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AFRICAN AGRICULTURAL TECHNOLOGY FOUNDATION
FONDATION AFRICAINE POUR LES TECHNOLOGIES AGRICOLES

BASF
The Chemical Company

Launch of STRIGAWAY® (IR-maize) technology for *Striga* control in Africa

5–6 July, 2005

Imperial Hotel, Kisumu, Kenya

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STRIGAWAY® (IR-maize) launch logistics team

Linda Ackel, Ebby Irungu, Fred Kanampiu, Volker Sthamer, Duncan Kirubi, Argwings Kodhek Otieno, Alpha Diallo, Nancy Muchiri and Gospel Omanya

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Contents

List of acronyms

AATF	African Agricultural Technology Foundation
AEZ	Agro-Ecological Zone
AREX	Agricultural Research and Extension Services
ARI	Agricultural Research Institute
BASF	The Chemical Company
CAN	Calcium Ammonia Nitrate
CG	Consultative Group
CILSS	Comité Inter-Etats de Lutte contre la Sécheresse au Sahel
CIMMYT	International Maize and Wheat Improvement Centre
CNRA	Centre National de Recherche Agricole
DAP	Diammonium Phosphate
DRC	Democratic Republic of Congo
EARO	Ethiopian Agricultural Research Organisation
ESE	Ethiopian Seed Enterprise
FICA	Farm Input Care Centre Ltd.
FORMAT	Forum for Organic Resource Management and Agricultural Technologies
GMO	Genetically modified organism
IIAM	Mozambique Institute for Agricultural Research
IITA	International Institute of Tropical Agriculture
IP	Intellectual Property
IR	Imazapyr Resistant
KARI	Kenya Agricultural Research Institute
KSC	Kenya Seed Company
Lagrotech	Lowlands Agricultural and Technical Services Seed Company
NARO	National Agricultural Research Organisation
NARS	National Agricultural Research Systems
NASECO	Namulonge Seed Company
NASFAM	National Smallholder's Farmers Association of Malawi
NGOs	Non-Governmental Organisations
NPT	National Performance Trials
NSCS	National Seed Certification Services
OPV	Open pollinated variety
SACRED	Sustainable Agriculture Centre for Research, Extension & Development in Africa
SARI	Savannah Agricultural Research Institute
SCODP	Sustainable Community-Oriented Development Programme
SEMOC	SeedCo Mozambique
SG 2000	Sasakawa Global 2000
SSA	Sub-Saharan Africa
TOSCA	Tanzania Official Seed Certification Agency
TSBF-CIAT	Tropical Soil Biology and Fertility Program of the International Centre for Tropical Agriculture
TPRI	Tanzanian Pathology Research Institute
WECAMAN	West and Central Africa Maize Network
We-RATE	Western Regional Alliance for Technology Evaluation
WSC	Western Seed Company

Executive summary

After years of struggle against *Striga* – the number one culprit of low harvests in maize in Sub-Saharan Africa (SSA) – CIMMYT, BASF and AATF together with other partners initiated the search for a more long-lasting solution to this problem. The efforts bore fruit and culminated into the launch of the STRIGAWAY® technology in Kisumu, Kenya in July 2005 as reported herein.

The event officially announced the release, performance and availability of the new technology and plans for Africa-wide deployment in *Striga* infested countries. This report captures a summary of processes leading to the development, potential and role of the STRIGAWAY® technology in alleviating poverty and increasing food security in SSA. It also provides a description of the significance of *Striga* as a constraint to maize production based on the field visits to heavily infested sites in western Kenya. The report further elucidates institutional partnerships for fostering deployment of STRIGAWAY® technology in SSA. Finally, it summarises country specific requirements solicited from participants for introduction, variety testing and release of STRIGAWAY® maize in various countries of SSA.

1 Background

1.1 *Striga* in Africa

Striga is a parasitic weed whose germination is enabled by germination stimulants produced by crops such as maize, rice, sorghum, millet and Napier spp. The roots of *Striga* attach to the host plant and withdraw water and nutrients. A single *Striga* plant is able to produce between 50,000 and 200,000 dust-like seeds which can remain dormant in the soil for 20 years until stimulated by a host, trap or catch crop.

From as early as 1936, *Striga* was described as a serious problem in western Kenya as well as in numerous other Sub-Saharan Africa (SSA) countries. From 1940 onwards researchers started work on *Striga* control, increasing their efforts to control the weed in the last 20 years. Nevertheless S*triga* distribution and intensity continues to increase drastically due to various factors that include high population growth, intensification of traditional cropping systems, reduction of fallow periods and the increasing need for major staple food crop cultivation.

Today, about 20 million hectares of maize are affected by S*triga* in Sub-Saharan Africa where yield losses range between 30% and 100%. The loss, estimated at 1 billion USD, affects 100 million people. Through the years, research has developed several methods for the control of *Striga* in maize. However, none of these methods have been widely adopted by the farmers, due to issues such as labour and financial constraints, and the fact that their benefits accrue in the long term. Lack of a clear understanding of the *Striga* life cycle among farmers, the high cost and limited efficacy of some of the control methods, and the small size farms that make it difficult for farmers to practice crop rotation are also some of the factors that make it necessary to seek other means of controlling the weed.

1.2 Development of STRIGAWAY® for control of *Striga*

CIMMYT and KARI in collaboration with the Weizmann Institute of Science in Israel receiving support from the Rockefeller Foundation and BASF have developed a unique method for the control of *Striga* in maize. Based on the CLEARFIELD® technology developed by BASF, the imazapyr-resistant maize, STRIGAWAY®, combines low dose seed coating of STRIGAWAY® (active ingredient imazapyr) applied to the IR-maize seed.

The technology relies on herbicide resistance that was derived from a naturally occurring gene in maize and made available to CIMMYT. Together with adapted CLEARFIELD® maize germplasm, CIMMYT has developed the herbicide seed-coating technology and appropriate rates for the humid mid-altitude ecology of western Kenya.

This technology virtually leaves the fields free of *Striga* for almost the whole crop season. Over the years, research and testing with the technology has shown that fields that are heavily infested with *Striga* can increase their maize harvest by more than three-fold compared to the checks (Table 1).

1.3 Cost benefit

The STRIGAWAY® technology is a cost effective means of controlling *Striga*. At present the price of hybrid maize in Kenya is valued at Ksh 15,000 per hectare. A farmer with a potential 3 tons/ha crop may be loosing 30% yield to *Striga.* With an extra cost of about Ksh 300 above the usual cost of maize seed, the same farmer could reverse this trend and even with a 10% loss, the benefit would be about Ksh 4,700 per hectare. It is to be noted, however, that current statistics indicate losses in excess of 50% in farmers' yields.

Table 1: Maize grain yields at different rates of imazapyr herbicide

Herbicide	Rate (g/ha)	Yield (kg/ha)
Control (no herbicide)	0	930
Imazapyr	30	3,063

1.4 Launch of STRIGAWAY® technology

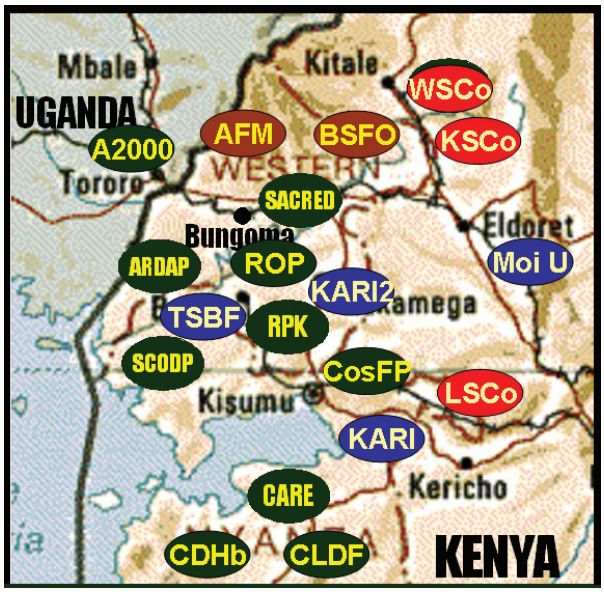


Figure 1. AATF-WeRATE *Striga* Network

In mid-2004, CIMMYT, BASF and AATF formed a steering committee to oversee the deployment of STRIGAWAY® technology in Kenya and the wider Sub-Saharan Africa (SSA). The committee enlisted the support of three local seed companies in Kenya, Lagrotech, Kenya Seed and Western Seed, and WeRATE (a consortium of NGOs including SACRED-Africa, SCODP, FORMAT) for the deployment of this technology. International organisations such as TSBF-CIAT were also involved in bulking and disseminating the seed for trials.

During the long rains season of 2005, on-farm testing was carried out in 12 districts: Bondo, Bungoma, Busia, Homa Bay, Kisumu, Kuria, Migori, Nyando, Rachuonyo, Siaya, Teso and Vihiga, covering a total of 50 hectares. Through contractual agreement with WeRATE, farmers' participation in the trials was quite good resulting in about 1,300 on-farm trials. Field test kits for the trials comprised 1kg STRIGAWAY® maize seeds, 1kg DAP and 1kg CAN fertiliser, and field test instructions. The trials carried out by farmers included different methods currently in use to control the weed such as crop rotation with catch crops like legumes.

The dream of the steering committee came true on 5–6 July 2005 in Kisumu, Kenya, when in a workshop attended by over 80 representatives (Annex 1), from different Sub-Saharan countries, CIMMYT and BASF formally launched the STRIGAWAY® technology. Participants included researchers and seed companies who discussed plans for the introduction of the technology to other parts of the continent. The technology is expected to be launched in Tanzania and Uganda in 2007.

Figure 2. Farmer receiving field test kits

The launch was presided over by Dr. Romano Kiome, the Director of KARI, Dr. Peter Matlon of the Rockefeller Foundation, Dr. Marianne Banziger of CIMMYT, Dr. Peter van den Hoek of BASF, Dr. Mpoko Bokanga of AATF and Dr. Jonathan Gressel of the Weizmann Institute. To mark the occasion, Dr. Kiome planted a tree at the KARI research centre in Kibos, Kisumu.

1.4.1 Objectives of the workshop and launch

The overall objective of the launch was to officially announce the release, performance and availability of the new STRIGAWAY® technology and to initiate plans for Africa-wide deployment in *Striga*-infested countries.

Specifically the workshop was organised to:

1. appreciate the seriousness of *Striga* as a parasitic weed in farmers' fields
2. elaborate the development, potential and role of the STRIGAWAY® maize technology in food security in Africa
3. elucidate institutional partnerships for fostering deployment of IR-maize technology in Sub-Saharan Africa
40. assess specific requirements for introduction, testing and deployment of IR-maize in target countries of Sub-Saharan Africa.

1.4.2 Design of the workshop

The two-day workshop consisted of key plenary presentations on the first day to provide background information. The presentations traced the technology's development, efficacy, on farm-trial results, deployment and partnerships. It also provided an overview of the *Striga* infestation in the continent, the suggested way forward and expected results. PowerPoint presentations are included in Annexes 1–6.

There were also field visits to on-farm trials and a tour of the KARI research centre at Kibos, Kisumu. The visits provided participants with an opportunity to witness the technology's performance and to hold discussions with farmers on their view of this new *Striga* control method.

The media was invited to the launch and field visits and were encouraged to seek clarification on any issues relating to the technology during a media conference on the first day. This provided the event and the technology launch with good local media coverage in both electronic and press media.

Figure 3. Farmer's field (Mr. Onyango Baridi) in Nyahera, Kisumu, Kenya

The second day consisted of the morning break-out sessions and afternoon plenary discussions. Participants were assigned five country specific working groups (see Annex 3), which discussed particular details relating to country specific roll-out plans and identified activities and resources required. The groups synthesised the discussions and reported to the plenary session in the afternoon where their recommendations were fully discussed.

The plenary discussions, break-out sessions, visits to farmers' fields and the KARI laboratory at Kibos provided participants and invited guests with useful information on the technology and its potential. Visits to the on-station fields provided participants with an opportunity to witness the technology's performance and to hold discussions with farmers on their view of this new *Striga* control method.

Figure 4. Drs Kiome (KARI), Bokanga (AATF) and Kanampiu (CIMMYT)

2 Issues discussed by the participants

2.1 The STRIGAWAY® maize technology: Its development, promise and role in food security

Speakers: Drs Fred Kanampiu and Peter Matlon

The STRIGAWAY® seed-coat technology combines herbicide resistance in maize varieties with low-dose application of a systemic herbicide – 30g imazapyr (STRIGAWAY®) per hectare, which is 20 times lower than 'normal' rates – for the control of *Striga*. This twin technology uses:

1. STRIGAWAY® maize: a natural, non-GMO, imidazolinone herbicide-resistant maize genotype
2. STRIGAWAY® herbicide: a systemic imidazolinone herbicide that kills any *Striga* weeds that attach to the maize plants carrying the herbicide.

The technology depletes the *Striga* seed bank by causing suicidal germination of the *Striga* seeds and the direct action of the herbicide on *Striga* seeds. The technology performs better in heavily infested *Striga* fields.

The STRIGAWAY® maize is compatible with farmers' cropping systems, fitting easily in an intercrop system. Sensitive crops can be safely sown as close as 15cm from treated maize, allowing the technology to be used in traditional smallholders' intercropping systems. The benefits of STRIGAWAY® technology include its effectiveness on *Striga* control, increased maize yields, depleted *Striga* seed bank in the soil and the potential to contain the *Striga* problem. The technology is also available to the farmers at affordable prices.

Dr. Kanampiu reported that CIMMYT IR-germplasm is sufficient to cover all *Striga* areas in Africa. New varieties include 60 late maturing OPVs for medium areas, 22 early maturing OPVs for medium areas, 10 OPVs for lowlands and 30 new inbreds.To achieve top yields, CIMMYT has bred herbicide resistance trait into elite material, maize streak virus resistance, *Turcicum* resistance, drought tolerance and low-N tolerance.

Recent developments include two new hybrids and 13 OPVs in NPT 2005, four hybrids nominated for full-release, one hybrid being produced by three seed companies, and wide-scale demos by the WeRATE consortium of NGOs and seed companies.

Future progress of the technology will require backstopping in testing, evaluation and production; fine-tuning to address any limitations; germplasm development for other AEZs in SSA; and cross-border activities and stewardship.

The Rockefeller Foundation has supported the IR-maize project for nine years since 1997. It was a very high-risk investment, unique in its approach and with enormous complexities. Rockefeller's decision to support it was based on the fact that it offered promise to the *Striga* problem and larger food security picture.

Kenya alone currently loses an equivalent of US$90 million per annum to *Striga*. In Africa, it is estimated that the loss is at US$1 billion. The results that have been reported and witnessed in farmers' fields are phenomenal.

Thus the expected impact of this technology on the continent's food security and economy is very promising. As Kenya nears commercialisation, the next step is to move the technology to other parts of Africa.

The STRIGAWAY® maize project is one of the best examples of a partnership arrangement that has brought together different players for a mutual good. The project has the technology inventors, developers, donors, seed producers and disseminators working together to help the smallholder farmer.

2.2 Partnerships for fostering deployment of STRIGAWAY® maize technology in Sub-Saharan Africa

Speakers: Drs Mpoko Bokanga and Peter van den Hoek

The AATF is registered as a charity by the Charity Commission of England and Wales and its mandate is to facilitate access to and delivery of IP-linked agricultural technologies addressing smallholder farmers' constraints in Sub-Saharan Africa. It is a knowledge-based African institution led and managed by Africans focusing exclusively on African priorities.

The Foundation's objectives are to create effective mechanisms to negotiate the access and transfer of proprietary and other technologies held by the public and private sectors from anywhere in the world to Africa and to create appropriate partnerships to manage the deployment of these technologies until they are within reach of smallholder farmers. Partnerships are an important means of advancing development initiatives although they are complex and require commitment.

In order to meaningfully serve the smallholder resource-poor African farmer, technology transfer involves a chain of activities involving various players. It includes negotiations with IP holders, technology adaptation and testing, technology commercialisation, technology dissemination, agreements, licensing and sublicensing, regulatory compliance, stewardship, public perception and awareness, market development and access and policy environment. To support technology transfer, AATF concentrates its activities in the areas of liability protection, negotiations with IP holders, agreements, licensing and sublicensing, regulatory compliance and stewardship.

At its launch, the Foundation identified ten problem areas for its intervention that include *Striga* control in maize, cowpea productivity improvement, bananas and plantain productivity, nutritional quality enhancement in cereals (maize, rice and sorghum), insect resistance in maize, drought tolerance in cereals, mycotoxins in food grains, cassava productivity improvement, control of locusts and grasshoppers with bio-pesticides and building stronger seed systems in Africa. However, currently the control of locusts and grasshoppers, and seed systems are not in the list of priority problems. The development of the projects is governed by the Foundation's Project Cycle Ladder that is made up of 14 steps divided into three distinct phases – business plan preparation, product development and product deployment.

Under the AATF *Striga* Management Project, NGOs, farmer associations, research institutions and the private sector are working together to confine, reduce and hopefully eradicate the scourge of parasitic *Striga* by integrating IR-maize into farmers' practice. Through this public/private partnership arrangement to bring STRIGAWAY® maize technology to smallholder farmers, over 1,400 farmers participated in on-farm trials of the technology in 12 districts in Western and Nyanza provinces of Kenya. BASF's involvement in the *Striga* control programme is through its acquisition of Cyanamid. It provided input into commercialising the concept. The company is committed and eager to continue providing support for the commercialisation and the Africa-wide roll-out. Dr. Peter van den Hoek indicated that BASF is happy to make a contribution to Africa's food security and poverty alleviation effort.

2.3 Perspectives of the way forward

Speaker: Dr. Marianne Banziger

The goal of the *Striga* control project is to make adapted STRIGAWAY® maize varieties available in all SSA countries where *Striga* is a major problem and to implement strategies that deploy STRIGAWAY® maize in a sustainable manner.

Some challenges in extending the technology to other parts of SSA include:

- rapid variety release in SSA countries affected by *Striga*
- scaling up seed production
- reaching *Striga*-affected farmers
- sustaining the effectiveness of the technology

Various collaborators have been testing STRIGAWAY® maize varieties in their countries during 2004/05. Through effective collaboration, STRIGAWAY® maize could become available in affected countries within 2–3 years.

1. Rapid variety release in SSA countries affected by Striga

There will be need to plan how to achieve variety release in the shortest time possible and to identify what varieties to achieve and who will conduct the trials. There will also be a need to ensure that measures are taken to register the herbicide at the same time. To ensure the right varieties are available, CIMMYT has converted many of its best germplasm to STRIGAWAY®.

2. Scaling up seed production

Unlike other maize varieties, STRIGAWAY® maize consists of a package of technologies – the maize variety and the seed coating with the herbicide and slow-release formulation. Seed producers need to adhere to standards for quality assurance and resistance monitoring. The question of who will produce treated seed of STRIGAWAY® maize varieties in the country that requires the technology is necessary.

3. Reaching Striga*-affected farmers*

It is likely that STRIGAWAY® maize will open new seed markets. CIMMYT will assist in defining commercially viable markets and those where other distribution mechanisms may need to be employed for reaching *Striga*-affected farmers. This would benefit the most from the involvement and participation of staff from NARS, NGOs and the private seed sector.

4. Sustaining the effectiveness of the technology

It will be important to ensure quality assurance of the seed treatment and the prevention of build-up of resistance. Training in quality assurance and resistance monitoring to generate wide awareness of suitable methods in the public and private sector, and increasing the awareness of integrated *Striga* management strategies is necessary.

The success of the *Striga* control initiative will depend on partnerships that harness complementary skills and strengths between NARS, NGOs and the private sector, which will accommodate the need for understanding of various viewpoints. The entrepreneurial approach of the private sector would make the delivery of the technology sustainable while the public and

NGO sector would add to the private sector's efforts to ensure that the technology reaches the poor. The public sector and IP holders would ensure the responsible and sustainable deployment of the technology.

2.4 Stewardship programs

Speaker: Dr. Chandler Mazour

BASF values the opportunity to work with CIMMYT, AATF and local seed companies to deliver a valuable technology to the African smallholder maize grower.

The objective of stewardship is to ensure the ability of African CLEARFIELD® maize grower to control *Striga* in their maize fields. Farmer stewardship and education will ensure safe farmer handling of STRIGAWAY® maize seed and protect the long-term ability of the smallholder resource-poor farmer to control *Striga* in their maize fields.

Stewardship will involve four key areas:

- STRIGAWAY® hybrid qualification
- STRIGAWAY® trait purity testing
- STRIGAWAY® treating methods and training
- post seed treatment quality testing

BASF will ensure methods are in place to deliver a high quality product to the farmer. Farmer stewardship and education will be structured to ensure the safe and proper handling of STRIGAWAY® maize by smallholder African farmers.

It will also support resistance management. Educational material will be distributed during farmer stewardship training sessions.

2.5 Specific concerns and status of regulatory requirements in countries targeted for IR-maize deployment

After the launch in Kenya, it is anticipated that STRIGAWAY® maize will be released for planting by farmers in the *Striga*-infested areas of western Kenya during the long rains season of 2006 while plans for cross-border expansion of this variety in other *Striga*-infested countries of Sub-Saharan Africa get underway. Thus, the launching of STRIGAWAY® maize was used as a forum for planning the much anticipated cross-border deployment of this new maize variety. Regulatory requirements that will have to be met in the countries include modalities for herbicide registration, maize germplasm introduction, variety testing, release and post release stewardship requirements.

Registration of STRIGAWAY® (imazapyr) herbicide

STRIGAWAY® technology is deployed as a twin technology combining coating of STRIGAWAY® maize seed with STRIGAWAY® herbicide. The herbicide was evaluated and approved for registration in Kenya by the Pest Products Control Board. To obtain approval for pesticide registration, an application containing detailed information on description of the product, composition and formulation of the product as well as toxicological details (see Annex I), are submitted to regulatory authorities for review. BASF, the manufacturer of imazapyr and partner in the *Striga* control project will take responsibility for applying for registration in all target countries. So far, registration of STRIGAWAY® has been secured in Kenya. An application for registration has been done in Ethiopia, Uganda and Tanzania.

Variety testing, registration and release

A summarised account of specific country work plans for maize variety testing in target countries is included in section 10 of this report. Clearly, the period taken during variety testing varies from country to country and typically ranges from 1–3 years/seasons. The main question to answer is: "What needs to be done, if CLEARFIELD® (IR-maize) is to be available to *Striga*-affected farmers in the specific country within the shortest time possible. Other issues that must be addressed by the stakeholders include:

i. identification of varieties with potential adaptation to each country
ii. evaluation of promising varieties in trials that provide data for release
iii. meeting other variety release requirements, for example distinctiveness, uniformity and stability (DUS)
iv. assigning successful varieties to seed producers
v. conducting efficacy trials
vi. herbicide registration
vii. scaling up seed production
viii. baseline study and market analysis
ix. ensuring farmers' access to IR-maize seed
x. quality assurance and resistance monitoring.

3. Institutional roles

Broadly institutional roles are as follow.

AATF

- Sublicensing of the germplasm to seed producers.
- Subcontracting/licensing entities for technology dissemination.
- Ensuring stewardship of the technology at farmer and retailer level.
- Facilitate registration of STRIGAWAY® maize varieties.
- Deal with intellectual property rights and regulatory issues.
- Assist in selection of seed companies.
- Conduct baseline study and market analysis for development of market.
- Demonstration trials on-farm.
- Development of communication plan and information dissemination.

BASF

- Herbicide registration.
- Sale, distribution and commercialisation of product.
- Train seed companies in seed treatment.
- Sign trademark agreement with seed companies.
- Provide guidelines for selection of seed companies.
- Commercialising the technology, including communication materials and publicity.
- Technical development, backstopping and stewardship, including seed coating, slow-release, quality assurances, resistance monitoring and provision of information.
- Training of seed companies and farmers.
- Monitoring of herbicide application and quality control with the local agents, distributors and regulatory bodies.

CIMMYT

- The provision of seed for variety trials and initiating breeder seed production.
- Technical backstopping and trouble shooting: variety trials, seed production, market analysis, resistance monitoring and provision of information.
- Financial support to high priority in-country activities.
- Supply testing kits.
- Supply genetic material, that is germplasms with the desired characteristics.
- Provide protocols for demonstration plots.
- Economics of *Striga* problem.
- Undertake impact assessment.
- Technology development – slow release, new genes conferring improved performance traits, possibly with resistance to other herbicides.
- Select seed companies.
- Quality assurance and resistance monitoring in conjunction with BASF.

NARs

- Variety evaluation and registration.
- Variety release requirements, for example distinctiveness, uniformity and stability (DUS).
- Conducting efficacy trials.
- Contract with seed companies.

Seed companies

- Variety evaluation and registration.
- Variety release requirements, for example distinctiveness, uniformity and stability (DUS).
- Maintenance of parental breeding materials.
- Foundation and certified seed production.
- Distribution of seed via stockist.
- Conducting efficacy trials.
- Seed coating and quality control.
- Organising demonstrations and field days.
- Undertake education of farmers.
- Quality assurance.

4 Prioritising the countries

Countries will be divided into two groups: Tier-1 and Tier-2. Tier-1 will be the first group to start registering the varieties and herbicide followed by Tier-2.

Tier-1 countries

1. Kenya
2. Ethiopia
3. Tanzania
4. Uganda
5. Malawi

Tier-2 countries

1. Zambia
2. Nigeria
3. Zimbabwe
4. Mozambique

5. Country specific work plans

5.1 Tier-1 countries

5.1.1 Kenya

Work plan for variety testing, release and commercialisation of IR-maize in Kenya

Resource persons

Marianne Banziger	CIMMYT
Alpha Diallo	CIMMYT
Fred Kanampiu	CIMMYT
Mpoko Bokanga	AATF
Gospel Omanya	AATF
Saleem Esmail	Western Seed Company

Certified seed production

CIMMYT in collaboration with Western Seed Company plans to produce 120–150 tons of *Ua Kayongo* for planting during the 2006 long rains season. In this regard, CIMMYT has produced 0.6 tons of the single cross parent and 2.6 tons of the male parent. This seed will be given to Western Seed Company to plant in August and certified for commercialisation in March 2006. All the other STRIGAWAY® maize with seed companies will be passed over to CIMMYT and sold to NGOs to be used for demonstration only.

Of the four released hybrids, one will be made available to Kenya Agricultural Research Institute while the other three will all be given to the three seed companies. In this year NPT, more and new hybrids and OPVs have been nominated by KARI, Freshco, Western Seed, Lagrotech and Kenya Seed. Some of these entries will address the problem of lack of short season germplasm.

Research areas

1. **Slow-release studies** will be conducted by CIMMYT and NARS in selected countries.
2. **Qualification studies** will be conducted by BASF and NARS in selected countries.
3. **Seed storage studies** will be conducted by CIMMYT. These studies need to be carried out with seed packed in both paper and polythene used by stockists to determine effect of storage duration and conditions on germination.
4. **Baseline study and market analysis:** This needs to be done to ensure farmers' access to IR-maize seed. These studies will determine:
   - the areas where the deployment of STRIGAWAY® maize will be commercially viable.
   - which farmers may not be able to benefit from STRIGAWAY® maize through commercial channels
   - the bottlenecks and how can they can be tackled.

Studies will be conducted by AATF showing benefits to group farmers to buy inputs in bulk, distribution of seeds along with other inputs. To achieve economies of scale, efforts will be made to assist in the formation of cereal growers associations. Strategies for getting seeds to

the poorest farmers and linking them with the grain market will be considered. AATF will facilitate the private sector involvement and where possible the public sector.

Dissemination

- STRIGAWAY® maize seed coating technology should be demonstrated with other *Striga* management strategies during promotions. Other management strategies involve use of *Striga* tolerant varieties, push-pull, legumes intercropping/crop rotations to improve soil fertility and reduction of *Striga* seed bank. However, this will depend on acceptability of these technologies in various agro-ecological zones.
- Extension services and NGOs will be involved in promoting other *Striga* management strategies.
- Field days, agricultural shows, booklets, brochures, radio programs, TV, etc will be used to increase farmer awareness on *Striga* management strategies.
- Promotion messages to farmers will emphasise on the benefits and general knowledge of the technology.
- Stockists/extension staff will be trained on STRIGAWAY® maize technology and its stewardship.
- Explanation of the STRIGAWAY® maize technology will be in terms relevant to the needs of the farmers and the emphasis will be on the importance of the trait rather than if it is a GMO or not. There is need to clearly explain to farmers on GMOs and food safety.
- Seed companies will be made aware that there might be investment costs by them to build separate treatment plants, distribute the seeds, educate the farmers, etc. In special cases funding of equipment might be necessary.

  Major points to farmers

  – Awareness and general knowledge around *Striga*, keying in on the biology of the *Striga* plant, that is amount of seeds left on the farm per season, the need to uproot the *Striga* plants and information on the seasonality – maturities of different STRIGAWAY® maize germplasm.
  – There is need to inform the farmers on the reason for washing hands while handling the seeds and the safety of consuming STRIGAWAY® maize grain in addition to provision of information on handling of pesticides.
  – Farmers should be made aware of integrated *Striga* management strategies.
  – Explanation should be given to farmers on the yellow flush in young plants. Yellow flush is an indication that the maize is protected and it happens because of the chemical used in the coating and disappears after a few days.

5.1.2 Uganda

Work plan for variety testing, release and commercialisation of IR-maize in Uganda

Resource persons

Alpha Diallo	CIMMYT
Fred Kanampiu	CIMMYT
George Bigirwa	NARO
William Nyakoojo	Victoria Seeds
Emmanuel Mubangizi	FICA Seeds
Justus Imanywoha	FICA Seeds

Year 1

Activities: – National performance trials and efficacy trials with selected varieties
– Training in how to conduct efficacy trials

2005B season

- National performance trials season 1 (conducted in 5 sites for 3 seasons): Hybrids and OPVs tested during previous years in Uganda and across other sites by NARO
- Conducting and training on efficacy trials by NARO and CIMMYT
- Breeder does the characterisation
- Technical backstopping
- Funding by CIMMYT

Year 2

Activities: – National performance trials and efficacy trials with selected varieties
– Backstopping of variety testing

2006–2007A seasons

- National performance trials **season 2** (conducted in 5 sites for 3 seasons): *Hybrids and OPVs tested for the last 2 years in Uganda and across other sites* by NARO
- DUS requirements – done in 3 locations by National Seed Certification Services
- Conducting and training on efficacy trials by NARO
- On-farm trials by NARO, FICA, NASECO, Victoria Seeds and Harvest Farm Uganda
- Technical backstopping by CIMMYT
- Funding by CIMMYT. However, seed companies will fund their demos.

Year 3

Activities: – Variety release, breeder and pre-basic/foundation seed production
– Backstopping of seed production and treatment
– Development of promotion material
– On-farm demonstrations and market definition
– Training in seed production, seed coating and product stewardship

2007B season

- National performance trials **season 3** (conducted in 5 sites for 3 seasons): *Hybrids and OPVs tested for the last 2 years in Uganda and across other sites*
- Varieties released by NARO, seed companies and NSCS
- Seed production by FICA, NASECO, Victoria Seeds and Harvest Farm Uganda
- Promotion materials by NARO, Ministry of Agriculture, NGOs, BASF, AATF and CIMMYT

- On-farm demonstrations by NARO, FICA, NASECO, Victoria Seeds, Harvest Farm Uganda, Ministry of Agriculture, NGOs, BASF, AATF and CIMMYT
- Training on seed coating and stewardship by BASF, AATF, CIMMYT and NARO
- Technical backstopping by CIMMYT and BASF

Year 4

Activities: – Seed production
– Wide-scale on-farm demonstration
– Backstopping of resistance monitoring strategies

2008B

- Seed production by seed companies
- Wide-scale on-farm demonstration by Ministry of Agriculture, FICA, NASECO, Victoria Seeds, Harvest Farm Uganda, NGOs and NARO
- Backstopping of resistance monitoring strategies by CIMMYT and BASF

5.1.3 Tanzania

Work plan for variety testing, release and commercialisation of IR-maize – Tanzania

Resource persons

Alpha Diallo	CIMMYT
Fred Kanampiu	CIMMYT
Ignath Rwiza	Ministry of Agriculture (Research) – ARI-Ukiriguru
Mahenya Muya	SATEC

Year 1

Activities: – National performance trials and efficacy trials with selected varieties
– Training in how to conduct efficacy trials

2005

- National performance trials on-station by Ministry of Agriculture–Research: *Hybrids and OPVs tested during previous years in Tanzania and across other sites*
- Conducting and training on efficacy trials by Ministry of Agriculture–Research and CIMMYT
- Technical backstopping by CIMMYT
- Funding by CIMMYT

Year 2

Activities: – National performance trials and efficacy trials with selected varieties
– Backstopping of variety testing

2006

- National performance trials on-station by Ministry of Agriculture–Research: *Hybrids and OPVs tested during previous years in Tanzania and across other sites*
- Multi-location on-farm testing by Ministry of Agriculture–Research, Care, World Vision, Kimkumaka and farmers
- DUS requirements – TPRI
- Technical backstopping
- Funding by CIMMYT. Seed companies to fund their demos.

Year 3

Activities: – Variety release, breeder and pre-basic/foundation seed production
– Backstopping of seed production and treatment
– Development of promotion material
– On-farm demonstrations and market definition
– Training in seed production, seed coating and product stewardship

2007

- Multi-location on-farm testing by Ministry of Agriculture–Research, Care, World Vision, Kimkumaka and farmers
- DUS requirements by TPRI
- Variety release by Ministry of Agriculture, SATEC, Kenya based seed companies and TOSCA
- Seed production by SATEC, SUBA-Agro, Kenya Seed and Western Seed
- Promotion materials by Ministry of Agriculture, Care, World Vision, Kimkumaka, BASF, AATF and CIMMYT
- On-farm demonstrations by Ministry of Agriculture, SATEC, SUBA-Agro,

Kenya Seed, Western Seed, Care, World Vision, Kimkumaka, BASF, AATF and CIMMYT

- Training on seed coating and stewardship by BASF, AATF, CIMMYT and Ministry of Agriculture
- Technical backstopping by CIMMYT and BASF

Year 4

Activities: – Seed production
– Wide-scale on-farm demonstration
– Backstopping of resistance monitoring strategies

2008

- Seed production by SATEC, SUBA-Agro, Kenya Seed and Western Seed
- Wide-scale on-farm demonstration by Ministry of Agriculture, Care, World Vision and Kimkumaka
- Backstopping of resistance monitoring strategies by CIMMYT and BASF

5.1.4 Malawi

Work plan for variety testing, release and commercialisation of IR-maize – Malawi

Resource persons

John MacRobert	CIMMYT
Rosan Ganuga	Ministry of Agriculture/Chitedze
Amos Ngwira	Ministry of Agriculture/Chitedze
Patrick Khonje	Ministry of Agriculture/Chitedze
Vernon Kabambe	Bunda College of Agriculture

Year 1

Activities: – National performance trials and efficacy trials with selected varieties
– Training in how to conduct efficacy trials

2005

- Testing in 12 or more locations based on hybrids and OPVs tested in previous seasons in Malawi and across other sites by Ministry of Agriculture
- Conducting and training on efficacy trials by NARS and CIMMYT
- Start registration procedures, that is intermediate testing
- Funding by CIMMYT

Year 2

Activities: – National performance trials and efficacy trials with selected varieties
– Backstopping of variety testing

2006

- Testing in 12 or more locations based on hybrids and OPVs tested in previous seasons in Malawi and across other sites by Ministry of Agriculture
- DUS declared by breeder
- Variety released by Ministry of Agriculture
- Conducting and training on efficacy trials by NARS and CIMMYT
- Technical backstopping
- Funding by CIMMYT. Seed companies to fund their demos

Year 3

Activities: – National performance trials and efficacy trials with selected varieties
– Training in seed production, seed coating and product stewardship

2007

- Testing in 12 or more locations based on hybrids and OPVs tested in previous seasons in Malawi and across other sites by Ministry of Agriculture
- DUS declared by breeder
- Train and equip seed companies in seed production and treatment
- Conducting and training on efficacy trials by NARS and CIMMYT
- Variety released by Ministry of Agriculture
- Technical backstopping by CIMMYT and BASF

Year 4

Activities: – Variety release, breeder and pre-basic/foundation seed production
– Backstopping of seed production and treatment
– Development of promotion material
– On-farm demonstrations and market definition

– Wide-scale on-farm demonstration
– Backstopping of resistance monitoring strategies

2008

- Seed production by Pannar and Monsanto
- Promotion materials by Ministry of Agriculture, Care, World Vision, Kimkumaka, BASF, AATF and CIMMYT
- Wide-scale on-farm demonstration by Ministry of Agriculture, World Vision, Concern Universal, Care, NASFAM, ASMAG and Sasakawa
- Training on seed coating and product stewardship by BASF, AATF, CIMMYT and Ministry of Agriculture
- Technical backstopping

5.1.5 Ethiopia

Work plan for variety testing, release and commercialisation of IR-maize – Ethiopia

Resource persons

Dennis Friesen	CIMMYT
Feleke Gezahegn	Ethiopian Seed Enterprise
Dawit Mitiku	Ethiopian Agricultural Research Organisation

Year 1

Activities: – Preliminary testing and identification of varieties to enter national performance trials
– Training in how to conduct efficacy trials

2005

- Testing & identification – Ecological trials (NPT) – 5–6 locations for 3 years by EARO
- Conducting and training on efficacy trials by CIMMYT
- Technical backstopping
- Funding by CIMMYT

Year 2

Activities: – National performance trials and efficacy trials with selected varieties
– Backstopping of variety testing

2006

- Testing and identification – Ecological trials (NPT) – 5–6 locations for 3 years by EARO
- Conducting and training on efficacy trials by CIMMYT
- Technical backstopping
- Funding by CIMMYT. Seed companies to fund their demos

Year 3

Activities: – Variety release, breeder and pre-basic/foundation seed production
– Backstopping of seed production and treatment
– Development of promotion material
– On-farm demonstrations and market definition
– Training in seed production, seed coating and product stewardship

2007

- Testing and identification – Ecological trials (NPT) – 5–6 locations for 3 years by EARO
- Variety evaluation trial (1 year) by variety release committee
- Conducting and training on efficacy trials by CIMMYT
- Promotion material development by Ministry of Agriculture, SG 2000, CPAR, CISP, BASF, AATF and CIMMYT
- Technical backstopping

Year 4

Activities: – Seed production
– Wide-scale on-farm demonstration
– Backstopping of resistance monitoring strategies

2008

- Seed production by ESE
- Variety released by Ministry of Agriculture
- Wide-scale on-farm demonstration by Ministry of Agriculture, SG 2000, CPAR and CISP
- Backstopping of resistance monitoring strategies by CIMMYT and BASF
- Training on seed coating and stewardship by BASF, AATF, CIMMYT and EARO

5.2 Tier-2 countries

5.2.1 Zambia

Work plan for variety testing, release and commercialisation of IR-maize – Zambia

Resource persons

John MacRobert	CIMMYT
Mwansa Kabamba	Ministry of Agriculture/Golden Valley
B. M. Verma	Zambia Seed Company

Year 1

Activities: – Preliminary testing and identification of varieties to enter national performance trials
– Training in how to conduct efficacy trials

2005

- Baseline survey to determine extent and areas of *Striga*
- Preliminary adaptation trials with stakeholders by SCCI
- Training on efficacy trials by NARS and CIMMYT
- Technical backstopping
- Funding by CIMMYT. Seed companies to fund their demos

Year 2

Activities: – National performance trials and efficacy trials with selected varieties
– Backstopping of variety testing

2006

- IR-maize preliminary adaptation trials with stakeholders by SCCI
- Conducting and training on efficacy trials by NARS and CIMMYT
- DUS by SCCI
- Technical backstopping

Year 3

Activities: – Variety release, breeder and pre-basic/foundation seed production
– Backstopping of seed production and treatment
– Development of promotion material
– On-farm demonstrations and market definition
– Training in seed production, seed coating and product stewardship

2007

- DUS by SCCI
- Variety released
- Training in seed production, seed coating and product stewardship
- Conducting and training on efficacy trials by NARS and CIMMYT
- Technical backstopping

Year 4

Activities: – Variety release, breeder and pre-basic/foundation seed production
– Backstopping of seed production and treatment
– Development of promotion material
– On-farm demonstrations and market definition

2008

- Breeders and pre-basic/foundation seed production by CIMMYT, Zamseed, Seed Co and Pannar
- On-farm trials by PAM, World Vision, ASP, Field Services, Zamseed, Seed Co and Pannar
- Promotion materials development by Ministry of Agriculture, NGOs, BASF, AATF and CIMMYT
- Market definition
- Technical backstopping

Year 5

Activities: – Seed production
– Wide-scale on-farm demonstration
– Backstopping of resistance monitoring strategies

2009

- Seed production by Zamseed, Seed Co and Pannar
- Wide-scale on-farm demonstration
- Backstopping of resistance monitoring strategies by BASF, seed companies and CIMMYT

5.2.2 Zimbabwe

Work plan for variety testing, release and commercialisation of IR-maize – Zimbabwe

Resource persons

John MacRobert	CIMMYT
Rosalia Madamba	AREX
John Makoni	Agpy Seeds
Paul G. Rupende	SeedCo Head Office

Year 1

Activities: – Preliminary testing and identification of varieties to enter national performance trials
– Training in how to conduct efficacy trials

2005

- Baseline survey to determine extent and areas of *Striga*
- Preliminary adaptation trials with stakeholders AREX and seed companies [*12 trials requested*]
- Training on efficacy trials by NARS and CIMMYT
- Technical backstopping
- Funding by CIMMYT. Seed companies to fund their demos

Year 2

Activities: – National performance trials and efficacy trials with selected varieties
– Backstopping of variety testing

2006

- National performance trials with stakeholders AREX and seed companies [*5 locations for 2 years*]
- Conducting and training on efficacy trials by NARS and CIMMYT
- Technical backstopping

Year 3

Activities: – National performance trials and efficacy trials with selected varieties
–Training in seed production, seed coating and product stewardship

2007

- National performance trials with stakeholders, AREX and seed companies [*5 locations for 2 years*]
- Conducting and training on efficacy trials by NARS and CIMMYT
- Training in seed production, seed coating and product stewardship
- DUS
- Begin breeders' seed production

Year 4

Activities: – Variety release, breeder and pre-basic/foundation seed production
– Backstopping of seed production and treatment
– Development of promotion material
– On-farm demonstrations and market definition

2008

- DUS
- Variety release

- Breeder and pre-basic/foundation seed production
- Backstopping of seed production and treatment
- Promotion material development by AREX, seed companies, BASF, AATF and CIMMYT
- On-farm demonstrations by AREX, Care, World Vision, ZFU, ZCFU and seed companies

Year 5

Activities: – Seed production
– Wide-scale on-farm demonstration
– Backstopping of resistance monitoring strategies

2009

- Seed production by seed companies
- Wide-scale on-farm demonstration by AREX, Care, World Vision, ZFU, ZCFU and seed companies
- Backstopping of resistance monitoring strategies by BASF, seed companies and CIMMYT

5.2.3 Mozambique

Work plan for variety testing, release and commercialisation of IR-maize – Mozambique

Resource persons

John MacRobert	CIMMYT
Pedro Silvestre Chaúque	IIAM
J. Jose Carlos	SEMOC Seed Co.

Year 1

Activities: – Preliminary testing and identification of varieties to enter national performance trials
– Training in how to conduct efficacy trials

2005

- Baseline survey to determine extent and areas of *Striga*
- Preliminary adaptation trials with stakeholders [*5 trials requested*] by IIAM and SEMOC Seed Co.
- Training on efficacy trials by NARS and CIMMYT
- Technical backstopping
- Funding by CIMMYT. Seed companies to fund their demos

Year 2

Activities: – National performance trials and efficacy trials with selected varieties
– Backstopping of variety testing

2006

- National performance trials with stakeholders IIAM and SEMOC Seed Co. [*10 agro-ecological zones for 2–3 years*]
- Conducting and training on efficacy trials by NARS and CIMMYT
- Technical backstopping

Year 3

Activities: – National performance trials and efficacy trials with selected varieties
–Training in seed production, seed coating and product stewardship

2007

- National performance trials with stakeholders IIAM and SEMOC Seed Co. [*10 agro-ecological zones for 2–3 years*]
- DUS by seed unit
- Variety released
- Begin breeders' seed production
- Technical backstopping

Year 4

Activities: – Variety release, breeder and pre-basic/foundation seed production
– Backstopping of seed production and treatment
– Development of promotion material
– On-farm demonstrations and market definition

2008

- Breeder and pre-basic/foundation seed production
- Backstopping of seed production and treatment

- Promotion material development by IIAM, World Vision, Care, FHI, SEMOC, BASF, AATF and CIMMYT
- On-farm demonstrations by AREX, Care, World Vision, ZFU, ZCFU and seed companies
- Technical backstopping

Year 5

Activities: – Seed production
– Wide-scale on-farm demonstration
– Backstopping of resistance monitoring strategies

2009

- Seed production by seed companies
- Wide-scale on-farm demonstration by World Vision, Care, FHI and SEMOC
- Backstopping of resistance monitoring strategies by BASF, seed companies and CIMMYT

5.2.4 Western Africa

Work plan for variety testing, release and commercialisation of IR-maize – Western Africa

Resource persons

Badu-Apraku	Nigeria	IITA
Ubale S. Abdullahi	Nigeria	Ahmadu Bello Univ. Zaria
Louise Akanvou	Ivory Coast	CNRA
Mashark Abdulai	Ghana	SARI

Comments

- WECAMAN to be approached for support to release IR-maize varieties in western Africa.
- There are weak seed systems in western African countries.
- Most maize seed marketed is OPV and farmers recycle seed. However, there is onset of hybrids use and this could reverse this trend.

General steps for variety registration

Ghana

Four steps involved

1. *On-station evaluation: one location for one year.
2. *Multi-location testing: four locations for two years.
3. On-farm evaluation, farmer managed – 20 farmers around multi-site testing locations for one year.
4. Varietal release inspection, like DUS done on station and could be done as the last year of multi-location testing.

Note: A minimum of three years for testing. Steps 1 and 2 can be run simultaneously.

Ivory Coast

Three steps involved

1. On station trial: two locations for one year done by research scientists.
2. Demonstration trials: four locations in different agro-ecological zones for two years done by scientists and NGOs, DUS conducted here, can be farmer managed.
3. Multi-location trials: conducted for one year, farmer managed, at least five sites in different agro-ecological zones.

Note: A minimum of four years for testing. Can be fast tracked to three years by combining steps 1 and 2.

Burkina Faso

Three steps involved

1. On-station trial: one location for one year by research scientists.
2. Demonstration trials: three locations all different agro-ecological zones for one year.
3. Multi-location farmer managed trials: conducted in at least five locations in different agro-ecological zones for one year.

Note: A minimum of three years for testing.

*New legislation coming in allowing registration in one member of CILS to confer registration to other members; testing procedures should not change.

Nigeria
Will get clarification from IITA HQ.

Benin, Togo and Cameroon
Not yet clarified. However, AATF and CIMMYT will obtain information.

Year 1

Activities: – Preliminary testing and identification of varieties to enter national performance trials
– Training in how to conduct efficacy trials

2005
- On-station evaluation of NARS variety
- Multi-location testing
- Technology information required from BASF and CIMMYT
- Technical backstopping
- Funding by CIMMYT. Seed companies to fund their demos

Year 2

Activities: – National performance trials and efficacy trials with selected varieties
– Backstopping of variety testing

2006
- On-station evaluation by NARS
- Multi-location testing
- Technical backstopping

Year 3

Activities: – National performance trials and efficacy trials with selected varieties
– Training in seed production, seed coating and product stewardship

2007
- On-farm trials by farmers, scientists and extension services
- Visits and evaluations by variety release committee
- Variety released
- Technical backstopping

Year 4

Activities: – Variety release, breeder and pre-basic/foundation seed production
– Backstopping of seed production and treatment
– Development of promotion material
– On-farm demonstrations and market definition

2008
- Pre-basic seed: Scientists, NARS, universities and CG
- Foundation seed
  - Ghana by Ministry of Food and Agriculture
  - Ivory Coast by NGOs and extension services
  - Burkina Faso by Ministry of Agriculture and NGOs
- Seed production
  - Ghana by Seed Growers Associations
  - Ivory Coast by NGOs and extension services
  - Burkina Faso by Ministry of Agriculture and NGOs
- Promotion material by researchers, NGOs, extension services promotion and on-farm demonstrations

- Market definition by researchers and socio-economists
- Technical backstopping

Year 5

Activities: – Seed production
– Wide-scale on-farm demonstration
– Backstopping of resistance monitoring strategies

2009

- Seed production
  - – Ghana by Seed Growers Associations
  - – Ivory Coast by NGOs and extension services
  - – Burkina Faso by Ministry of Agriculture and NGOs
- Farm demonstrations by researchers, NGOs and extension services
- Resistance monitoring strategy development by researchers and BASF in collaboration with Ministries. They will monitor for resistance to pesticides.
  - – Ghana by Ministry of Food and Agriculture
  - – Ivory Coast by Ministry of Agriculture and Agricultural Chemical Association
  - – Burkina Faso by Ministry of Agriculture

6. Variety recommendation for registration

Material	Sites tested	Number selected	Country tested
IR-3W2004A	17	5	Kenya, Uganda, Ethiopia, Sudan and DRC
3W-IR2004B	11	6	Kenya and Zimbabwe
IR-MAOPVL2004A	16	8	Kenya, Uganda, Ethiopia, Sudan and DRC
IR-MAOPVL2004B	7	9	Zimbabwe and Malawi
IR-MAOPVE2004A	22	11	Kenya, Ethiopia, Uganda and Sudan
IR-MAOPVE04B	8	8	Tanzania, Zimbabwe, Kenya and Malawi
IR-LLOPV04	19	5	Ghana, Kenya, Nigeria, Sudan, DRC, Ethiopia and Benin

Kenya

Two new IR-maize hybrids and 11 OPV were nominated in 2005 NPT (Table 1).

Table 1. IR-maize hybrids and OPV nominated in NPT 2005, Kenya

Material	Institution	Number
3W IR-hybrids	KARI SeedCo	1 1
Late IR-OPVs	KARI KSC WSC Freshco	1 1 1 2
Early IR-OPVs	KARI KSC WSC Freshco Lagrotech	1 1 1 1 2

East Africa

Based on results of evaluation of several three-way hybrids across 17 sites (Table 2), four hybrids (shaded green) can be recommended to NARS and seed companies in Kenya, Uganda and Ethiopia for their registration.

Table 2. Performance of IR-three way (IR-3W04A) planted across 17 sites in Kenya, Uganda, Ethiopia, Sudan and DRC in 2004A

Variety	Optimum across t/ha	*Striga* infested across t/ha	Husk cover %	Ear rot %	GLS 1-5	*E. turcicum* 1-5	*Striga* #/sq m
CML445-IR(BC3)F1/CML202/BC3-2-3 IR 76-B/CML204/BC3-1-2 IR	4.1	2.1	7	5	1.4	1.8	7
CML444-IR(BC3)F1/CML202/BC3-2-3 IR 76-B/CML204/BC3-1-2 IR	3.7	2.2	3	4	1.9	2.0	5
CML390-IR(BC3)F1/CML202/BC3-2-3 IR 76-B/CML204/BC3-1-2 IR	3.7	1.8	1	3	2.0	1.9	5
CKT026061	4.2	2.7	10	9	1.9	2.2	7
CKT026065	4.1	2.2	6	6	1.9	2.2	1
WH502	4.7	2.6	17	9	2.0	2.1	92
WH403	4.8	2.4	10	4	1.4	2.0	211
Local check	3.7	1.8	5	5	2.3	2.3	85
WH904	4.0	1.6	3	4	1.4	2.7	124
H513	2.3	1.7	15	8	2.1	2.3	117
Mean	3.7	1.9	7.1	6.2	1.8	2.1	39.9
LSD (0.05)	0.7	0.6	4.2	5.4	0.3	0.2	32.3
CV	25.1	25.4	69.4	71.0	25.8	18.6	94.7
Number of significant sites	5	2	4	4	4	8	4

COLOR LEGEND	
	VERY GOOD
	GOOD
	AVERAGE
	POOR
	VERY POOR

Based on results of evaluation of several mid-altitude late OPV (16 sites) in Kenya, Uganda, Ethiopia, Sudan and DRC (Table 3), eight late OPVs (shaded green) can be recommended to NARS and seed companies in these countries for their registration.

Table 3. Performance of mid-altitude late OPV (IR-MAOPVL04A) planted across 16 sites in Kenya, Uganda, Ethiopia, Sudan and DRC in 2004A

Variety	Optimum across t/ha	*Striga* infested across t/ha	Root lodging %	Husk cover %	Ear rot %	GLS 1-5	*E. turcicum* 1-5	*Striga* #/sq m
ECA-STRIGOFF-VL-125	5.5	1.9	35	8	13	2.0	2.2	5
ECA-STRIGOFF-VL-144	5.6	1.9	40	9	10	2.0	1.8	4
ECA-STRIGOFF-VL-131	5.3	2.0	55	7	8	2.0	2.1	3
ECA-STRIGOFF-VL-102	5.2	2.1	42	10	9	1.9	2.0	2
ECA-STRIGOFF-VL-130	5.3	1.9	54	7	10	2.1	2.4	3
ECA-STRIGOFF-VL-107	5.2	1.9	45	11	14	2.1	2.2	3
ECA-STRIGOFF-VL-141	5.1	1.9	28	9	17	2.0	1.8	3
ECA-STRIGOFF-VL-140	5.1	1.9	64	7	6	1.9	2.4	5
WH502	5.3	1.7	37	20	18	2.1	2.2	75
WH403	2.9	1.9	60	18	9	1.4	2.3	40
KSTP	3.3	1.5	64	11	30	2.1	2.2	50
Mean	4.7	1.5	44.1	9.5	12.8	2.0	2.4	6.7
LSD (0.05)		0.8	9.5	0.11	5.3	7.3	0.6	0.4
CV	18.2	19.1	29.7	61.3	56.3	17.0	18.4	142.1
Number of significant sites	5	1	1	5	4	3	6	3

Based on results of evaluation of several mid-altitude early OPV (22 sites) in Kenya, Uganda, Ethiopia and Sudan (Table 4), 11 early OPVs can be recommended to NARS and seed companies in these countries for their registration.

Table 4. Performance of mid-altitude early OPV (IR-MAOPVE04A) planted across 22 sites in Kenya, Ethiopia, Uganda and Sudan in 2004A

Variety	*Striga* infested across t/ha	Optimum across t/ha	Husk cover %	Ear rot %	GLS 1-5	*E. turcicum* 1-5	*Striga* #/sq m
ECA-STRIGOFF-VE-216	2.5	3.0	8	2	1.7	2.4	1.0
ECA-STRIGOFF-VE-206	2.4	3.2	8	1	2.0	2.3	2.7
ECA-STRIGOFF-VE-217	2.2	2.9	10	2	1.8	2.5	0.2
ECA-STRIGOFF-VE-210	2.1	2.8	8	3	2.1	1.9	1.1
ECA-STRIGOFF-VE-208	2.2	2.9	7	3	1.6	2.5	1.0
ECA-STRIGOFF-VE-211	1.9	2.8	9	8	2.0	2.3	1.7
ECA-STRIGOFF-VE-215	2.0	2.7	6	1	2.3	2.9	0.9
ECA-STRIGOFF-VE-209	2.0	2.6	9	2	2.1	2.8	0.6
ECA-STRIGOFF-VE-212	2.1	2.6	9	5	2.1	2.4	1.9
ECA-STRIGOFF-VE-221	2.0	2.4	8	2	2.3	2.3	1.3
ECA-STRIGOFF-VE-219	2.0	2.5	7	1	2.4	2.6	1.8
LOCAL CHECK : Longe-4	1.2	3.1	7	10	3.0	2.1	21.7
KSTP- LOCAL CHECK	0.9	2.5	30	3	2.8	2.0	24.8
WS202- LOCAL CHECK	1.1	2.2	12	3	2.1	3.2	13.7
Mean	1.7	2.4	11.8	3.4	2.2	2.5	3.4
LSD (0.05)	0.4	0.5	7.2	4.8	0.6	0.5	3.8
CV	28.3	21.2	81.5	93.5	19.5	16.4	139.4
Number of significant sites	7	5	8	2	2	3	7

Southern Africa (Zimbabwe, Malawi and Tanzania)

Based on results of evaluation of several three-way hybrids across (11 sites) in Kenya and Zimbabwe (Table 5); mid-altitude late OPVs (seven sites) in Malawi and Zimbabwe (Table 6); mid-altitude early OPVs (eight sites) in Malawi, Zimbabwe, Tanzania and Kenya (Table 7); six hybrids, nine late OPVs and eight early OPVs can be recommended to NARS and seed companies in these countries for their registration.

Table 5. Performance of three-way hybrids (3W-IR04B) planted across 11 sites in Kenya and Zimbabwe in 2004B

Variety	Optimum across t/ha	Random drought across t/ha	Low nitrogen across t/ha	Husk cover %	Ear rot %	GLS 1-5	*E. turcicum* 1-5
CML444-IR/CML373-IR//CML390-IR	7.2	1.7	1.7	5	4	2.6	2.6
CML444-IR/CML202-IR//CML395-IR	6.7	1.5	1.2	11	7	1.2	2.4
CML445-IR/CML373-IR//CML390-IR	6.4	2.5	1.7	8	6	1.7	2.8
CML312-IR/CML373-IR//CML390-IR	6.4	1.8	1.9	10	6	1.5	2.2
CML204-IR/CML202-IR//CML395-IR	5.9	2.1	1.4	6	0	1.9	2.3
CML202/CML395//CML312-RE1	5.6	1.9	1.8	25	7	1.6	2.3
CML202-IR/CML373-IR//CML390-IR	5.9	1.8	1.8	9	3	2.3	2.2
WS502-STR TOLERANT HYB	6.2	1.9	1.5	20	24	2.7	2.7
LOCAL CHECK 1	6.7	1.4	2.4	17	18	1.7	2.8
LOCAL CHECK 2	4.3	2.1	1.5	19	15	1.5	3.2
Mean	5.5	1.7	1.5	12.0	7.0	2.0	2.6
LSD (0.05)	1.2			6.3	7.8	0.8	0.5
CV	23.3			56.5	92.2	25.7	9.5
Number significant sites	5			5	3	2	1

Table 6. Performance of mid-altitude late OPV (IR-MAOPVL04B) planted across seven sites in Zimbabwe and Malawi in 2004B

Variety	Random drought across (t/ha)	Managed low nitrogen across (t/ha)	*Striga* infested (t/ha)	Random low nitrogen t/ha	Root lodging (%)	Husk cover (%)	*E. turcicum* (1-5)
ECA-STRIGOFF-VL-133	1.7	1.6	3.5	3.5	6	4.2	2.3
ECA-STRIGOFF-VL-102	1.6	1.6	3.0	3.7	18	4.1	2.3
ECA-STRIGOFF-VL-141	1.7	1.9	2.9	3.3	17	4.7	2.2
ECA-STRIGOFF-VL-129	1.5	2.4	2.8	3.0	7	5.2	1.9
ECA-STRIGOFF-VL-126	1.7	1.6	2.6	3.5	10	6.6	2.3
ECA-STRIGOFF-VL-128	1.5	2.1	2.8	3.0	11	6.0	2.3
ECA-STRIGOFF-VL-103	2.0	1.5	2.8	3.0	22	2.6	2.1
ECA-STRIGOFF-VL-113	1.6	1.9	3.0	2.2	44	4.9	2.7
ECA-STRIGOFF-VL-139	1.1	1.3	2.7	3.3	22	12.8	2.4
Local check	0.7	3.2	2.1	3.6	44	3.1	2.4
Mean	1.6	2.0	2.5	2.2	21.4	9.1	2.4
LSD (0.05)					12.1	9.3	0.5
CV				26.7	58.5	118.5	10.8
Number of significant sites				1	1	1	3

Table 7. Performance of mid-altitude early OPV (IR-MAOPVE04B) planted across eight sites in Tanzania, Zimbabwe, Kenya and Malawi in 2004B

Variety	Optimum across t/ha	*Striga* infested across t/ha	Low N across t/ha	Stem lodging %	Husk cover %	Ear rot %	GLS (1-5)
ECA-STRIGOFF-VE-222	2.3	1.4	3.2	20	12	4	1.4
ECA-STRIGOFF-VE-212	2.4	2.2	0.7	4	22	0	1.4
ECA-STRIGOFF-VE-213	2.5	1.7	1.1	11	13	3	1.0
ECA-STRIGOFF-VE-214	2.5	1.3	1.6	16	17	0	1.0
ECA-STRIGOFF-VE-207	1.9	2.2	1.8	6	9	6	1.3
ECA-STRIGOFF-VE-220	1.8	1.8	2.4	7	10	8	1.0
ECA-STRIGOFF-VE-216	2.0	2.1	1.0	12	30	0	1.0
ECA-STRIGOFF-VE-201	2.1	1.9	1.0	18	11	0	1.0
LOCAL CHECK 1	1.2	0.6	4.2	-3	8	7	1.0
LOCAL CHECK 2	0.8	1.0	2.8	16	8	1	1.0
KSTP-STRIGA TOLERANT POP-RE1	1.0	1.3	0.0	6	6	7	1.5
WS202-STRIGA TOLERANT HYBRID-RE2	1.4	0.2	0.0	19	14	0	1.0
Mean	2.0	1.4	1.3	9.5	16.4	3.1	1.1
LSD (0.05)	0.8	0.7	0.8	9.6	24.5	8.1	24.5
CV	17.5	22.7	28.5	47.7	99.2	175.3	17.1
Number of significant sites	1	1	1	1	2	2	1

Western Africa

Based on results of evaluating several lowlands OPV across 19 sites in Ghana, Kenya, Nigeria, Sudan, DRC, Ethiopia and Benin (Table 8), five OPVs can be recommended to NARS and seed companies in these western African countries for their registration.

Table 8. Performance of late lowland OPV (IR-LLOPV04) planted across 19 sites in Ghana, Kenya, Nigeria, Sudan, DRC, Ethiopia and Benin in 2004

Variety	*Striga* infested across t/ha	Optimum across t/ha	Low nitrogen across t/ha	Root lodging %	Stem lodging %	Husk cover %	Ear rot %	GLS 1-5	*E. turcicum* 1-5	*Striga* #/sq m
ECA-STRIGOFF-VL-10	2.4	2.9	2.3	11	6	7	7	1.0	3.1	1
ECA-STRIGOFF-VL-3	1.8	2.9	2.2	10	9	9	4	1.0	2.4	1
ECA-STRIGOFF-VL-4	2.1	2.6	2.1	12	9	11	7	1.0	2.6	0
LOCAL CHECK 2	2.3	3.4	2.2	9	6	7	9	2.0	1.7	2
ECA-STRIGOFF-VL-7	2.7	2.7	2.0	13	7	10	7	1.2	3.1	1
ECA-STRIGOFF-VL-2	2.0	2.2	2.0	11	8	4	6	1.0	3.2	0
KSTP	0.0	1.8	-2.8	45	55	40	54	2.2	2.1	0
Mean	1.82	2.55	1.63	15.8	12.1	10.2	10.2	1.2	2.9	0.7
LSD (0.05)	0.82	0.68	0.30	7.1	4.7	5.2	3.8	0.4	0.4	1.7
CV										
Number significant sites	1	3	7	5	5	3	4	1	4	3

7. Available varieties for various countries

Entry	Pedigree	Origin	Seed required (kg)	Seed available (kg)
IR-3W2004A: Kenya, Uganda and Ethiopia				
12	CKT026061	KB03-0A20-5/6		
13	CKT026065 (Released in Kenya)	KB03-0A20-1/2		
–	CKT026067 (Released in Kenya)			
–	CKT026069 (Released in Kenya)			
–	CKT026071 (Released in Kenya)			
11	CML445-IR(BC3)F1/CML202/BC3-2-3 IR 76-B/CML204/BC3-1-2 IR	KB03-0B43-11		
9	CML444-IR(BC3)F1/CML202/BC3-2-3 IR 76-B/CML204/BC3-1-2 IR	KB03-0B43-9		
8	CML390-IR(BC3)F1/CML202/BC3-2-3 IR 76-B/CML204/BC3-1-2 IR	KB03-0B43-8		
3W-IR2004B: Kenya and Zimbabwe				
9	CML444-IR/CML373-IR//CML390-IR	KB04-0A01-9		
22	CML444-IR/CML202-IR//CML395-IR	KB04-0A02-9		
11	CML445-IR/CML373-IR//CML390-IR	KB04-0A01-11		
1	CML312-IR/CML373-IR//CML390-IR	KB04-0A01-1		
26	CML204-IR/CML202-IR//CML395-IR	KB04-0A02-13		
12	CML202-IR/CML373-IR//CML390-IR	KB04-0A01-12		
IR-MAOPVL04A: Kenya, Uganda and Ethiopia				
26	ECA-STRIGOFF-VL-125	KB03-0B30-2		
45	ECA-STRIGOFF-VL-144	KB03-0B30-21		
32	ECA-STRIGOFF-VL-131	KB03-0B30-8		
3	ECA-STRIGOFF-VL-102	KB03-0B31-3		
31	ECA-STRIGOFF-VL-130	KB03-0B30-7		
8	ECA-STRIGOFF-VL-107	KB03-0B31-8		
42	ECA-STRIGOFF-VL-141	KB03-0B30-18		
41	ECA-STRIGOFF-VL-140	KB03-0B30-17		
IR-MAOPVL04B: Zimbabwe and Malawi				
34	ECA-STRIGOFF-VL-133	KB03-0B30-10		
3	ECA-STRIGOFF-VL-102	KB03-0B31-3		
42	ECA-STRIGOFF-VL-141	KB03-0B30-18		
30	ECA-STRIGOFF-VL-129	KB03-0B30-6		
27	ECA-STRIGOFF-VL-126	KB03-0B30-3		
29	ECA-STRIGOFF-VL-128	KB03-0B30-5		
4	ECA-STRIGOFF-VL-103	KB03-0B31-4		
14	ECA-STRIGOFF-VL-113	KB03-0B31-14		
40	ECA-STRIGOFF-VL-139	KB03-0B30-16		

IR-MAOPVE04: Kenya, Ethiopia and Uganda				
17	ECA-STRIGOFF-VE-216	KB03-0B29-5		
7	ECA-STRIGOFF-VE-206	KB03-0B33-1		
18	ECA-STRIGOFF-VE-217	KB03-0B29-6		
11	ECA-STRIGOFF-VE-210	KB03-0B33-5		
9	ECA-STRIGOFF-VE-208	KB03-0B33-3		
12	ECA-STRIGOFF-VE-211	KB03-0B33-6		
16	ECA-STRIGOFF-VE-215	KB03-0B29-4		
10	ECA-STRIGOFF-VE-209	KB03-0B33-4		
13	ECA-STRIGOFF-VE-212	KB03-0B29-1		
22	ECA-STRIGOFF-VE-221	KB03-0B29-10		
20	ECA-STRIGOFF-VE-219	KB03-0B29-8		
IR-MAOPVE04B: Tanzania, Zimbabwe, Kenya and Malawi				
23	ECA-STRIGOFF-VE-222	KB04-0A10-9		
13	ECA-STRIGOFF-VE-212	KB03-0B29-1		
14	ECA-STRIGOFF-VE-213	KB03-0B29-2		
15	ECA-STRIGOFF-VE-214	KB03-0B29-3		
8	ECA-STRIGOFF-VE-207	KB03-0B33-2		
21	ECA-STRIGOFF-VE-220	KB03-0B29-9		
17	ECA-STRIGOFF-VE-216	KB03-0B29-5		
2	ECA-STRIGOFF-VE-201	KB04-0A10-2		
IR-LLOPV04: Ghana, Nigeria and Benin				
10	ECA-STRIGOFF-VL-10	KB03-0B32-6		
3	ECA-STRIGOFF-VL-3	KB03-0B31-13		
4	ECA-STRIGOFF-VL-4	KB03-0B31-18		
7	ECA-STRIGOFF-VL-7	KB03-0B32-3		
2	ECA-STRIGOFF-VL-2	KB03-0B31-12		

8. List of participants

IR-maize (STRIGAWAY®) launch, July 5-6, 2005

Imperial Hotel, Kisumu, Kenya

Name	Country	Title/Discipline	Institution	Address	E-mail	Telephone	Cell	Fax
Aberra Deressa	Ethiopia	Deputy Director General	EARO	P.O. Box 2003, Addis Ababa	ddgr@earo.org.et	251-1-460382	251-203871	251-1-461251
Dawit Mitiku	Ethiopia	Researcher	EARO	Pawe – ARI	dawitmitiku@hotmail.com	251-8-202525	–	251-8-202535
Feleke Gezahegn	Ethiopia	Senior Crop Protection Expert	Ethiopian Seed Enterprise	–	ese@telecom.net.et	251-1-612266	–	251-1-613388
Karl-Volker Sthamer	Ethiopia	Trade Representative Office	BASF	Addis Ababa	basf.tro@ethionet.et	251-1–61-25-39	251- 9 - 68 29 90	-
Michael Burnet	Germany	Director	Hi-Cap Formulations	August-Lämmle Str 2; , D-72127 Kusterdingen	Michael.Burnet@gmx.com	49-178-796-7672	–	49 178 796 7672
Peter van den Hoek	Germany	–	BASF	67 M7 Limburgerhof	peter-van-den.hoek@ central-europe.basf.org	–	–	49-621-6028828
Mashark Seidu Abdulai	Ghana	Plant Breeder/ Geneticist	Savanna Agricultural Research Institute	P.O. Box 52, Tamale	msabdula@yaoo.com	233-71-22411	233-20-8235584	233-71-23251
Jonathan Gressel	Israel	Professor Emeritus	Weizmann Inst. of Science	Plant Sciences, Rehovot	jonathan.gressel@weizmann.ac.il	972-8-934-3481	–	972-8-934-4181
Louise Akanvou	Ivory Coast	Maize Breeder/Leader Maize Millet Sorghum Prog.	Centre National de Recherche Agronomique	07 BP 13, Abidjan 07	reneakanvou@yahoo.fr	225-23-472424	225-5-958555	225-23-453302
A.K. Otieno	Kenya	Marketing Manager	Topserve/BASF	P.O. Box 43741 –00100, Nairobi	aotieno@topserve.co.ke	254-20-555928	254-722-528883	254-20-558423
Alpha O. Diallo	Kenya	Team Leader/Breeder	CIMMYT	P.O. Box 1041 –00621, Nairobi	a.o.diallo@cgiar.org	254-20-7224600	–	254-20-7224601
Beatrice Salasya	Kenya	Senior Research Officer	KARI/Kakamega	P.O. Box 169, Kakamega	beatsakwa@yahoo.com	254-56-30031	254-723-582586	254-56-30039
Boly Hamidou	Kenya	–	C/o AATF	P.O. Box 30709 –00100, Nairobi	–	254-20-4223000	–	254-20-4223701
Caleb Wangia	Kenya	EA Regional Director/Managing Director	CNFA & AGMARK	P.O. Box 2326 –40000, Kisumu	cwangia@agmarkkenya.org	254-57-2023151	–	254-57-2020242
Collins Ooko	Kenya	Agronomist	Lagrotech Seed Co.	P.O. Box 1244, Kisumu	conyango76@yahoo.co.uk	254-57-2024182	254-733-435363	254-57-2024182
Craig Neilson	Kenya	Market Dev. Manager East Africa	Pannar Seed K. Ltd.	P.O. Box 10383 –00100, Nairobi	craig.neilson@pannar.co.ke	254-20-820121	254-722-202051	254-20-820161
Daisy Ouya	Kenya	Science Writer/Editor	CIMMYT	P.O. Box 1041-00621, Nairobi	d.ouya@cgiar.org	254-20-7224600	–	254-20-7224601
David Ithigi Kibaara	Kenya	–	BASF	P.O. Box 4691, Kisumu	davidkibaara@yahoo.com	–	254-720-495527	–
David Tyrell	Kenya	Director	Dascot Ltd/BASF	P.O. Box 1262 –00606, Nairobi	Dascot@nbi.ispkenya.com	254-20-891368	254-733-604078	–
Debora McKenzie	Kenya	Farmer	Nyabondo Dairy Farmers Group	P.O. Box 165, Sondu	–	–	254-720-678095	-
Dismas Okello	Kenya	–	SCODP	P.O. Box 5, Sega	infoscodp@yahoo.com	254-57-34253	–	–
Duncan Kirubi	Kenya	Breeder	CIMMYT	P.O. Box 1041 –00621, Nairobi	d.kirubi@cgiar.org	254-20-7224600	–	254-20-7224601
Eusebius J. Mukhwana	Kenya	Executive Director	SACRED Africa	P.O. Box 8771 –00200, Nairobi	sacred@africaonline.co.ke	254-20-2730709	–	–

Name	Country	Title/Discipline	Institution	Address	E-mail	Telephone	Cell	Fax
Francis M. Ndambuki	Kenya	Research Manager	Kenya Seed	P.O. Box 553, Kitale 30200	info@kenyaseed.co.ke	254-54-31909-14	254-733-793415	254-54-30385
Francis Nang'ayo	Kenya	Regulatory Matters Specialist	AATF	P.O. Box 30709 –00100, Nairobi	f.nangayo@aatf-africa.org	254-20-4223745	254-735-992203	254-20-4223701
Fred Kanampiu	Kenya	Coordinator Maize Striga Project	CIMMYT	P.O. Box 1041 –00621, Nairobi	f.kanampiu@cgiar.org	254-20-7224600	254-722-154877	254-20-7224601
George Odhiambo	Kenya	Lecturer	Maseno University	P.O. Box 9399, Kisumu	gdodhis@yahoo.co.uk	–	254-722-653304	–
Gospel Omanya	Kenya	Project Manager/ Seed Systems Specialist	AATF	P.O. Box 30709 –00100, Nairobi	g.omanya@aatf-africa.org	254-20-4223746	254-735-992204	254-20-4223701
Haron Karaya	Kenya	Research Assistant	CIMMYT	P.O. Box 44, Kisumu	karayaharon2002@yahoo.com	–	254-722-578082	254-20-7224601
J. A. W. Ochieng	Kenya	Assistant Director/Plant Breeding	KARI	P.O. Box 57811, Nairobi	–	254-20-4183344	–	254-20-4183294
Jacob Hodeba Mignouna	Kenya	Technical Operations Manager	AATF	P.O. Box 30709 –00100, Nairobi	h.mignouna@aatf-africa.org	254-20-4223736	254-735-992202	254-20-4223701
Jane Ininda	Kenya	Principal Research Officer	KARI/Muguga	P.O. Box 30148, Nairobi	jininda@todays.co.ke	254-66-32884	254-722-732801	254-66-32884
Jennifer Chumo	Kenya	Plant Breeder	Kenya Seed Co. Ltd.	P.O. Box 553, Kitale 30200	j.chumo@kenyaseed.co.ke	254-54-31909-14	254-722-821799	254-54-30385
Joseph Agunda Aloo	Kenya	Field Officer	Care – Nyando	P.O. Box 88, Kisumu	agunda@ksm.care.or.ke	254-59-22622	254-733-256497 254-722-683411	254-59-22517
Joseph Omokamba	Kenya	Sales & Marketing Manager	Kenya Seed Co. Ltd.	P.O. Box 553, Kitale 30200	info@kenyaseed.co.ke	254-54-31909-14	254-722-430335	254-54-30385
MacDonald Wesonga	Kenya	Director	Agricl. Rural Dev. Agric. Programme	P.O. Box 11, Bar Ober, Busia	ardapkenya@access350.co.ke	–	254-735-969378	–
Marianne Banziger	Kenya	Director – Africa Livelihoods Program	CIMMYT	P.O. Box 1041 –00621, Nairobi	m.banziger@cgiar.org	254-20-7224600	–	254-20-7224601
Mark Marika Otieno	Kenya	Camera man	Picasso Productions	P.O. Box 49030 –00100, Nairobi	marika@picasso@co.ke	254-20-253543	254-720-496929	254-20-316795
Moses Onim	Kenya	Managing Director	Lagrotech Seed Co.	P.O. Box 1244, Kisumu	lagrotech@lagrotech.org	254-57-2024182	254-722-739583	254-57-2024182
Mpoko Bokanga	Kenya	Executive Director	AATF	P.O. Box 30709 –00100, Nairobi	m-bokanga@aatf-africa.org	254-20-4223700	254-735-992200	254-20-4223701
Musa Omare	Kenya	–	FORMAT	P.O. Box 79, Village Market, Nairobi	africancrops@wananchi.com	254-20-6752866	254-734-276382	–
Naftali Mungai	Kenya	Science Writer/Editor	Picasso Productions	P.O. Box 49030 –00100, Nairobi	naftali@yahoo.co.uk	254-20-253543	254-721-840141	254-20-316795
Nancy Muchiri	Kenya	Communications & Partnerships Manager	AATF	P.O. Box 30709 –00100, Nairobi	n.muchiri@aatf-africa.org	254-20-4223733	254-735-992206	254-20-4223701
Omari Odongo	Kenya	Centre Director	KARI/Kakamega	P.O. Box 169, Kakamega	omariodongo@yahoo.com	254-56-30031	254-722-652536	254-56-30039
Paul Woomer	Kenya	Research Director	SACRED Africa	P.O. Box 79, Village Market, Nairobi	plwoomer@africaonline.co.ke	254-20-7122337	254-733-972722	–
Peter A. Okora	Kenya	Farmer	Nyabondo Dairy Farmers Group	P.O. Box 165, Sondu	Peterokora@yahoo.com	–	254-734-542951	–
Peter Matlon	Kenya	Country Director	Rockefeller Foundation	P.O. Box 47543, Nairobi	pmatlon@rockfound.org	254-20-228061	–	254-20-218840

Name	Country	Title/Discipline	Institution	Address	E-mail	Telephone	Cell	Fax
Peter Mbogo	Kenya	Research Officer	SeedCo Kenya Office	P.O. Box 616 –00621, Nairobi	mbogop@agriseed.co.ke petermbogo2002@yahoo.com	254-20-532750	254-722-509410	254-20-559877
Peter Werehire	Kenya	Publications & Website Officer	AATF	P.O. Box 30709 –00100, Nairobi	p.werehire@aatf-africa.org	254-20-4223000	254-735-992207	254-20-4223701
Philip Tembu Makheti	Kenya	PDA Western	MoA Kakamega	P.O. Box 27, Kakamega	pdawestern@africaonline.co.ke	254-56-31265	254-733-317873	254-56-31265
Rachael Lambert	Kenya	Rural Livelihoods Adviser	DFID (C/o AATF)	P.O. Box 30465 –00100, Nairobi	r-lambert@dfid.gov.uk	254-20-2717609	254-733-607587	–
Richard Y. Boadi	Kenya	Legal Counsel	AATF	P.O. Box 30709 –00100, Nairobi	r.boadi@aatf-africa.org	254-20-4223735	254-735-992205	254-20-4223701
Romano Kiome	Kenya	Director	KARI	P.O. Box 57811, Nairobi	director@kari.org	254-20-4183291	–	254-20-4183294
Saleem Esmail	Kenya	Chief Executive Officer	Western Seed Co. Ltd.	PO Box 1022, Kitale.	western@swiftkenya.com	254-54-30232	254-722-514236	254-54-31282
Sarah Hearne	Kenya	Plant Molecular Geneticist	IITA	P.O. Box 30709 –00100, Nairobi.	s.hearne@cgiar.org	254-20-4223666	–	254-20-4223001
Sarah V. Injairu	Kenya	Deputy Director of Agriculture	MoA	P.O. Box 30028 –00100, Nairobi	sinjairu@yahoo.com	254-20-2710911	254-722-634382	–
Simeon K. Komen	Kenya	Regional Manager	KEPHIS	P.O. Box 249, Kitale	kephis@africaonline.co.ke	254-54-30908 or 31971	254-722-509842	–
Stephen Mugo	Kenya	Coordinator IRMA	CIMMYT	P.O. Box 1041 –00621, Nairobi	s.mugo@cgiar.org	254-20-7224600	–	254-20-7224601
Tabitha Akinyi Ajwang	Kenya	Provincial Crops Officer – Nyanza	MoA Kisumu	P.O. Box 1700-40100, Kisumu	–	254-57-2024974	254-722-471836	254-57-2024979
Wilfred Mwangi	Kenya	Economist/ Principal Scientist	CIMMYT	P.O. Box 1041 –00621, Nairobi	w.mwangi@cgiar.org	254-20-7224600	–	254-20-7224601
Winfred Okore	Kenya	Researcher	KARI/Kibos	P.O. Box 1490, Kisumu	wikore2000@yahoo.co.uk	254-57-44401	254-733-944897	254-57-44200
Amos Ngwira	Malawi	Agronomist	MoA/Chitedze Res. Station	P.O. Box 158, Lilongwe	amosingwira@yahoo.co.uk	265-1-707222	265-8378167	265-1-707041
Patrick Khonje	Malawi	Maize Team Leader	MoA/Chitedze	P.O. Box 158, Lilongwe	icrisat-malawi@malawi.net	–	265-9-938999	265-1-707298
Vernon Kabambe	Malawi	Senior Lecturer in Agronomy	Univ. of Malawi, Bunda College of Agr.	P.O. Box 219, Lilongwe	vkabambe@hotmail.com	265-1-277222	265-9-343465	265-1-277364
J. Jose Carlos	Mozambique	Maize Breeder	SEMOC Seed Co.	Av. FPLM NO. 1884, Maputo	jcarlos@tvcabo.co.mz	258-1-460044	258-82-3228830	258-1460186
Pedro Silvestre Chaúque	Mozambique	Maize Breeder	IIAM	Avenida das FPLM No. 2698, Caixa Postal 3658, Mavalane, Maputo 8	pchauque@teledata.mz chauquepedro@hotmail.com	258-1-460190	258-82-7267680	258-1-460074
Ubale S. Abdullahi	Nigeria	Lecturer	Ahmadu Bello Univ., Zaria	Dept. of Plant Science, PMB 1044, Zaria	drusa999@yahoo.co.uk	–	080-32846295	–
Tom Argyle	South Africa	Head of Agricultural Products for SSA	BASF	71 La Gratitude Circle	Tom.argyle@bast-s-africa.co.za	–	27-829001637	–
Esron N. Manyiri	Tanzania	Branch Manager	Suba Agro Ltd.	P.O. Box 14703, Arusha		–	255-744-301831	255-27-2548541
Ignath Rwiza	Tanzania	Agricultural Scientist	ARI-Ukiguru	P.O. Box 1433, Mwanza	rwizaih@hotmail.com rwizaih@yahoo.com	–	255-744-574190	255-28-2500676
Emmanuel Mubangizi	Uganda	General Manager	FICA Seeds	P.O. Box 34095, Kampala	fica.project@mail.com	256-41-566631	–	256-41-567159
George Bigirwa	Uganda	National Maize, Research Coordinator	NARO/NAARI	P.O. Box 7084, Kampala	g.bigirwa@naro-ug.org gbigirwa2@yahoo.com	–	256-77-405600	256-41-321070

Name	Country	Title/Discipline	Institution	Address	E-mail	Telephone	Cell	Fax
Justus Imanywoha	Uganda	Plant Breeder	FICA Seeds	P.O. Box 34095, Kampala	fica.project@mail.com	256-41-566631	–	256-41-567159
William Nyakoojo	Uganda	Sales Manager	Victoria Seeds Ltd.	P.O. Box 11913, Plot 69, Kibira Road, Kampala	victoriaseeds@infocom.co.ug jo-seeds@infocom.co.ug	–	–	–
Annette Babita	UK	Programme Officer	DFID (C/o AATF)	1 Palace Street	a-babita@dfid.gov.uk	–	–	–
Jennifer Leavy	UK	–	DFID (C/o AATF)	1 Palace Street	j-leavy@dfid.gov.uk	–	–	–
Mazour Chandler	USA	–	BASF	P.O. Box 13528, North Carolina 27709–3528	mazour@basf-corp.com	–	–	1-919 547-2476
B.M. Verma	Zambia	Research & Production Manager	Zambia Seed Co.	P.O. Box 35441, Lusaka	soverma@zamnet.zm	260-1-248026	260-97-774013	260-1-248028
Mwansa Kabamba	Zambia	Agricultural Officer	Zambia ARI, Golden Valley, Research Trust	P.O. Box 54, Fringilla	kabambamwansa@yahoo.com maize@zamnet.zm	260-213829	260-965959	–
John MacRobert	Zimbabwe	Seed Systems Specialist	CIMMYT	P.O. Box MP 163, Harare	j.macrobert@cgiar.org	263-4-369120	263-91312750	263-4-301807
John Makoni	Zimbabwe	General Manager	Agpy Seeds	P.O. Box 66024, Kopje, Harare	john@agpy.co.zw OR johnmakoni@yahoo.co.uk	–	–	–
Paul G. Rupende	Zimbabwe	Maize Breeder/Programs Manager	SeedCo Ltd., Rattray Arnold Res. Station	P.O. Box CH 142, Chisipite, Harare	nikiweka@seedcogroup.com seedco@seedcogroup.com	263-74-2407	263-91-241291	–
Rosalia Madamba	Zimbabwe	Head, Crop Breeding Institute	Crop Breeding Institute	P.O. Box CY550, Causeway, Harare	Rosaliamadamba@yahoo.com	263-4-704531/9	263-91-237884	263-4-731133

9. Launch program

IR-maize (CLEARFIELD®) launch

5–6 July, 2005

Imperial Hotel, Kisumu Kenya

DAY 1 – **Monday, July 4, 2005**

1800–1900	Registration	*Linda Ackel/Ebby Irungu, CIMMYT*

DAY 2 – **Tuesday, July 5, 2005**

0800–0900	Registration	*Linda Ackel/Ebby Irungu, CIMMYT*

Launch session

Chair: Wilfred Mwangi, CIMMYT Rapporteur: Nancy Muchiri, AATF

0900–0910	Welcome	*Wilfred Mwangi, CIMMYT*
0910–0920	"We wouldn't be here if I spoke Hungarian"	*Jonathan Gressel Weizmann Institute of Science*
0920–0940	STRIGAWAY® technology for *Striga* control	*Fred Kanampiu, CIMMYT*
0940–0950	AATF and their role in the deployment of STRIGAWAY® technology	*Mpoko Bokanga, AATF*
0950–1000	BASF contribution to STRIGAWAY® technology	*Peter van den Hoek, BASF Africa*
1000–1010	Perspective of the way forward	*Marianne Banziger, CIMMYT*
1010–1020	Role of STRIGAWAY® – in food security	*Peter Matlon, Rockefeller Foundation*
1020–1045	Formal launch	*Romano Kiome, KARI*
1045–1115	Coffee/Tea Break/Displays	*Linda Ackel/ Ebby Irungu*

Field visits

Chair: Alpha Diallo, CIMMYT Rapporteur: Gospel Omanya, AATF

1115–1315	Visit 2 farms in Nyahera area	
	Group 1	*Alpha Diallo, CIMMYT*
	Group 2	*Fred Kanampiu, CIMMYT*
1315–1415	Packed lunch at Kibos	*Linda Ackel, CIMMYT*
1415–1430	Welcome	*Washington Kouko, KARI* *George Okwach, KESREF*
1430–1600	Visit demonstration plots Striga elutriation laboratory displays	*Alpha Diallo* *George Odhiambo, KARI* *Fred Kanampiu*

Chair: Mpoko Bokanga, AATF ***Rapporteur: Daisy Ouya, CIMMYT***

1600–1730	Questions and Answers	
1730	Depart to hotel	
1900–2100	Dinner	*Linda Ackel/Ebby Irungu*

DAY 3 – **Wednesday, July 6, 2005**

Chair: Marianne Banziger, CIMMYT ***Rapporteur: Volker Sthamer, BASF***

0830–0845	Stewardship programs	*Chandler Mazour, BASF*
0845–0900	Lessons learned from the AATF Striga management project.	*Paul Woomer, FORMAT*
0900–1100	Introduction: Country specific work plans	*Fred Kanampiu, CIMMYT and Gospel Omanya, AATF*
1100–1115	Coffee/Tea break	*Linda Ackel/Ebby Irungu*
1115–1230	Working groups	
1230–1400	Lunch	*Linda Ackel/Ebby Irungu*
	Group presentations	*Facilitators*
1400–1415	Ghana, Nigeria, Benin and Ivory Coast	*Alpha Diallo, CIMMYT*
1415–1430	Zambia, Zimbabwe, Angola, Mozambique, Malawi and South Africa	*John MacRoberts, CIMMYT*
1430–1445	Uganda, Tanzania and Ethiopia	*Stephen Mugo, CIMMYT*
1445–1515	Kenya	*Marianne Banziger, CIMMYT/Volker Sthamer, BASF/Mpoko Bokanga, AATF*
1515–1615	Wrap-up & close	*Marianne Banziger, CIMMYT*
1615–1645	Coffee/Tea break	*Linda Ackel/Ebby Irungu, CIMMYT*
1645	Departure	

10. Composition of work groups

Group I – Kenya: SeedCo. *(Chair: Alpha Diallo)*

1	Alpha Diallo	Kenya	CIMMYT
2	Craig Neilson	Kenya	Pannar
3	David Tyrell	Kenya	BASF
4	Francis Ndambuki	Kenya	Kenya Seed
5	Moses Onim	Kenya	Lagrotech Seed
6	Richard Boadi	Kenya	AATF
7	Saleem Esmail	Kenya	Western Seed

Group II – Kenya: SeedCo., KARI, NGOs *(Chair: Marianne Banziger)*

1	Argwings Otieno	Kenya	BASF
2	Duncan Kirubi	Kenya	CIMMYT
3	Jane Ininda	Kenya	KARI/Muguga
4	Jennifer Chumo	Kenya	Kenya Seed
5	Joseph Ochieng	Kenya	KARI/Headquarters
6	Marianne Banziger	Kenya	CIMMYT
7	Mpoko Bokanga	Kenya	AATF
8	Musa Omare	Kenya	FORMAT
9	Paul Woomer	Kenya	SACRED

Group III – West Africa *(Chair: Jacob Hodeba Mignouna)*

1	Francis Nang'ayo	Kenya	AATF
2	Jacob Hodeba	Kenya	AATF
3	Karl-volker Sthamer	Ethiopia	BASF
4	Louise Akanvou	Ivory Coast	CNRA
5	Mashark Abdulai	Ghana	SARI
6	Sarah Hearne	Kenya	IITA/BECA

GROUP IV – Southern Africa *(Chair: John MacRobert)*

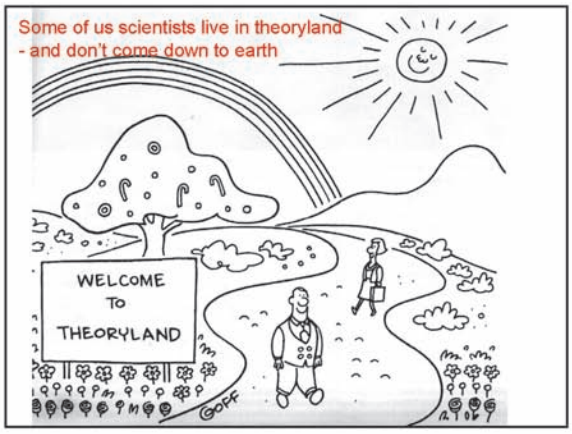
1	Amos Ngwira	Malawi	MoA/Chitedze
2	B.M. Verma	Zambia	Zambia Seed Co.
3	Gospel Omanya	Kenya	AATF
4	John MacRobert	Zimbabwe	CIMMYT
5	John Makoni	Zimbabwe	Agpy Seeds
6	J. Jose Carlos	Mozambique	SEMOC Seed Co.
7	Mwansa Kabamba	Zambia	MoA/Goldern Valley
8	Patrick Khonje	Malawi	MoA/Chitedze
9	Paul G. Rupende	Zimbabwe	SeedCo Head Office
10	Pedro Silvestre Chaúque	Mozambique	IIAM
11	Rosalia Madamba	Zimbabwe	ARE
12	Simba Zengeni	Zimbabwe	Prime Seeds
13	Vernon Kabambe	Malawi	MoA/Chitedze

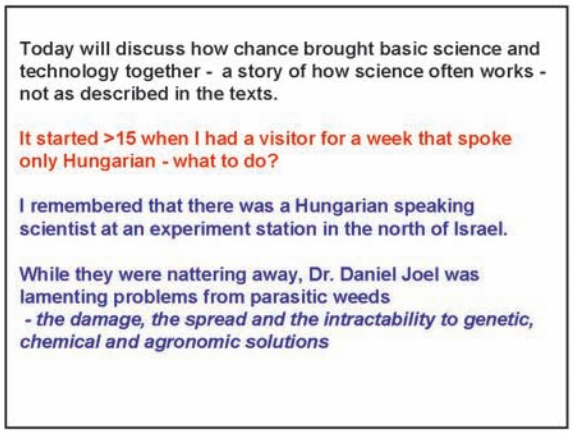
GROUP V: Eastern Africa *(Chair: Stephen Mugo)*

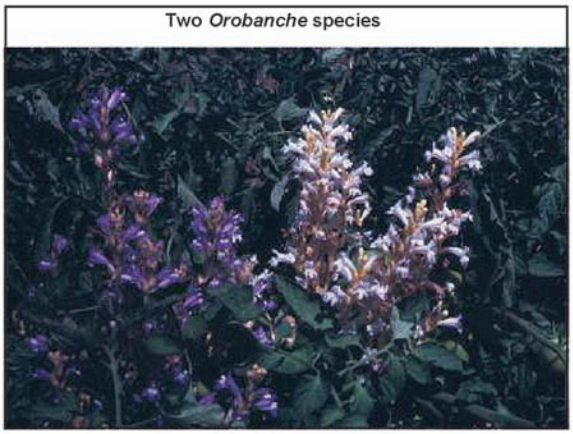
1	Aberra Deressa	Ethiopia	EARO
2	Dawit Mitiku	Ethiopia	EARO – Pawe
3	Emmanuel Mubangizi	Uganda	FICA Seeds
4	Feleke Gezahegn	Ethiopia	ESE
5	George Bigirwa	Uganda	NARO/NAARI
6	Ignath Rwiza	Tanzania	ARI – Ukiguru
7	Justus Imanywoha	Uganda	FICA Seeds
8	Mahenya Muya	Tanzania	SATEC
9	Mazour Chandler	USA	BASF
10	Nancy Muchiri	Kenya	AATF
11	Stephen Mugo	Kenya	CIMMYT
12	William Nyakoojo	Uganda	Victoria Seeds

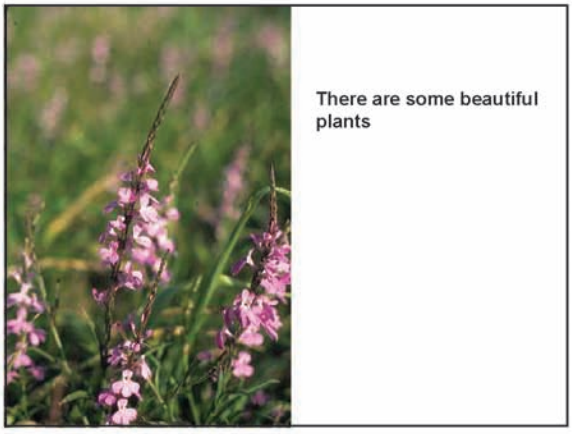
Annex 1: **We would not be here today if I spoke Hungarian**

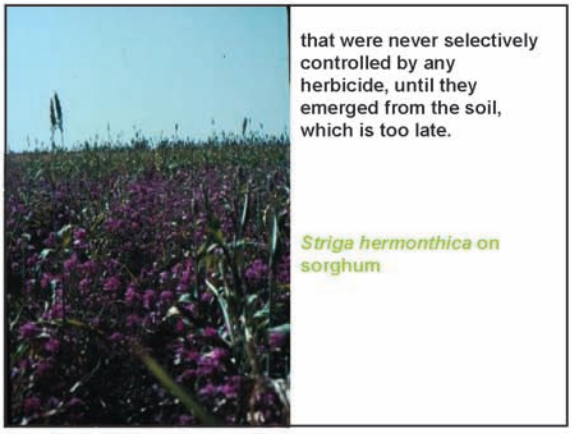
Jonathan Gressel
Department of Plant Sciences
Weizmann Institute of Science
Rehovot, Israel











Striga germinates after being stimulated by crop roots, and then grow stowards the crop roots, attaches, and sucks nutrients from the crop.

Striga also poisons the crop.

Cannot be conventionally controlled before emergence of flower stalk.

Actually, we will discuss

HIV

Which stands for

Highly Invasive Vegetation

Human population displacements facilitate disease epidemics
- war
- labour migration
- land abandonment

HIV=Highly Invasive Vegetation

Causes:
- labour migration
- land abandonment

Striga

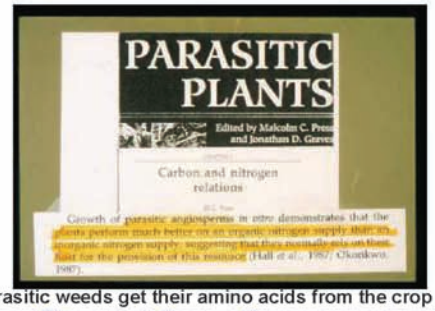
The seeds captured by a puff of wind
  Escaped their primal pod.
Scattering themselves on the soil,
  Then waited, quiescent in dormancy.
Moved to germinate only on that signal,
  Endogenous clocks set in motion;
Seeking, tubelike to their host,
  Clasping, bent on parasitism
Tuned to synthesize only their own,
  Never sharing,
And never waiting, knowing that
  Their host is in a terminal state,

David Sands

A theory was formulated -
– if a crop has target site resistance
– and the herbicide is systemic
The herbicide should move un-metabolized from the leaf, through the stem into the parasite underground

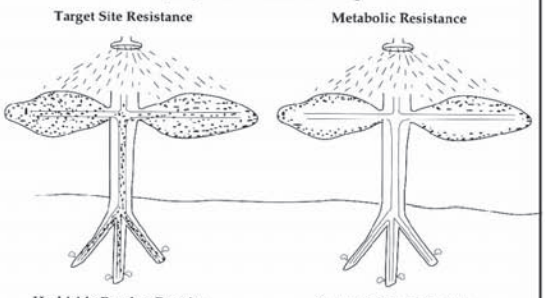
I asked Dr Joel: Do parasites make their own amino acids?
Has anyone proposed such herbicide resistant crops?

The only target site resistances to systemic herbicides were to glyphosate and ALS inhibitors.
Common book knowledge was that



Parasitic weeds get their amino acids from the crop
Wrong! They grow in tissue culture on ammonium as N source

Spray Herbicide on Crop With:



Other requirements to kill parasites:
1. Herbicide must be translocated systemically
2. Herbicide must inhibit a process in the parasite

Two types of crops came to mind - whose development was known 15 years ago:

Transgenic glyphosate, sulfonylurea and asulam resistant vegetable crops appropriate for *Orobanche*

Mutant imidazolinone resistant maize for *Striga*

[Later: transgenic glyphosate resistant maize for *Striga*]

I went on begging expeditions to obtain material to test our hypotheses

It took some convincing to get industry to provide the genetic material for testing

For a long time there was no success -

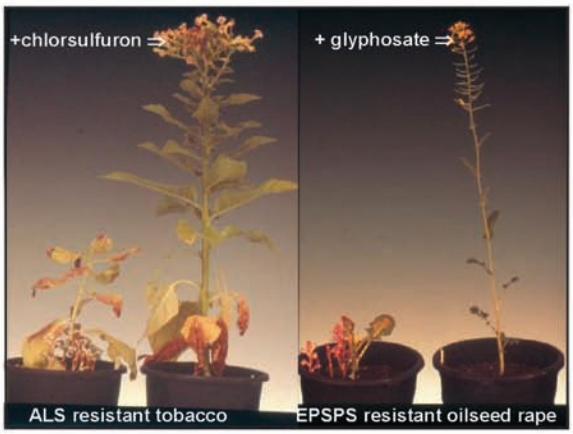
Frustrated: In 1991 described the concept in a meeting -published 1992

Finally, graciously
Monsanto provided glyphosate resistant rapeseed
Dupont provided chlorsulfuron resistant tobacco
Rhone-Poulenc provided asulam resistant tobacco

It took a year to have the seeds pass customs/quarantine

Dr. Daniel Joel tested in greenhouse in 1993

We reported in 1994 and published in 1995 in Nature



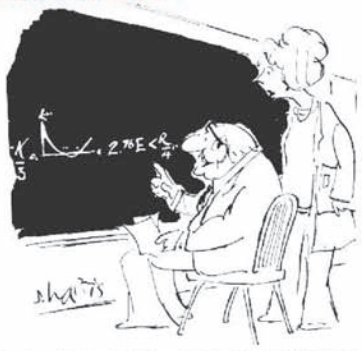
In 1993 IR-maize became commercially available in USA

Dr. Robert Eplee of the USDA *Striga* lab bought some at my behest - planted in *Striga* - infested maize fields, sprayed herbicide

Reported his to me in 1994 in Amsterdam, Dr. Joel Ransom of CIMMYT-Nairobi was at the table

Joel Ransom was excited until he asked a few questions

The way it was used



"The beauty of this is that it is only of theoretical importance, and there is no way it can be of any practical use whatsoever."

Joel Ransom asked:
How could this work for *Striga?*
– farmers can't afford herbicides
– farmers can't afford sprayers

I suggested a new approach:
Treat crop seeds with herbicides instead of fields
The target-site resistant maize would need a very large margin of resistance. Low herbicide conc. per ha, but very high near seed

Eplee quickly got seed to Ransom at end of 1994

Ransom asked Dr. George Odhiambo to plant out
the herbicide was full of detergent so seeds not trt
- drenched on soil above seed - great results

Ransom quickly had me visit in 1995 - planned new experiments, with many herbicides - performed by Gordon Abayo - also seed drench

Gordon reported our first work in 1996, in Cordoba

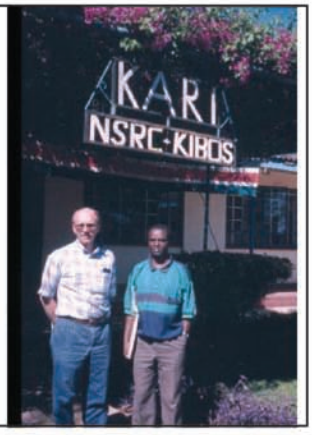
Ransom reported findings to CIMMYT Hq and we applied to Rockefeller for support
Dr. Dana Berner - IITA reported similar work in 1997

Rockefeller supported

Fred Kanampiu was hired

I made crystalline imazapyr for seed priming and dressing

Fred beautifully developed the technologies, and the CIMMYT breeders in Mexico, Zimbabwe, and especially Kenya backcrossed the IR gene into super-elite material, as we will hear and see
All because I do not speak Hungarian



What can we learn from this at the

And ask why it took these wonderful people 15 years

-Zeneca seeds had come up with IT maize in 3 yrs pollen mutagenesis of elite lines

1. ***Most ideas of ivory tower scientists are not doable***
2. ***Lack of interest in African markets - <u>then</u>***
3. ***CIMMYT and donor reluctance to support projects with commercial components - <u>then</u>***
4. ***Lack of infrastructure for rapid product development***
5. ***No manpower dedicated only to the project***
6. ***Perfectionism when emergency release of almost ready material could be done***

Hopefully we have all learned from the experience, and the next products will come out more quickly

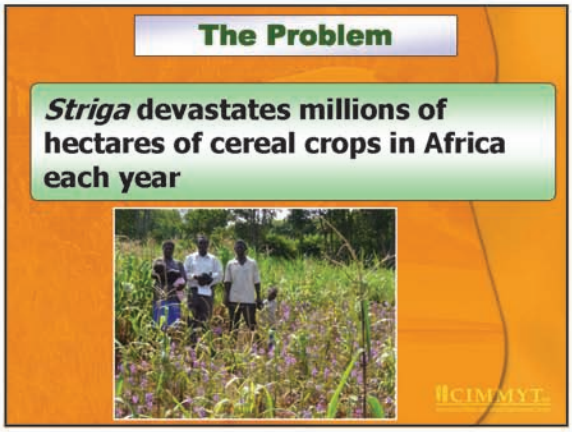
But most important to recognize:

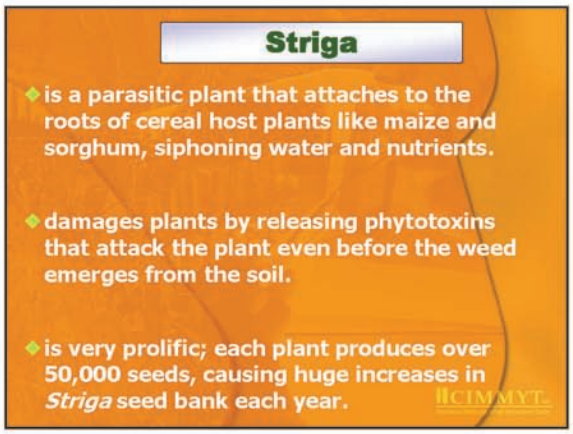
Peter Solymosi
Danny Joel
Joel Ransom
George Odhiambo
Gordon Abayo
Dale Shaner
Fred Kanampiu
Dennis Friesen
Michael Burnet
The breeders
KARI and collaborators
The seed companies
BASF
& especially Rockefeller

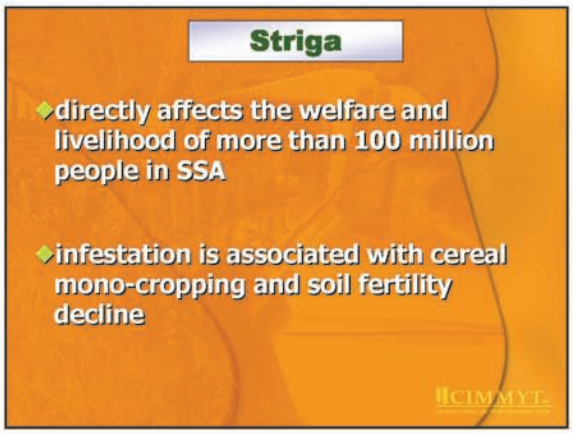
& the Weizmann Institute of Science that let me out of the ivory tower to be a small part of this

Annex 2: IR-maize (Clearfield) technology for *Striga* control

Fred Kanampiu
CIMMYT
Nairobi, Kenya







A Solution to the *Striga* Menace

The IR seed-coat technology uses:

IR-Maize: A natural, non-GMO, imidazolinone herbicide-resistant maize genotype.

Imazapyr:

-A systemic imidazolinone herbicide, kills any *Striga* weeds that attach to the maize plants carrying the herbicide

-The maize crop is unharmed by the herbicide

CIMMYT

A Solution to the *Striga* Menace

- The Technology combines herbicide resistance in maize varieties with low-dose application of a systemic herbicide, for the control of *Striga*
- The dose of herbicide used, 30 g imazapyr per hectare, is 20 times lower than 'normal' rates

CIMMYT

How Does the Technology Work?

- *Striga* is stimulated to germinate by maize roots
- As IR-maize germinates and grows it absorbs some of the herbicide from the seed coat
- When the *Striga* germling attaches to the maize root, it is killed before it can damage the host plant
- Some *Striga* directly is killed in the soil

CIMMYT

How Does the Technology Work?

The technology depletes the *Striga* seed bank by:

- causing suicidal germination of *Striga* seeds; and
- direct action of herbicide on *Striga* seeds

The field is almost *Striga*-free for 3 months after planting

CIMMYT

How Does the Technology Work?

Even better in heavily infested farmers' field

CIMMYT

A Practical Solution with Benefits

IR-maize is an effective technology that is compatible with farmers' cropping systems

Sensitive crops can be safely sown as close as 15 cm from treated maize, allowing the technology to be used in traditional smallholders' intercropping systems.

CIMMYT

Benefits

Clearfield (IR-Maize) Technology

- Effective in *Striga* control
- Increases maize yield several-folds
- Depletes *Striga* seed-bank in soil
- Has the potential to contain the *Striga* problem

CIMMYT

Benefits

Clearfield (IR-Maize) Technology

- Is inexpensive (< $4/ha)
- Compatible with farmers' cropping systems
- Easy to adopt on small-scale farmers in SSA

CIMMYT

Development

CIMMYT IR-germplasm sufficient to cover all *Striga* areas in Africa

Recent bred:

- 60 late maturing OPVs for medium areas
- 22 late maturing OPVs for medium areas
- 10 OPVs for lowlands
- 30 new inbreds

CIMMYT

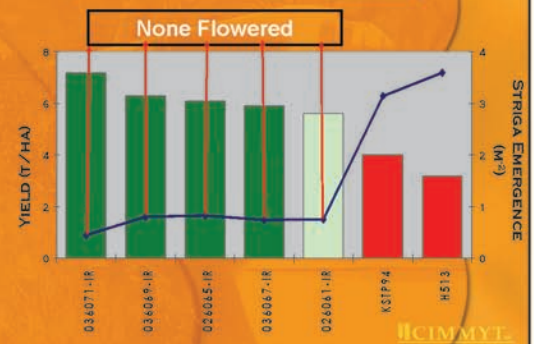
Development

Put in elite material for top yields:

- Maize streak virus resistance
- *Turcicum* resistance
- Drought tolerance
- Low-N tolerance
- Bt?

CIMMYT

Deployment



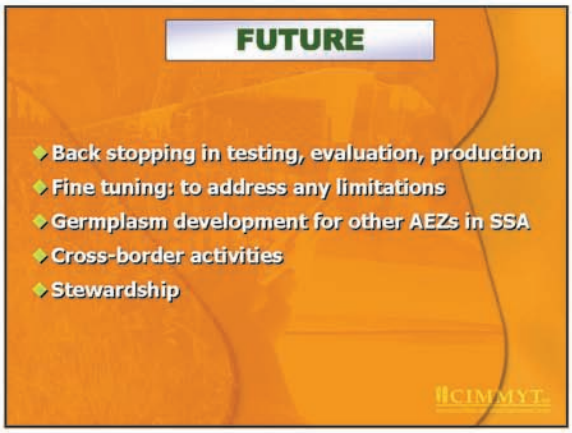
CIMMYT

Deployment

- 2 new hybrids and 13 OPVs in NPT 2005
- 4 Hybrids nominated for Full-Release
- One hybrid being produced by 3 SEEDCOs
- Wide-scale demos by WE-RATE and SEEDCOs

CIMMYT

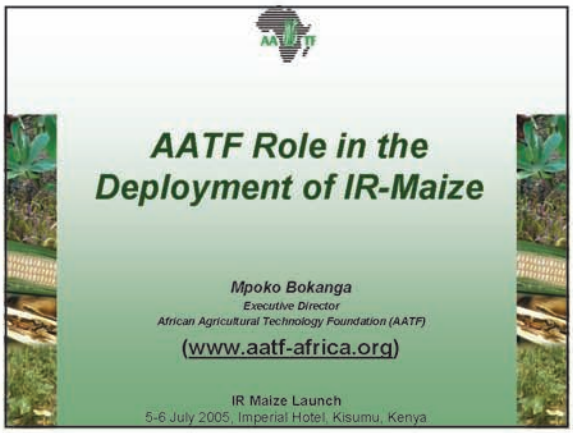

The Partnership
CIMMYT
KARI
Weizmann Institute
BASF
AATF
Seed Companies
NGO's
Farmers
Hi-Cap Formulations
NARS in SSA
CIMMYT

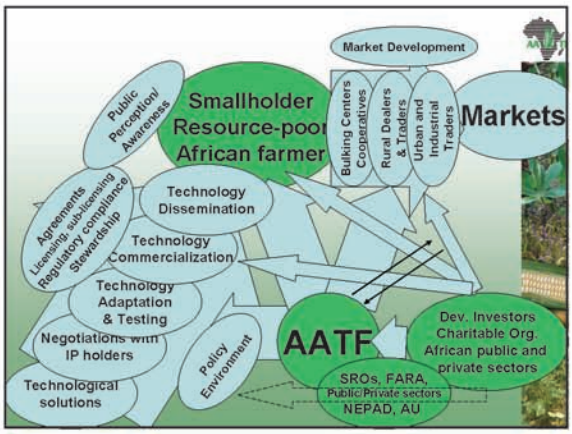

FUTURE
Back stopping in testing, evaluation, production
Fine tuning: to address any limitations
Germplasm development for other AEZs in SSA
Cross-border activities
Stewardship
CIMMYT

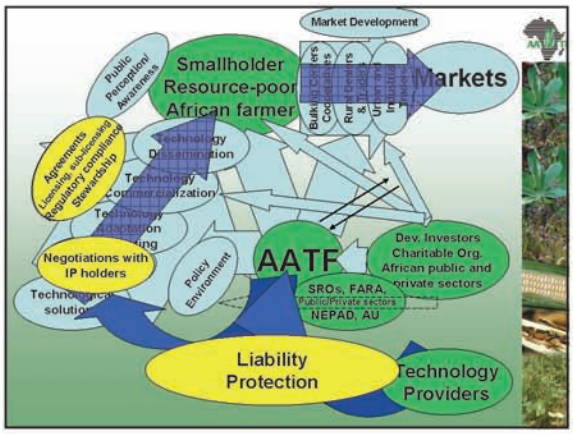

Acknowledgments
Jonny Gressel – Weizmann
Joel Ransom-NDSU
George Odhiambo – MU
Gordon Abayo - KESREF
CIMMYT Breeders
(Diallo, Mugo, Pixley & Jewell)
Dennis Friesen-CIMMYT
Peter Mbogo-SEEDCo
Haron Karaya-CIMMYT
Michael Burnnet-Hi-cap
BASF
Rockefeller Foundation
KARI collaborators
AATF
Seed Companies
NGO's
KEPHIS
KESREF
NARS colleagues in SSA
Farmers
CIMMYT

Annex 3: AATF role in the deployment of IR-maize

Mpoko Bokanga
Executive Director
African Agricultural Technology Foundation
Nairobi, Kenya





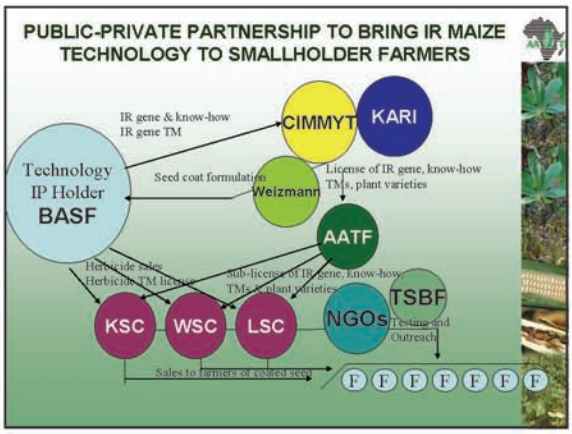


Priority Problem Areas for Project Development by AATF

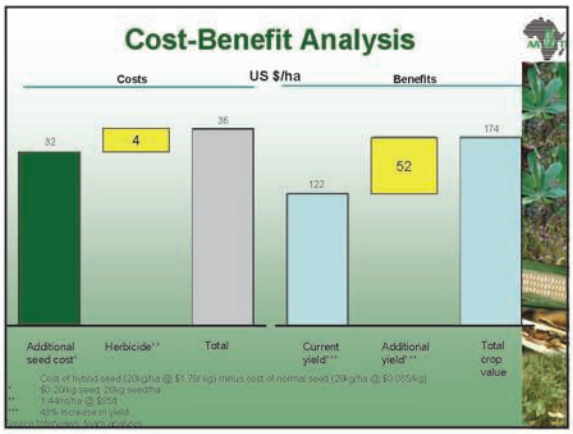
- Striga control in cereals
- Cowpea productivity improvement
- Bananas and plantain productivity
- Nutritional quality enhancement in cereals (maize, rice, sorghum)
- Insect resistance in maize
- *Drought tolerance in cereals*
- *Mycotoxins in food grains*
- *Cassava productivity improvement*
- *Control of locust and grasshoppers with bio-pesticides*
- *Building stronger seed systems in Africa*

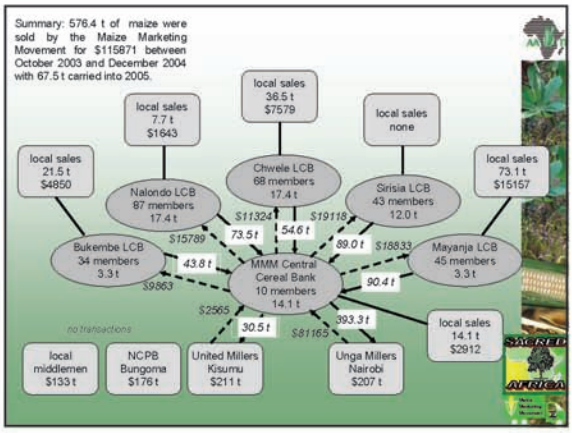
AATF Project Cycle Ladder

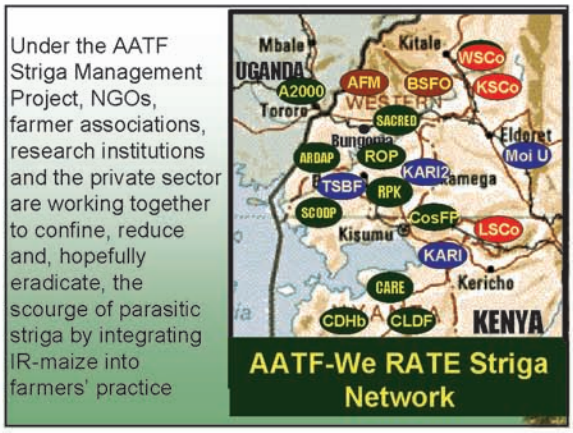
PUBLIC-PRIVATE PARTNERSHIP TO BRING IR MAIZE TECHNOLOGY TO SMALLHOLDER FARMERS



Cost-Benefit Analysis



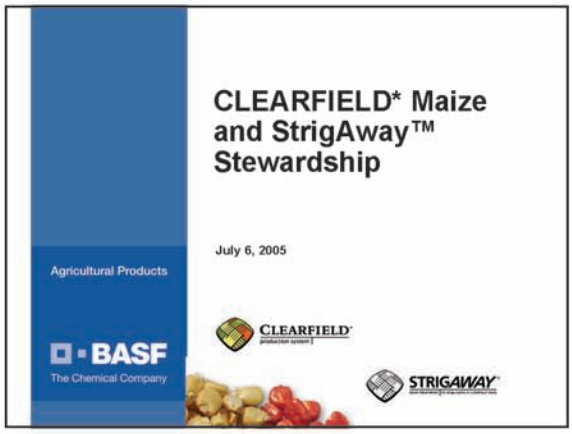

Summary: 576.4 t of maize were sold by the Maize Marketing Movement for $115871 between October 2003 and December 2004 with 67.5 t carried into 2005.
local sales 36.5 t $7579
local sales 7.7 t $1643
local sales none
local sales 21.5 t $4850
local sales 73.1 t $15157
Chwele LCB 68 members 17.4 t
Nalondo LCB 87 members 17.4 t
Sirisia LCB 43 members 12.0 t
Bukembe LCB 34 members 3.3 t
Mayanja LCB 45 members 3.3 t
MMM Central Cereal Bank 10 members 14.1 t
$11324
$19118
$15789
73.5 t
54.6 t
89.0 t
$18833
43.8 t
$9863
90.4 t
$2565
30.5 t
$81165
393.3 t
no transactions
local sales 14.1 t $2912
local middlemen $133 t
NCPB Bungoma $176 t
United Millers Kisumu $211 t
Unga Millers Nairobi $207 t

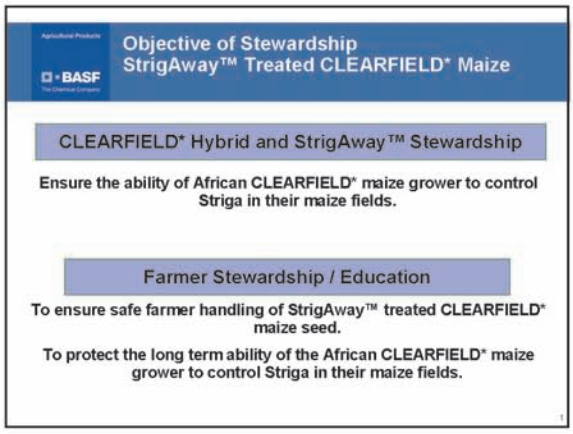

Under the AATF Striga Management Project, NGOs, farmer associations, research institutions and the private sector are working together to confine, reduce and, hopefully eradicate, the scourge of parasitic striga by integrating IR-maize into farmers' practice
Mbale
Kitale
UGANDA
WSCo
AFM
BSFO
KSCo
A2000
Tororo
WESTERN
SACRED
Eldoret
Moi U
ARDAP
ROP
KARI2
TSBF
RPK
SCODP
CosFP
LSCo
Kisumu
KARI
CARE
Kericho
CDHb
CLDF
KENYA
AATF-We RATE Striga Network

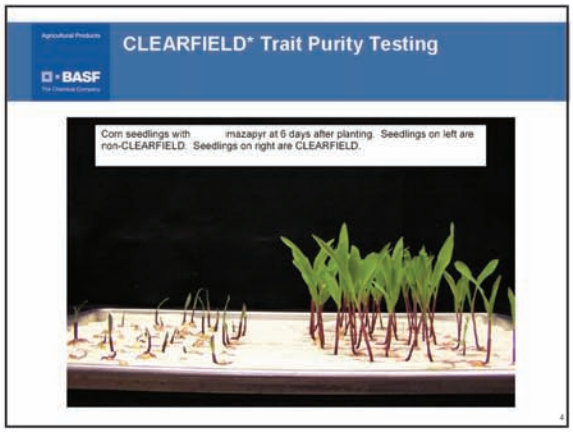

AFRICAN AGRICULTURAL TECHNOLOGY FOUNDATION
FONDATION AFRICAINE POUR LES TECHNOLOGIES AGRICOLES

Annex 4: BASF contribution to IR-maize (Clearfield) technology

Peter van den Hoek
BASF African







CLEARFIELD® Hybrid and StrigAway™ Stewardship

Methods will be in place to deliver a high quality product to the farmer.

Post StrigAway™ Seed Treatment Quality Testing

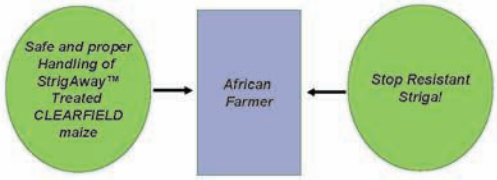
Imazapyr seed treatment (2X) to non-CLEARFIELD (top) and CLEARFIELD (bottom) corn at 6 days after treatment.

7

CLEARFIELD® Hybrid and StrigAway™ Stewardwhip

Methods will be in place to deliver a high quality product to the farmer.

Farmer Stewardship / Education



Educational material will be distributed during farmer stewardship training.

Thank You!

CLEARFIELD® production system

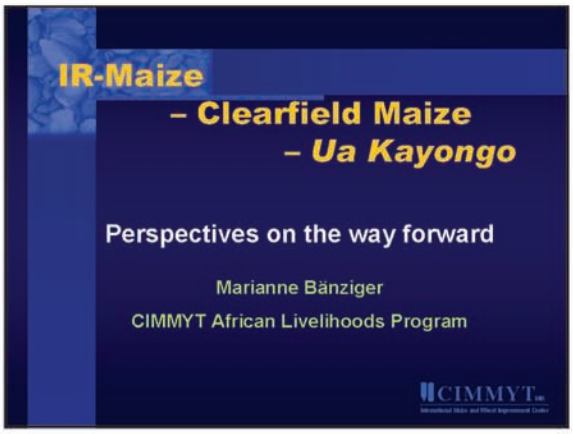
STRIGAWAY®

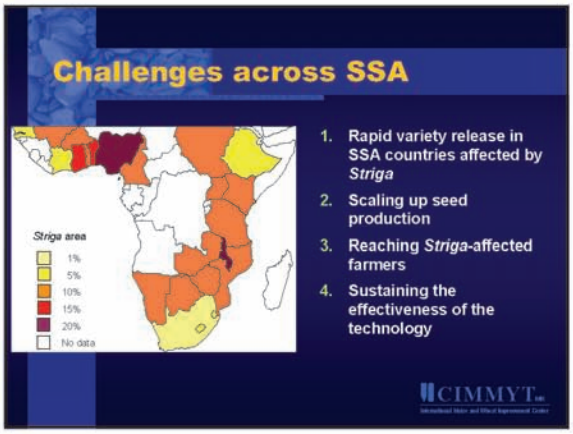
BASF values the opportunity to work with CIMMYT, AATF and Seed Companies to deliver a valuable technology to the African maize grower.

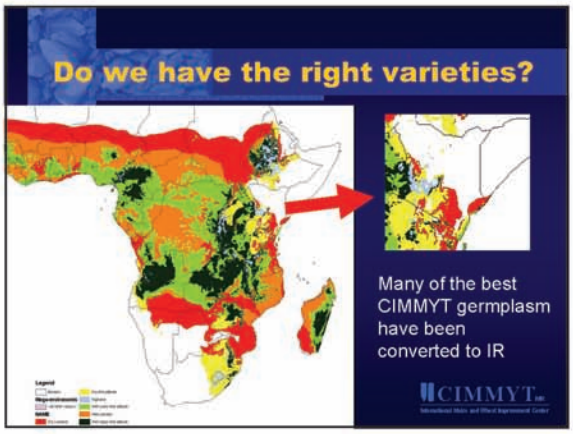
10

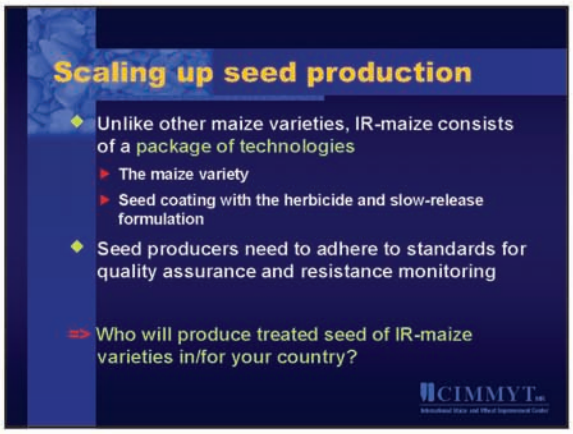
Annex 5: Perspectives on the way forward

Marianne Bänziger
CIMMYT African Livelihoods Program
Nairobi, Kenya









Reaching Striga-affected farmers

- IR-maize will likely open new seed markets
- CIMMYT will assist in defining commercially viable markets and those where other distribution mechanisms may need to be employed for reaching *Striga*-affected farmers

=> Greatest benefits if staff from NARS, NGOs and the private seed sector work together

CIMMYT

Sustaining the effectiveness of the technology

- Quality assurance of the seed treatment
- Prevent the build-up of resistance

=> Training in quality assurance and resistance monitoring to generate wide awareness of suitable methods in the public and private sector

=> Increase the awareness of integrated *Striga* management strategies

CIMMYT

Partnerships are essential

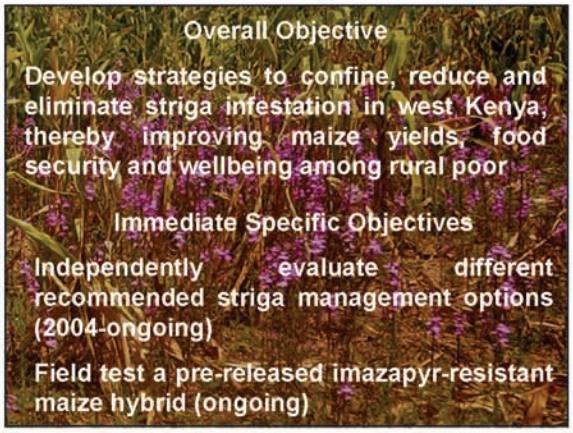
- Complementary skills and strengths between NARS, NGOs, and the private sector
- Need for understanding of various view-points
  - Private sector: entrepreneurial approach makes the delivery of the technology sustainable
  - Public and NGO sector: add to private sector's efforts to ensure that the technology reaches the poor
  - Public sector and IP holders: Responsible and sustainable deployment of the technology
- Need for common and transparent planning

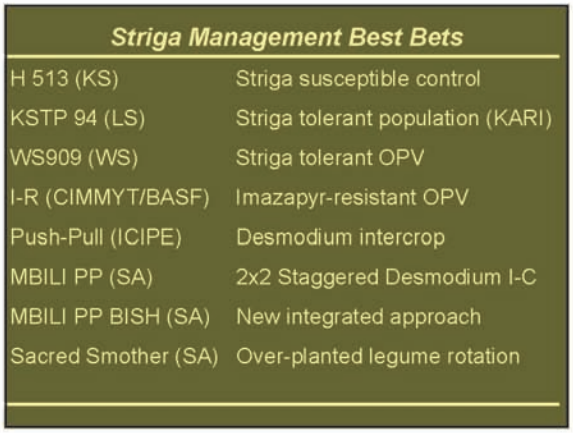
CIMMYT

Ua Kayongo – You can make it a reality in your country

Annex 6: Lessons learned from the AATF Striga management project

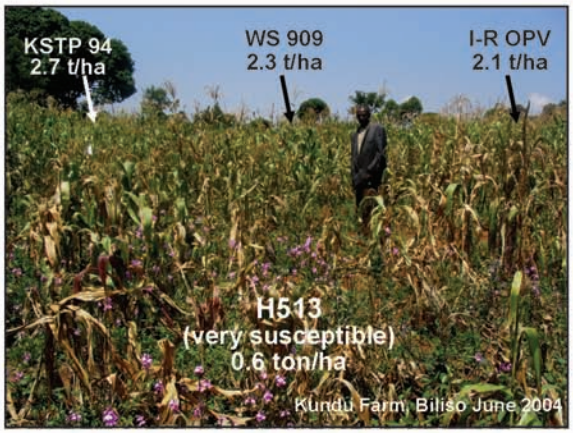
P.L. Woomer, J. Maina, Henry Otieno and Canon Savala
We-RATE

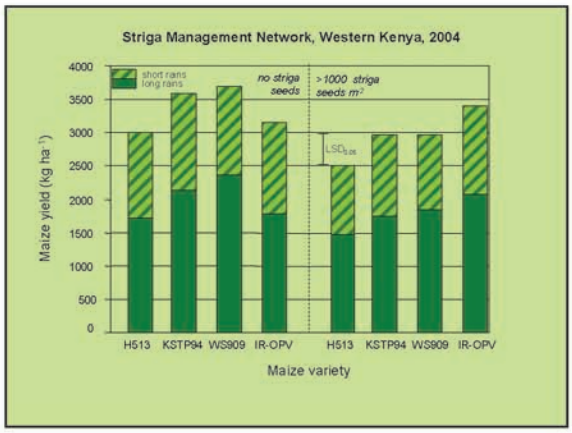


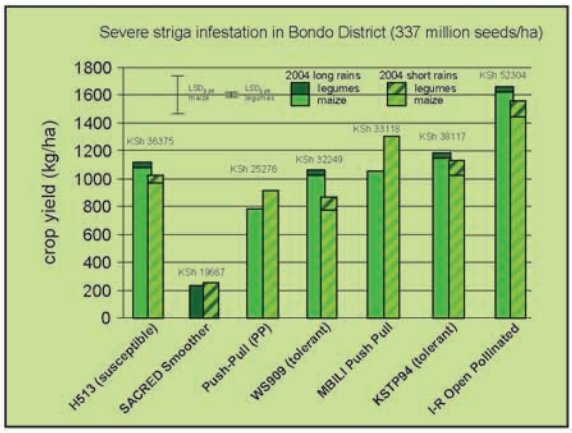


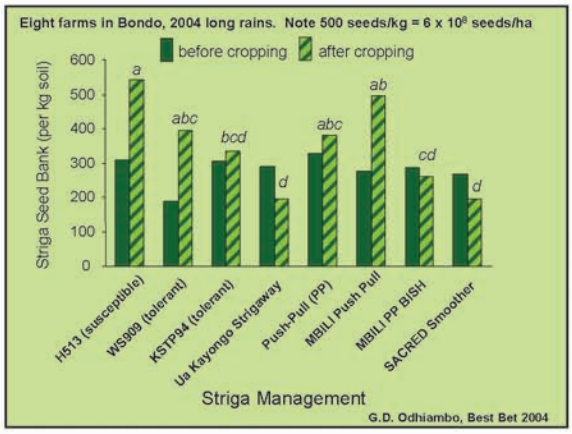
Performance of striga management options over two seasons

practice	average yield		net return
	maize	legume	
	--- kg ha^{-1} ---		KSh
H513	1332	196	8299
WS909	1678	211	13106
KSTP 94	1705	213	13162
I-R OPV	1733	199	14911
Push-Pull	1629	n.a.	5597
MBILI PP	1621	n.a.	6118
MBILI PP BISH	1782	243	15276
SACRED Smother	n.a.	554	9750







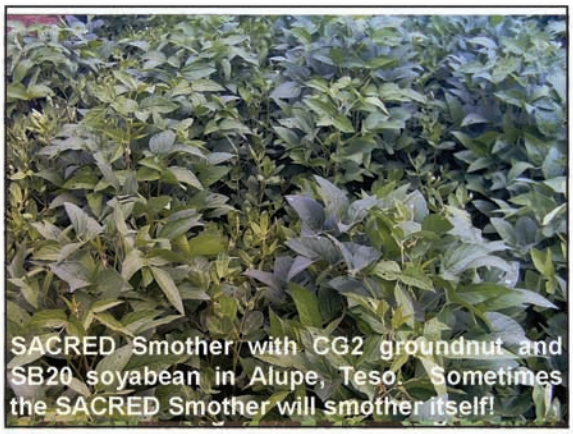


Costs and labor requirements of eight different striga management strategies in Western Kenya (long- and short-rains 2004).

Striga Network: Striga >1000 seeds m-2 Long & Short Rains 2004
Management Costs and Returns Utility

C&R Utility II.xsl
PL Woomer 18/3/2005

management	SEED COST	FERTILIZER COST	LABOR COST	PROCESSING COST	TOTAL COST	GROSS RETURN	NET RETURN	BENEFIT: COST RATIO	MZ COST per BAG (KSh)	LABOR DAYS per ha
				KSh ha-1						
H513 w/bean	9239	5800	14280	2018	31337	47935	16598	1.53	807	78
WS909 w/bean	6989	5800	14280	2364	29433	55644	26211	1.89	634	78
I-R w/bean	9989	5800	14120	2682	32591	62412	29821	1.92	645	76
KSTP94 w/bean	6989	5800	14280	2364	29433	55757	26324	1.89	635	78
Push Pull	9150	5800	13880	1992	30822	42015	11193	1.36	738	73
MBILI PP	9150	5800	13880	2044	30874	43110	12236	1.40	723	73
K94 MPP BISH	8144	5800	14520	2653	31118	61668	30551	1.98	577	81
Sacred Smoother	6400	1600	13400	740	22140	41640	19500	1.88	n.a	67



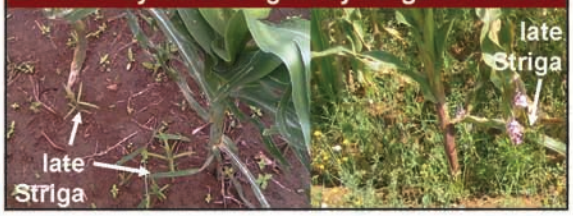
SACRED Smother with CG2 groundnut and SB20 soyabean in Alupe, Teso. Sometimes the SACRED Smother will smother itself!

Why do Ua Kayongo seedlings sometimes become yellow 14 to 21 days after emergence?

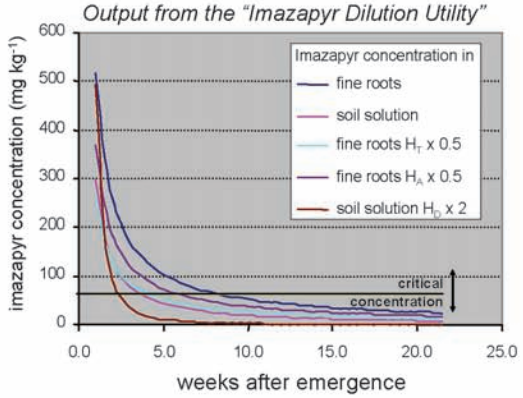
This is the Yellow Flush that results from the initial absorption of *Strigaway*$_{TM}$ signaling that the maize is now defended against *Striga!*

Appearance of *Striga* on treated I-R maize

- ☑ **Insufficient herbicide on seed: H_T**
- ☑ **Rapid dissipation within soil: H_D**
- ☑ **Reduced adsorption by plant: H_A**
- ☑ **Basipodal "dilution" in fine roots: H_B**
- ☑ **Loss by maize or gain by *Striga* of I-R trait**



Output from the "Imazapyr Dilution Utility"



Observations and Suggestions

- 2004 LR was a poor season with early and late drought, an effect that likely reduced maize yield and decreased the difference between *Striga* management options
- Striga seed banks were reduced by I-R and SACRED Smother management options, suggesting that new, integrated management technologies can further reduce, or even eliminate striga in soil
- NGOs and farmers are already adapting and combining some of the striga management options and we should document the impacts of the grassroot efforts
- *Ua Kayongo* is extremely promising in most *Striga*-infested areas with farmers and NGOs eager to purchase seeds for the next season (10 t SR, 40 t LR)