KARI

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Insect Resistant Maize for Africa Project

An Outstanding Partnership

The Project in Brief

The Insect Resistant Maize for Africa (IRMA) Project is a broad-based partnership that examines the use of biotechnology to address one of the most important production problems—losses from stem borers—in one of sub-Saharan Africa's most important food crops: maize. To understand the context and the scope of the IRMA Project, it is important to know some basic facts.

- Insect pests, of which stem borers are the most widely distributed and most damaging, seriously affect a significant proportion of the 96 million hectares of maize in developing countries. In Kenya, stem borers cause 15% losses in maize grain yields, equivalent to US$ 90 million annuallyIn years when the insect problem is particularly bad, or when it is compounded by drought, farmers can lose the entire maize crop. Many farmers cannot afford or do not have the labor to apply the pesticides that kill borers.
- Maize is the dominant food staple in sub-Saharan Africa, accounting for 40% of the calories consumed, with high per capita consumption averaging more than a 100 kg per year in many countries. Rapid population growth will drive the demand for maize in sub-Saharan Africa upward by 3.0–3.5% per annum over the next 20 years. The International Food Policy Research Institute (IFPRI) projects that annual maize demand in sub-Saharan Africa will double by 2020 to reach about 504 million tons. Sub-Saharan Africa imports around 2–3 million tons of maize annually, an amount that probably will rise sharply, especially through food aid. The current famine in southern Africa, which will require an estimated 14 million tons of additional food aid, only emphasizes the acute need to solve food production constraints.
- Maize varieties with genetic resistance to borers would increase productivity, reduce pesticide use and expenses, and require no additional labor from farm families that often have no labor to spare. The development of insect-resistant maize varieties through conventional plant breeding alone is usually extremely time-consuming.
- Bt maize, which produces insecticidal proteins from genes derived from *Bacillus thuringiensis*, a naturally occurring soil bacterium, has been available commercially in the USA since 1996. It has been one of the most rapidly accepted agricultural improvements since the introduction of hybrids.
- Because Bt maize technology is the product of genetic engineering, however, it has proven controversial. Many critics of biotechnology contend that Africa does not need biotechnology to improve agricultural production, not least because African nations cannot develop the necessary infrastructure to use the products of biotechnology.

Goals

The IRMA Project has five general goals.

1. Combine conventional and biotechnology-based strategies (particularly Bt maize) to develop maize varieties resistant to the major stem borer species in Africa, including *Chilo partellus* Swinhoe (Spotted stem borers), *Busseola fusca* Fuller (African stem borers), *Sesamia calamistis* Hampson (pink stem borers), and *Eldana saccharina* Walker (African sugarcane borer). These varieties will initially be developed in Kenya.

2. Establish procedures for disseminating those varieties to resource-poor farmers.
3. Assess the impact of the varieties in smallholders' farming systems.
4. Document and communicate experiences with the technologies so that other countries, particularly in sub-Saharan Africa, can learn from the project.
5. Transfer technologies from Kenya to other interested countries in sub-Saharan Africa through training and infrastructure development.

Partnerships: Defining features

The IRMA Project could not achieve its goals without a broad coalition of partners. In much of the development literature, descriptions of projects that partner public and private organizations, NGOs, farmers, and other important interest groups are common fare. The IRMA partnerships extend far beyond the expected research-extension links to encompass farmers', women's, and church associations, non-governmental organizations, the private sector, various government ministries, maize processors, and consumers. Even so, it is reasonable to ask what differentiates the IRMA Project from similarly structured initiatives.

First, the ambitious use of conventional and biotechnology-based processes to develop insect-resistant maize offers an opportunity for IRMA partners to answer one of the great questions in public agricultural research today: What is the potential for biotechnology to contribute to food security in developing countries, especially in Africa? The combined use of conventional and non-conventional breeding techniques also ensures that farmers have a range of alternative products from which to choose.

Second, the complementary and mutually reinforcing assets of all partners (described later) are needed to solve the stem borer problem. The project is not about developing and promoting a single technology in isolation; it is about developing workable strategies for integrated pest management among smallholders. For this reason, farmers' perspectives are as important to the Project's outcome as the building of a research facility or the resolution of intellectual property issues.

Third, the inclusion of a strong documentation and communications effort ensures that knowledge gained through the project is preserved. Equally important, the documentation and communications effort encourages a more open and balanced public policy debate about the role of biotechnology in improving food production.

Finally, success in Kenya will offer a blueprint for successful partnerships in other developing countries where policy makers are striving to understand the role of biotechnology in solving agricultural problems.

Project activities and innovation: Some examples

It is well known that Bt maize offers farmers an effective, practical option for reducing stem borer damage in maize. It is also well known that the use of this technology generates considerable and often relatively uninformed debate. From the outset, Project partners have acknowledged widely and publicly that the development and routine use of Bt maize requires biosafety, environmental, and community concerns to be addressed. The Project supports considerable research and information gathering to respond to those concerns and achieve the Project's goals. Information sharing among all partners, and with the public, is emphasized through annual stakeholders' meetings that are held much like press conferences to stimulate the open exchange of questions and comments.

Other research activities include the gathering of baseline data for monitoring and evaluating the eventual use of insect-resistant maize in Kenya. Suitable *Bt* genes have been acquired or synthesized, and Bt gene events containing only the gene of interest and no antibiotic or herbicide resistance markers, have been developed by CIMMYT-Mexico. Through bioassays on Bt maize leaves introduced from CIMMYT-Mexico, the *Cry*-proteins with the greatest effectiveness against the major maize stem borers in Kenya were identified. For Bt maize to be used safely and effectively, researchers are studying its prospective impact on target and non-target arthropods by initially characterizing and quantifying the insect species found in resource-poor farmers' fields. Strategies for managing insect resistance are also being developed by assessing the

effectiveness of various plant species used as refugia. Locally adapted maize varieties are identified and developed through conventional breeding, usuing locally adapted and exotic germplasm. Materials that perform well will be used as recipients for the best Bt events, enabling breeders to pyramid genes for resistance and reduce the chance that borers will develop resistance to the Bt genes.

Socioeconomic impact studies are determining which factors influence the adoption of Bt and other improved maize in Kenya—information vital for developing products that farmers want and can use. A relatively unusual feature of this project, compared to others normally undertaken by CGIAR Centers such as CIMMYT, is the special attention given to developing effective ways of communicating about the new technology with farmers. This and other capacity building efforts (the project is currently establishing a biosafety greenhouse facility and quarantine field site in Kenya) are integral to the project.

Research results and capacity building efforts have been reported in Project documents, professional meetings, institutional publications, and peer-reviewed journals (see Annex 1).

The Partners and Their Contributions

The IRMA Project was developed by its three core partners: the Kenya Agricultural Research Institute (KARI) and the International Maize and Wheat Improvement Center (CIMMYT) from the public sector, and the Syngenta Foundation for Sustainable Agriculture, a private foundation. Each partner's contribution is described here.

The Kenya Agricultural Research Institute (KARI)

The KARI works to increase sustainable agricultural production in Kenya by generating appropriate technologies through research and disseminating them to the farming community. KARI has several assets as a Project partner.

- The Institute has an extensive history of productive collaborations with national and international institutes, universities, and the private sector.
- Experience with transgenic sweet potato developed KARI's capacity for, and interest in, evaluating Bt maize.
- Biosafety regulations are in place in Kenya, and that country has a reputation for carefully processing applications for the introduction of genetically modified plant material.
- The testing system comprises more than six regional research centers, as well as biotechnology and entomology laboratories at the National Dryland Farming Research Center and at the KARI Biotechnology Center located in the National Agricultural Research Laboratories.
- An effective research–extension liaison system involves farmer associations and offers great potential for scaling up technologies.
- Locally adapted maize can be used to develop insect-resistant maize.

International Maize and Wheat Improvement Center (CIMMYT)

CIMMYT collaborates with agricultural research institutions worldwide to improve the productivity, profitability, and sustainability of maize and wheat systems for poor farmers in developing countries. CIMMYT also has a number of assets as a Project partner.

- The Center has source lines with several Bt genes effective against a variety of insect pests.
- CIMMYT offers expertise in a range of disciplines, including genetic engineering, entomology, intellectual property rights, biosafety, socioeconomics research, documentation, communications, and project management.
- CIMMYT also has expertise in training scientists in the laboratory, greenhouse, and field aspects of conventional and biotechnology-based maize improvement.

Syngenta Foundation for Sustainable Agriculture

Although the Syngenta Foundation for Sustainable Agriculture is the major funding partner, it contributes much more than just financial resources and is an equal partner in the IRMA Project. Based in Basel, Switzerland, the Syngenta Foundation is dedicated to addressing sustainable security of food supplies in the poorest regions of the world through collaborative research projects and public policy discussions. Aside from providing financial support and sharing some of the development goals of KARI and CIMMYT, the Foundation has several assets as a Project partner.

- The Foundation is an active participant in the debate on development policy, based on a perspective acquired through its research projects.
- The Foundation can provide access to expertise from the private sector for training, fostering a product-oriented research approach, marketing, intellectual property, and other areas relevant to the Project.
- The Foundation also supports documentation of the IRMA Project's development and achievements, so that other countries can learn from the experience.

Other partners

As noted, the three founding partners could never be effective without the involvement of many others. Farmers' perspectives are integral to the development of appropriate research products. An understanding and proper handling of biosafety issues is also essential; IRMA has interacted with the Ministry of Agriculture and Rural Development of Kenya, the National Council of Science and Technology of Kenya, and the Kenya Plant Health Inspectorate Service. Representatives of all of these organizations have participated in stakeholders' meetings.

Seed of improved maize varieties is unlikely to reach farmers without the involvement of private seed companies. The IRMA Project also will work with the private sector to gain rights to use some components of the Bt gene constructs in commercial products. Links to the Kenya Industrial Property Institute have garnered essential information on intellectual property issues.

Because informed public debate is a major component of this project, an extensive communications network is needed. By working with the African Biotechnology Stakeholders' Forum and South Africa's AfricaBio, Project members have raised public awareness about biotechnology, especially in the African context. Additional communication about biotechnology issues with the media has focused greater attention on the role of new technology for food production in Kenya.

The IRMA Project has also strengthened partner institutions through technical instruction, participation in various events, and financial support.

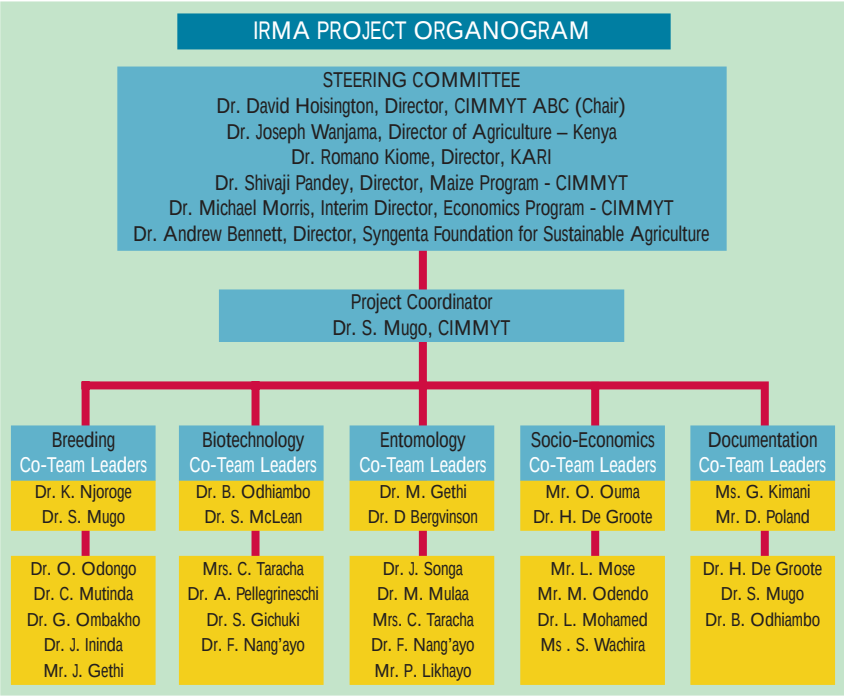
Partner Interactions

How do these multiple partners work together? The IRMA Project has established teams corresponding to the Project's five major objectives: 1) product development, 2) product dissemination, 3) impact, 4) technology transfer, and 5) documentation and communication (see Figure). Each team includes an appropriate mix of entomologists, socioeconomists, molecular biologists, breeders, and communications experts. These teams meet as an entire group at the IRMA Project annual review and planning meetings, where research results are presented and reviewed and work plans are developed. Work plans define specific activities with monthly goals, identify the lead scientist, and propose an annual budget. Work plans are submitted for approval by the Steering Committee, whose members include representatives from KARI, CIMMYT, the Syngenta Foundation for Sustainable Agriculture, and Kenya's Ministry of Agriculture and Rural Development.

The project's achievements are presented to all partners at the annual stakeholders' meeting.

Summary

The IRMA Project responds to a serious need in smallholder farming with exacting science and careful attention to consumer and social concerns, technology transfer, capacity building, communications, intellectual property, and biosafety. This holistic approach to the development and diffusion of insect-resistant maize, particularly Bt maize, is possible only because of the Project's highly inclusive set of partners, whose collaboration is focused not merely on scientific goals but also on social welfare goals. Because the partners are so firmly committed, the research and other components of the project have been strongly established. For all of the partners, an especially motivating aspect of the Project is that success in Kenya is likely to mean success elsewhere in Africa and the developing world.



IRMA project, September 2002

Annex 1

IRMA Project Scientific Reports

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