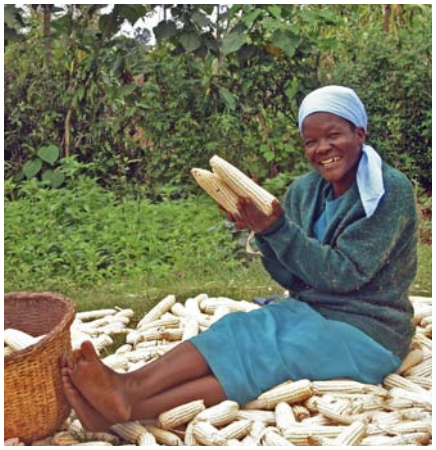
Teresa Lubusi from Sabatia says that *Ua Kayongo* maize means no empty food stores for farmers. "This maize helps farmers manage the problem of *Striga* weed (*oluyongo*) in their maize fields. In our culture *oluyongo* means something that strangles. It is believed that *Striga* weed strangles both maize and the soil. Farmers have baptised *Ua Kayongo mwiha mulahi* (a good bride groom)."

These stories are clearly encouraging, as are the scientific findings from extensive field testing. There are also other effective technologies that control *Striga*, including: the "push-pull" system developed by the International Centre of Insect Physiology and Ecology (ICIPE); and suicidal germination and soil fertility management recommendations from the Tropical Soil Biology and Fertility programme of the International Centre for Tropical Agriculture (TSBF-CIAT). AATF and its partners are thus proposing to join forces in a *Striga* Eradication Initiative (SEI) with the aim of reducing *Striga* infestation to negligible levels in maize fields in Sub-Saharan Africa. In this initiative, *Striga* control technologies will be tailored to the needs of each country.

In western Kenya, partnerships between public research institutes, private companies, NGOs and government agencies have demonstrated their effectiveness in bringing the valuable STRIGAWAY® technology to smallholder farmers. It is expected that the SEI will benefit from the same sort of synergies realised by those public/private partnerships and to lead the way in eliminating the *Striga* scourge affecting maize farming in Sub-Saharan Africa.

Striga Management Project update

AATF's *Striga* Management Project, initiated in January 2005, was designed to confine, reduce and eliminate *Striga* infestation in western Kenya, thereby improving maize yields, food security and the well-being of the rural poor. Field tests of the Imazapyr resistant maize hybrid, *Ua Kayongo*, treated with STRIGAWAY® have now been conducted during two cropping seasons in 18 administrative districts in western Kenya and eastern Uganda. To date, 5,299 field test packages have been distributed for on-farm testing by twelve NGOs, three research organisations, two farmer associations and the Ministry of Agriculture extension staff. In most cases, the technology effectively controls *Striga*. However, some emergence is observed late in the maize cropping cycle, suggesting that Imazapyr provides 6-10 weeks of protection from *Striga* and that the herbicide eventually becomes either



Clockwise from bottom left:
Farmers Rose Katete and Lydia Alice Ngereso: Happy with produce from STRIGAWAY® maize harvested from fields previously rendered unproductive by Striga;
Members of the Sabatia Smallholder Farmer's Association in Vihiga District at a meeting in Vihiga where they learned how to produce STRIGAWAY® maize.

immobilised or diluted within the plant.

In 2005, the AATF *Striga* Management Project installed IR-maize field tests on 1,353 farms during the long rains and on over 3,500 farms during the short rains. In some cases, farmers reported no rain for 60 days during the short rains and were impressed with *Ua Kayongo's* ability to tolerate dry conditions. In most cases, *Ua Kayongo* offered excellent control of *Striga* and, in the *Striga* infested fields, its productivity was markedly better than the maize varieties farmers are currently planting. A weed-free band occurs around the base of each maize plant that likely results from diffusion of the Imazapyr that was not absorbed by the maize seedling. This weed-free band extends from

2cm to 5cm from the base of the maize stem and, because the hardest weeds to manage are generally those closest to the plant, it makes for easier weeding operations.

Farmers see *Ua Kayongo* as the best *Striga* control technology now available and want to adopt it for use on their farms. In addition to the immediate benefits, most farmers noticed that in the fields where they grew *Ua Kayongo* for a second time there was very little *Striga* emergence as compared to fields where they grew other commercially available hybrids.

Striga Network field trials (led by WeRATE)

The purpose of the field trials was to independently evaluate alternative *Striga* management technologies across the range of agro-ecological conditions in western Kenya. During the long rains in 2005, 97 on-farm trials examining eight management options were conducted in districts of Western and Nyanza Provinces, specifically Bungoma, Busia, Bondo, Vihiga, Siaya and Teso Districts. Data were collected from 94% of the on-farm experiments and the amount of *Striga* seed in the soil was measured on 90% of those farms. On 18% of the farms, there was no *Striga* infestation at all. Moderate and severe *Striga* infestations were observed on 37% and 45% of these farms, respectively.

Measuring *Striga* seed in the soil (led by KARI-Kibos)

Towards the end of the short rains season of 2004/2005, a total of 100 sites were selected based on intensity of *Striga* infestation for the implementation of the *Striga*Net trials. During 2005, the *Striga* laboratory located at the Kenya Agricultural Research Institute (KARI) at Kibos measured the amount of *Striga* seed found in 777 soil samples. The highest amount of seed (and least variability) was noted among field trial sites in Bondo (371 x 10^6 seeds/ha) and Busia Districts (200 x 10^6 seeds/ha). Overall moderate infestation was observed in Siaya, Teso and Vihiga Districts (73 x 10^6 seeds/ha). Infestation was lowest and most irregular in Bungoma District, where only 20% of soil samples tested positive for *Striga* seed. These results suggest that efforts should be redirected to areas and farms where *Striga* is worse, particularly when operating at the periphery of its biological invasion.

Striga awareness

A number of high profile activities to publicise the *Striga* Management Project both nationally and internationally were undertaken in 2005. These activities included:

- 6,000 hard copies of the project's press release were distributed;
- An article on *Striga* management was published by the *Farmer's Journal*;
- A 16-page illustrated extension booklet, "*Ua Kayongo*: The *Striga* Killer" was printed and over 3,000 copies distributed;
- Over 80 participants attended a stakeholders meeting held in early June, which featured 18 presentations, 8 exhibits and plenary discussions on *Striga* management;

- An exhibit on *Striga* management was prepared and displayed at six events in Kenya, including the Nairobi International Show and the AATF Board Meeting;
- A 15-minute documentary on the AATF *Striga* Management Project was produced and broadcast on KBC television, and then copied onto compact disks and distributed to interested parties;
- Web pages on *Striga* management and the project were posted on websites www.africancrops.net and www.formatkenya.org; and
- Project scientists presented and published 3 papers at the Seventh African Crop Science Conference conducted in Entebbe, Uganda from 5 to 9 December 2005.

Through the efforts of AATF and its consortium of partners, smallholder farmers are benefiting from the donation of modern technology that is leading to the availability of *Striga*-reducing maize varieties. Fields covered with the witchweed's purple flowers will soon diminish and hopefully become a thing of the past. These same fields will instead be covered with healthy, productive maize plants, giving hope to millions of resource-poor smallholder farmers and their families in Sub-Saharan Africa.

Top: Farmer Salome Ken from Vihiga District, Kenya explains the perfomance of STRIGAWAY® maize on her farm during a field visit.
Bottom: Farmers at work in a maize plantation in Zambia.