CIM 0235-R

Insect Resistant Maize for Africa
(IRMA II)
"Delivering Products to Farmers" (2004-2008)

Fifth Stakeholders Meeting
Hilton Hotel, Nairobi, Kenya, 9 December 2004

S. Mugo, S. Gichuki, D. Poland, D. Ouya, H. De Groote,
and M. Mulaa (Editors)

IRMA Project Document No. 19

KARI
syngenta foundation for sustainable agriculture
CIMMYT

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Cover Photo: His Excellency, Hon. Mwai Kibaki, the President of the Republic of Kenya opens the Biosafety Greenhouse complex at KARI Biotechnology Center, NARL on 23 June 2004.

The Kenya Agricultural Research Institute (KARI) **(http://www.kari.org/)** was established in 1979 with the express mission of increasing sustainable agricultural production by generating appropriate technologies through research, and disseminating these to the farming community. Inherent to this mission is the protection, conservation, and improvement of the basic resources, both natural and human. Such resources are critical for Kenya's agricultural development and expansion of the nation's scientific and technological capacity. KARI has an extensive history of productive collaborators with national and international institutes and universities, as well as with the private sector.

The Syngenta Foundation for Sustainable Agriculture provides major funding for the project. The Foundation is dedicated to fostering sustainable development in poor countries of the South through its support of programs and projects in the areas of sustainable agriculture, health, and social development. It is also an active player in development policy debate through its preparation and dissemination of research analysis. Further information about the Foundation may be found at its web site **(http://www.syngentafoundation.com/).**

CIMMYT® **(http://www.cimmyt.org/)** is an internationally funded, not-for-profit organization that conducts research and training related to maize and wheat throughout the developing world. Drawing on strong science and effective partnerships, CIMMYT works to create, share, and use knowledge and technology to increase food security, improve the productivity and profitability of farming systems, and sustain natural resources. Financial support for CIMMYT's work comes from many sources, including the members of the Consultative Group on International Agricultural Research (CGIAR) (http://www.cgiar.org/), national governments, foundations, development banks, and other public and private agencies.

The Insect Resistant Maize for Africa (IRMAII) Project phase II, "Delivering products to Farmers". is the second phase of IRMA Project that was launched as a collaborative effort between CIMMYT and KARI. Its primary goal is to increase maize production and food security for African farmers through the development and deployment of maize that offers resistance to destructive insects, especially stem borers. To achieve this goal, project scientists will identify conventional and novel sources of resistance to stem borers and incorporate them into maize varieties that are both well adapted to Kenya's various agro-ecological zones and well-accepted by its farmers and consumers. Varieties and technologies that are appropriate for other African nations may be extended to them for their use.

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AGROVOC Descriptors Africa; Kenya; Maize; *Zea mays*; Biotechnology; Sustainability; Plant production; Food production; Food security; Production factors; Pests of plants; Plant breeding; Pest resistance; Production increase; Yield increases; Diffusion of research; Technology transfer; Innovation adoption; Project management

Additional Keywords KARI; CIMMYT

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Figure 1. Speakers during the Fifth IRMA Project Stakeholders meeting Hilton Hotel, Nairobi, 9 Dec 2004. From left: S. Gichuki, J. Frei, M. Bokanga, A. Diallo, J. DeVries, and S. Mugo

List of Acronyms

AATF	African Agricultural Technology Foundation
ABSF	African Biotechnology Stakeholders Forum
ALP	African Livelihoods Program
BGH	Biosafety greenhouse
BGHC	Biosafety greenhouse complex
Bt	*Bacillus thuringiensis*
CIMMYT	International Maize and Wheat Improvement Center
DG	Director General
EC	Executive Committee
FAO	Food and Agricultural Organization
GIS	Geographic information system
GM	Genetically modified
GMOs	Genetically modified organisms
IBRS	International Biotechnology Regulatory Services
ICIPE	International Centre for Insect Physiology and Ecology
ICRAF	International Centre for Research on Agroforestry (World Agroforestry Centre)
IP	Intellectual property
IPR	Intellectual property rights
IRMA	Insect Resistant Maize for Africa
KARI	Kenya Agricultural Research Institute
KEPHIS	Kenya Plant Health Inspectorate Services
KIPI	Kenya Industrial Property Institute
KSTCIE	Kenya Standing Committee on Imports and Exports
MOARD	Ministry of Agriculture and Rural Development
NARL	National Agricultural Research Laboratories
NBC	National Biosafety Committee
NCPB	National Cereals and Produce Board
NCST	National Council for Science and Technology
NEMA	National Environment Management Authority
NGOs	Non-governmental organizations
NPTs	National Performance Trials
OPVs	Open pollinated varieties
OQS	Open quarantine site
PR	Public relations
PM	Quality protein maize
RF	Rockefeller Foundation
SFSA	Syngenta Foundation for Sustainable Agriculture
SH	Stakeholders
TAIL PCR	Thermal asymmetric interlaced polymerase chain reaction
USAID	United States Agency for International Development

Executive Summary

The IRMA project is aimed at producing stem borer resistant and locally adapted maize for various Kenyan agro-ecological zones using conventional and biotechnology mediated methods, especially Bt technology. Transgenic maize containing *Bacillus thuringiensis* (Bt) is a focal point of the project, prompting project organizers to emphasize public involvement and awareness through events such as the Stakeholders Meeting.

The IRMA project was publicly launched on March 3, 2000 with the convening of the first Stakeholders' Meeting in Nairobi, Kenya. A stakeholder meeting is held every year leading to this fifth meeting held on 9 December 2004 (Mugo et al. 2001, 2002, 2003, and 2004). The stakeholders have included: farmers' associations, women's groups, religious organizations, seed producers, regulatory agencies, NGOs, the media, consumer associations, food processors, project scientists from KARI, CIMMYT and participating and potentials donors.

The specific objectives of the Stakeholders' Meeting have variously been to:

1. Introduce the IRMA project to stakeholders,
2. Create awareness on the economic importance of stem borers in Kenyan agriculture,
3. Create awareness on the control options for stem borers,
4. Solicit responses from stakeholders on the need and processes of developing insect resistant maize for Kenya
5. Inform the stakeholders on the progress as well as to review the progress,
6. Solicit feedback for the project scientists to direct their way forward
7. Visit the biosafety facilities that IRMA has developed at the KARI Biotechnology Center at NARL including the biosafety greenhouse complex and the biosafety level II laboratory.

In all these meetings, the stakeholders have expressed the need to use sound management strategies and to follow the national regulations strictly during introduction and testing of *Bt* genes in the country. The view shared by nearly all was that we could only evaluate *Bt* genes if they are in the country. Bt maize was viewed as having high chances of closing the wide and increasing food deficit in Kenya. During the more recent stakeholders meetings, participants expressed satisfaction with the progress of the project and suggested greater emphasis on training.

The fifth stakeholders' meeting attracted 93 participants from 34 institutions that were categorized into eight groups (Figure 2). This was almost double the participation in 2003 by institutions as well as total number of participants.

The meeting was held in two parts. First, participants visited the biosafety greenhouse complex at the KARI Biotechnology center at NARL, Kabete. Participants had the opportunity to see not only the completed structure but also the research work on the Bt maize events that were introduced in May 2004. Among the activities in the BGHC were:

1. Evaluate of the efficacy and effects of Bt-genes from the nine events against the target stem borer species;
2. Seed increase of the nine Bt maize events for future experimental studies; and
3. Crossing of Bt maize events with Kenyan germplasm at the initiation of conversion of adapted maize germplasm to Bt maize.

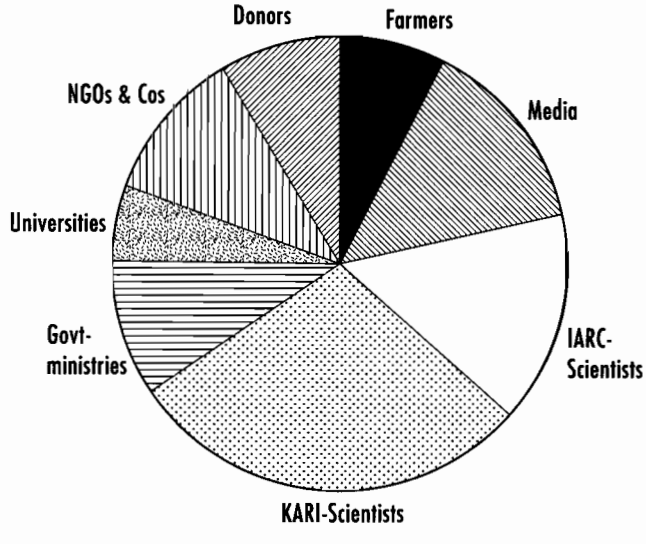

Figure 2. Percent of participants (by categories of institutions) attending the fourth IRMA Stakeholders Meeting at the Hilton Hotel, Nairobi, Kenya, 9 December 2004.

The second part was the meeting held at the Hilton hotel.

Dr. Mpoko Bokanga, the Executive Director, AATF, chaired the meeting. The chairman welcomed the stakeholders and made his remarks, after which participants made self introductions. The chair then called upon Dr. Simon Gichuki to open the meeting on behalf of Dr. Romano Kiome, the Director KARI.

In his address, Dr. Gichuki stresses on the importance of maize to Kenya's food security and thanked the IRMA Partners (CIMMYT, KARI< RF and SFSA) for their efforts in maize improvement. He noted that IRMAI laid a solid foundation on capacity building (training and infrastructure development) as well as developed insect resistant conventional and Bt source germplasm. He looked forward for IRMA II to deliver products to farmers. Dr. Kiome and KARI fully support IRMA Project and Dr. Kiome was to preside over the Project's steering committee set for 10 Dec 2005.

Dr. Stephen Mugo, IRMA coordinator, presented the progress of the IRMA project. Dr. Mugo emphasized that the goal of the project was to increase maize production and food security through the development of insect resistant maize. He noted significant milestones of IRMA:

1. Molecular characterization of the genes and products to better target the pests and ensure compliance with the Kenyan regulatory system.
2. Completion, approval and official opening of the biosafety greenhouse complex by His Excellency, the Honorable Mwai Kibaki, the President of the Republic of Kenya.
3. Introduction of the Bt maize seeds in Kenya, testing of Bt maize plants for activity against Kenya stem borers, and the initiation of backcrossing program into adapted Kenya maize varieties.
4. Nomination, entry and testing of conventional insect resistant maize OPVs in the Kenyan Maize National Performance Trials
5. Advances made in the development of the insect resistance management strategy and the holding of the first stakeholder workshop on Integration of pastures, fodders and cereal crops as refugia for stem borers" at KARI Mtwapa.
6. Baseline and consumer awareness studies as we strive to understand the fit of insect resistant germplasm in the maize framing systems of Kenya.
7. Enhanced training efforts and program that emphasized biosafety and regulatory aspects of our technology.
8. Pursuance of our commitment to communication and documentation through development of print and electronic materials, presentation of seminars, and engagement of stakeholders.
9. Development of a comprehensive IRMA project plan that include a plausible regulatory approach.

Dr. Mugo concluded his presentation by informing the participants that IRMA activities will ensure that the improved maize variety with insect resistance will be put in farmers' hands in the form of seed, which will be adapted to the Kenyan eco-zones and tolerant to other common stresses.

Dr. Alpha Diallo, speaking on behalf of Dr. Masa Iwanaga, DG CIMMYT and Dr. M. Bänziger Director CIMMYT-ALP indicated that hunger kills in Africa and that IRMA is in a serious effort to save lives. He recognized the emphasis placed on stake holder inputs in the project. He noted IRMA achievements in 2004 as: including opening of BGHC by the president of Kenya, introduction, and growing of Bt maize in Kenya, testing of conventional insect resistant maize in Kenya NPTs among others. He challenged the IRMA team to develop products while observing biosafety regulations but looks forward to support and inspiration from stakeholders. He thanked the SFSA and RF for support and KARI for the good collaboration and availing of facilities.

Dr. Jost Frei representing Dr. Andrew Bennett the Executive Director of the Syngenta Foundation for Sustainable Agriculture said emphasized on significant developments in the regulatory and biosafety issues, the development of feasible 2005 workplans and the strengthened management structure, steps that will contribute towards success. He thanked the team for hard work in 2004 and wished success for next year.

Dr. Joe DeVries of the Rockefeller Foundation (RF) mentioned that RF is a new support from mid 2004. He noted that RF has all along appreciated IRMA's choice of public domain effective labor saving technologies that resource poor farmers deserve. Such technologies also offers Kenya scientists to work on

novel technologies. He hoped that the new structure workplan and efforts will being success. He also hoped that the policy environment in Kenya will favor the research on and commercial use of this effective technology.

A lively question and answer session ensued, where participants engaged scientists on relevant issues. Notable is that participants yet again dwelt on the implementation and timing for availability of the products rather than questioning the technology.

Many people contributed to the success of the third stakeholders meeting. We especially appreciated Dr. M. Bokanga for chairing; Dr. Simon Gichuki for the official opening, Dr. Jost Frei for assuring continued support to the IRMA II Project by the Syngenta Foundation for Sustainable Agriculture, Mrs. Catherine Taracha for conducting the participants at the biosafety greenhouse complex, Mrs. Ebby Irungu, Ms. Grace Kimani, and Mrs. Linda Ackel for logistical support. We recognize the input of the CIMMYT and KARI scientists who took part in planning and driving the project. We also wish to thank stakeholders for attending the meeting and offering suggestions on what needs to be done to ensure success.

Figure 3. Mr. J. O. Odondi, PDA Coast Province, Kenya asks a question during the SH meeting.

IRMA Project in Brief

Introduction

The Insect Resistant Maize for Africa (IRMA) project focuses on delivering insect resistance in a form familiar to farmers—the maize seed they plant. During the initial project (1999-2003), IRMA I produced source lines of the key Bt genes *cry1Ab* and *cry1Ba*, which are effective against the target pests *Chilo partellus, C. orichalcocillielus, Sesamia calamistis, and Eldana saccharina*. These are the starting material needed to transfer the genes to the target germplasm in Kenya. The project established the necessary infrastructure and trained staff in Kenya to allow the safe introduction and handling of Bt maize. Germplasm containing good levels of conventional insect resistance were identified and are ready to be moved toward delivery to farmers. Baseline information required for proper targeting of insect resistant maize, development of appropriate insect resistance management of Bt varieties, and ex-ante impact assessments of products is now available. Finally, communication via various forms of media has been established, and educational materials are under development, to enhance the acceptance of Bt varieties by a wide range of stakeholders.

IRMA II (2004-2008) builds on the successes of the IRMA I project, with the goal of providing Kenyan farmers with their first insect resistant maize varieties by 2005. The project design is based on a business model that ensures the products developed are delivered in a timely manner and address the needs of the customer—the Kenyan farmer. The plan employs a two-pronged approach: (1) development and release of conventional insect resistance in adapted Kenyan open pollinated varieties (OPVs) and hybrids, and (2) development and release of Bt-based insect resistant OPVs and hybrids.

To ensure the safe release and stewardship of these products, ten project themes will run concurrently:

1. Bt maize event, development of Bt source line, & human health safety assessment
2. Development of conventional and Bt products and compositional analysis
3. Environmental impact assessment
4. Insect resistance management and contingency plans
5. Biosafety and regulatory issues
6. IPR/Licensing
7. Seed production
8. Market assessment and analysis
9. Economic impact assessment
10. Communication and Promotion

Each theme is interdisciplinary and involves a team of entomologists, biotechnologists, breeders, economists, communications experts, IP counsels, extension officers, policymakers, regulatory officials, and most importantly, Kenyan farmers. The principal output of IRMA II will be the delivery of maize germplasm products containing conventional and Bt-based insect resistance to Kenyan farmers.

Although IRMA II's primary emphasis is on delivering products, it will also provide a number of "firsts" for Kenya: (1) the first Bt maize seed introduction, (2) the first Bt maize field trials; (3) a complete dossier of human health safety assessment, environmental safety assessment data for the *cry1Ab* and *cry1Ba* gene products, (4) an insect resistance management strategy for small scale farmers, (5) extensive experience for Kenyan scientists, officials, stakeholders, and farmers in the development, delivery, and stewardship of Bt-based insect resistant maize varieties. This is in addition to Kenya, through IRMA I, having established the first level 2 biosafety lab and greenhouse in East Africa. A number of milestones were set against which progress will be measured. These are in four broad categories: 1) facilities & permits milestones, 2) breeding milestones: 3) environmental safety assessments milestones, and socio-economic impacts.

The total five-year budget for the project is approximately US$ 6,670,000. While the Syngenta Foundation for Sustainable Agriculture is the principal development partner, the Rockefeller Foundation has supported the variety and seed activities in KARI and CIMMYT. The highlights of IRMAII in 2004 are presented by the ten themes.

Highlights of IRMA Project in 2004

1. Bt maize event analysis, development of Bt source line, and human health safety assessment

- The work on genetic engineering in the laboratory in Mexico proceeded according to the planned schedule and set priorities. Molecular characterization of the events 127 (*cryIBa* driven by the maize ubiquitin promoter) and 216 (*cryIAb* driven by the maize ubiquitin promoter) were finalized.
- Characterization and sequencing of the flanking regions of the inserted transgenic to be able to complete the application for commercial release of these lines has been done. The first attempt was by using TAIL PCR, but only a few flanking regions could be sequenced. However, excellent results were obtained by using the "Genome Walker" strategy. All assays have been done and the data analyzed to prove that no endogenous gene(s) have been interrupted and/or the plants are producing fusion proteins as desired.
- Transformation with Bt *cryIC* gene was done and plants developed. Eleven lines have been developed, and although these plants have shown resistance against *Diatrea* spp., there is no evidence of increased resistance against *Spodoptera frugiperda*.
- A new Bt *cry2A* gene has been obtained and new plantlets (still in vitro) with this gene have been developed. This was a demanding activity as there was need to develop new constructs with the new gene.

2. Development of Bt maize and conventional products and compositional analysis

2.1 Development of Bt source lines

- The transgenic seeds of nine events were sown on 28 May 2004 to (1) evaluate the efficacy and effects of Bt genes against the target stem borer species; (2) production of additional seed for future experiments; and (3) initiate conversion of adapted maize germplasm to Bt maize. These initial experiments in the BGHC will involve growing plants from Bt maize seeds to confirm results obtained from cut leaf bioassays carried out in the biosafety laboratory.
- The Biosafety Level 2 Greenhouse Complex was inaugurated by his Excellency the president of Kenya, Hon. Mwai Kibaki in June 2004 in a ceremony attended by senior Government of Kenya officials, Andrew Bennett and Jost Frei of Syngenta, Masa Iwanaga of CIMMYT, and representatives of agricultural research leaders in SSA, ambassadors from various countries and members of the donor community in Kenya.
- Seed increase through self pollination of insect resistant Bt maize plants from all 9 events has been completed and harvesting was done in late November 2004. Likewise, a number of crosses to initiate conversion of adapted maize inbred lines was initiated, and seeds will be harvested within December 2004.

Figure 4. Biosafety level 2 Greenhouse Complex at KARI Biotechnology Center inaugurated on June 23 2004.

- A study to determine the level of tolerance within stem borer populations collected from different agroecological zones within Kenya was initiated as part of an MSc research project for Regina Tende. The study is entitled: "Screening for Development of Resistance in the African stem borer (*Busseola fusca*) and the spotted stem borer (*Chilo partellus*) to Bt maize delta endo-toxins."
- An application on "Application for field Testing Maize Seeds Containing the Bt Genes *Cry1Ab* and *cry1Ba* for Evaluation, Seed Increase and backcrossing into Other Maize Lines Under Field Confinement in the Open Quarantine Site at Kiboko" has been forwarded to the KARI Biosafety Committee on 15 Dec 2004.
- Mock trials continue to be grown at the open quarantine site (OQS) at Kiboko for training staff and other stakeholders. The set sown in February was harvested. Collection of non-target organisms in the maize crop to form baseline data for monitoring as soon as Bt maize is grown in the OQS continued. We continued after harvesting the mock trial to give us the situation in ma maize free conditions.

2.2 Development of adapted insect resistant maize germplasm

- Development of insect resistant germplasm progressed in 2003. Seed of the 40 inbred lines identified to be insect resistant was increased for use and distribution. A partial diallel involving 20 of these lines was developed as an MSc student project. A full data set was collected over two seasons and the data is being analyzed. However, observations from the first season showed less heterosis than desired. Three sets of complete diallel involving 30 of the insect resistant lines and CMLs were therefore set up and one season's data from evaluation of the diallel crosses is available. These efforts will give us combining ability information that will enhance the utility of the lines in the formation of their hybrids and OPVs.
- Nearly 300 new inbred lines were screened for resistance to *C. partellus* and to *B. fusca*, the most important stem borers in East and Central Africa.
- In addition to the 330 new single cross hybrids tested in the combining ability studies, about 140 single cross and 3-WC hybrids from tester crosses were also evaluated. Double cross hybrids involving insect resistant lines were formed and will be tested 2004.
- Two OPVs developed from insect resistant inbred lines, were advanced to the F2 stage and will be available for testing in 2004. In addition, a set of 6 insect resistant OPVs from Mexico and Kenya have been identified from three seasons of testing of about 36 such OPVs at various locations including farmer evaluations in Kenya. Seed of these are being increased in preparation for nomination to the Kenya maize National Performance Trials (NPTs) in2004.
- Development of maize with resistance to weevil (*Sitophilus zeamais*) and larger grain borer (*Prostephanus truncatus*) was initiated in collaboration with CIMMYT-Mexico and CIMMYT-Zimbabwe, using germplasm identified at the three sites. About 100 inbred lines are available while 150 hybrids were screened for weevil resistance in 2003.
- Development of insect resistant germplasm continued with emphasis on identifying germplasm through screening putative source germplasm from CIMMYT-Mexico, Zimbabwe, and Kenya. Characterizing the germplasm from various CIMMYT stations for resistance to Kenyan stem borers and for general adaptation in Kenya not only adds value to CIMMYT maize germplasm but also allows us to identify good germplasm to receive the *Bt* genes. In 2003, a total of 28 international maize testing trials were grown in Kenya, with 12 of the trials infested with *C. partellus* and 5 with *B. fusca*, the two major Kenyan stem borers. Three of these trials were IPTT for the low land tropics populations 21, 25, and 30 grown at KARI Mtwapa, Kenya.

2.3. Characterization of maize hybrids and varieties for resistance to post harvest pests in Kenya

- Laboratory studies aimed at identifying weevil and larger grain borer resistance in materials harvested from various breeding activities continued though at very much reduced scale due to lack of finance. CIMMYT has focused its research on storage pests and we now have some technologies to deal with maize weevil and LGB, with research efforts at CIMMYT's Mexico, Zimbabwe and Kenya locations. Our understanding of storage pest resistance has increased in the past five years in both the genetics and the biochemical basis for resistance, a factor which is important when considering food safety and grain processing issues.
- A 4-day post-harvest training course was conducted at KARI Kiboko substation, co-sponsored by CIMMYT ALP QPM-D Project. The 22 participants were breeders and entomologists drawn from Burundi, Rwanda, Kenya, Tanzania and Uganda. Hands during practical sessions on screening maize varieties, analysis and interpretation of results were very exciting to participants. One way forward was to establish a network to facilitate information exchange and share technologies that are suitable for African farmers. Decisions were made on how to best to exchange information and technologies between different centers and organizations, and how to disseminate proven post harvest technologies to the government and farmers.

2.4. Compositional analysis

- The generations of backcrossing that were initiated in the greenhouse will form the materials that will be used for compositional analysis.

3. Environmental impact assessment

3.1. Characterization of target and non-target arthropods of *Bt* gene-based resistance in four major maize growing regions in Kenya

- Baseline studies have continued in order to establish the diversity and relative abundance of target and non-target organisms that are associated with the maize cropping system. Field collections having been completed in 2003 at five locations: (Mtwapa, Machakos, Embu, Kakamega, and Kitale), the samples were sorted for identification of family and genus. Digital photos were taken of a representative number of specimens; and entered into a database for easy access by regional offices. A core and reference insect collection was established at KARI-Katumani. Collection data was formatted for use in a Geographical Information Systems (GIS) to facilitate future monitoring efforts once *Bt* maize is introduced. This database will enable targeted monitoring of regions where insect species may be adversely affected by *Bt* maize, and enable efficient and effective monitoring of impacts at an early stage of release.
- Non-target organisms of *Bt* maize were collected in mock trials at the OQS at Kiboko to establish a database similar to the one in the maize cropping systems. This will be important, as this will be the first site for testing *Bt* maize outside of a greenhouse environment in Kenya.

4. Insect resistance management and contingency plans

4.1. Development of appropriate insect resistance management strategies for resource poor farmers in Kenya

- A study to identify suitable alternate hosts which can serve as a refugia for Bt maize in different agro-ecological zones within Kenya continued. These were meant to document the efficacy of different alternative hosts of stem borers and were grown in Kitale, Kakamega, Mtwapa and Embu. Different species were identified at various locations and included sorghums, maize, Pearl millet, Giant setaria, Columbus grass, and Napiers (French Cameroon, Kakamega 2, Pakistan hybrid, Mariakani, Ex-Matuga, Uganda boarder and 16798).
- The first of planned four stakeholder workshops with the theme "Integration of pastures, fodders and cereal crops as refugia for stem borers in the farming systems of the humid coastal Kenya "was conducted at KARI Mtwapa. The workshop attracted 32 participants (12 farmers, 9 extension staff and12 researchers). Participants shared their experiences in growing and utilizing the pastures and fodders During the workshop, the criteria used to select varieties for use as pastures and refugia were developed, previous and on-going research on pastures/fodders, the farming systems of the coast province, major fodders/forages grown by farmers and the type of natural pastures/fodders and grasses were captured.
- A study to estimate and document the area covered by existing alternative hosts of major stem borer species which may be recommended as natural refugia, and map percent refugia at a district level to identify regions where structured refugia was concluded.

4.2. Development of contingency plans

- No activities in 2004.

5. Biosafety and regulatory issues

- Construction of the Level-2 Biosafety Greenhouse Complex was completed and inspected and approved by the Kenya Standing Committee on imports and Exports (KSTCIE) on 6 May 2004.
- A plant Importation Permit Number PH/408/2004, was issued to allow introduction of transgenic maize seed from The International Maize and Wheat Improvement Center (CIMMYT), Mexico to Kenya for testing in the Biosafety Level II Greenhouse Complex. The transgenic maize seed arrived in Kenya on Friday 28th-May 2004. It was inspected and received by KEPHIS inspectors.

- More than 30 KARI and KEPHIS technical staff were trained on Biosafety Greenhouse (BGH) Operations 8-12 march 2004. These included: 1) the BGH core staff comprising of the responsible, technical and support staff including scientists, technicians, cleaners and waterers, and security. 2) staff managing products from the BGH by growing them in the OQS, and 3) the regulatory agents mainly KEPHIS plant inspectors that would be making regular inspections. The major objective was there to develop capacity to run the IRMA II BGH complex effectively, efficiently and in a safe manner.
- A fire and Emergency training was carried out in the BGH on Thursday 25 March 2004.
- In June 2004, Dr. Willy De Greef, a private consultant from Belgium, was invited to give an overview of regulatory issues in transgenic crops before an extraordinary IRMAII steering committee gathering. The presentation became the reference point and starting of detailed regulatory issues in IRMA.
- A team of five scientists from CIMMYT (Allesandro Pellegrineschi and Stephen Mugo), KARI (Margaret Mulaa and Simon Gichuki), and KEPHIS (R. Onamu) attended a two-week course on regulatory issues at Ghent University, Belgium, 9-20 August 2004. The course was entitled "Biosafety Assessment and Regulation of Agricultural Biotechnology". This was to boost the knowledge and skills among scientists as IRMA II Project planned regulatory issues as well as during implementation of the project.
- S. Gichuki, B.O Odhiambo, and S. Mugo participated in a workshop organized by NCST and PBS, and supported by USAID for potential applicants, regulators for GMOs in confined field trials applications 27th-29th October2004. S. Mugo hosted a field visit for participants to Kiboko on Oct 28 2004.
- Two technicians, Mr. Joel Mbithi (KARI Kiboko) and Mr. David Karuri (KARI-Embu), and three scientists, Mr. Geoffrey Murenga, Dr. S. Gichuki, and Dr. Benjamin Odhiambo, all of KARI Biotechnology Center attended a 2-day training at KARI Kakamega. They participated in the February 2004 variously as participants and resource persons in the workshop on management of biosafety screen houses and open quarantine sites for cassava.

6. IPR/licensing

The CIMMYT legal counsel approached University of Ottawa for release from Research only MTA and started a cascade of talks towards this. These involved RF and patent holders.

7. Seed production

A total of 784 kg of seed was produced during 2004A and 2004B seasons including 88 kg of inbred line generations and 696 kg of OPVs and other seed bulks.

8. Market assessment and analysis

9. Economic impact assessment

- The budgetary constraints did not allow to start new studies, so most of the work in 2004 consisted of analysis of the data, write-up, presentations to conferences and workshops, and submission of papers to journals.
- The last part of the baseline data survey, the highlands, was finished, and all data were entered, cleaned and assembled. During a meeting with all collaborating economists, smaller teams were organized to analyze the data according to different topics such as the evolution of adoption of new varieties and fertilizers, biodiversity in maize, economics of pesticide use against stem borers, cost of maize production, and seed systems.
- Data from the consumer survey were analyzed. It was found that awareness of GM crops is already fairly high (38% of consumers). The most important sources of information are the media, especially newspapers, but there is a big difference between socioeconomic groups: television and newspapers are more important for high-income groups, radio more for low-income groups. Most people consumers have a rather positive attitude towards GM food, and most (68%) would buy it at the same price as regular maize. Consumers do, however, express concerns about potentially negative aspects, in particular
- The study on the recycling of hybrids showed that recycling of the most popular hybrid H614 is very common, up to 5 cycles. Moreover, to recycle this variety once turns out to be quite economical: the value of the loss of production turns out to be less than the cost of seed. This does not the case, however, neither for further cycles or for other hybrids.

- The social scientists group presented many papers at conferences and other venues. General presentations on the potential impact of insect resistant maize varieties were given at FAO (Rome), at ICRAF (Nairobi) and at CIMMYT headquarters (Mexico). The presentations, with input from the discussants, were incorporated in a final paper, presented at the American Agricultural Economics Association meetings in Denver. The paper was well received and many copies were requested. A second paper on the distribution of the benefits was presented at that meeting.
- IRMA social scientists were also invited to give presentations at the KARI scientific conference (Nairobi), the Success with presentations at national and international conferences, the Workshop on Biotechnology and Biosafety Workshop (MoA, Nakuru), the Regional Consultation on Genetic Engineering/GMOs for Development in Eastern and Southern Africa (IDRC and IPGRI, Nairobi), and the Inaugural Symposium of the African Association of Agricultural Economics.
- Six papers have been submitted to international journals, and several more are in preparation.

10. Project communication and promotion

10.1. Develop and produce publications that track the project's progress

- KARI and CIMMYT. 2004. *Insect Resistant Maize for Africa: IRMA in 2004 Briefs. KARI/CIMMYT IRMA Project.* IRMA Project Document No. 16. Nairobi, Kenya: KARI and CIMMYT.
- S. Mugo, D. Poland, M. Mulaa, B. Odhimabo, and D. Hoisington (eds.). *Insect Resistant Maize in Africa Project: Fourth Stakeholders Meeting.* IRMA Project Document No. 15. Nairobi, Kenya: KARI and CIMMYT.
- Murenga, G.M., S.M. Mugo, B. Odhiambo, S. McLean, and C. Taracha. 2004. *Manual for Biosafety Level II Greenhouse for Research on Transgenic Plants at KARI Biotechnology Centre.* IRMA Project Document No. 14. Nairobi, Kenya: KARI and CIMMYT.
- Mugo S., M. Gethi, J. Songa, O. Odongo, G. Ombakho, J. Gethi, K. Njoroge, J. Ininda, and D. Bergvinson. 2003. *Development of Locally Adapted Insect Resistant Maize in Kenya Data for 2000-2003. KARI/CIMMYT IRMA Project.* IRMA Project Document No. 13. Nairobi, Kenya: KARI and CIMMYT.
- KARI and CIMMYT. 2004. *Insect Resistant Maize for Africa Phase II (IRMA II- 2004-2008), Delivering Products to Farmers, Project Plan for IRMA II.* IRMA Project Document No. 18. Nairobi, Kenya: KARI and CIMMYT.
- CIMMYT. 2004. Overcoming Biotic Constraints through Breeding, Biotechnology, and Agronomy. In CIMMYT's Work for Maize Systems and Farmers in Sub-Saharan Africa (Center Commissioned External Review (CCER) 14-24 April 2004. Mexico D.F.: CIMMYT. Pp.21-24.

10.2 . Solicit and convey public input to project scientists and managers

- The Fourth Annual IRMA Stakeholders Meeting was held on 19 November 2003 to solicit input from project stakeholders and questions from the media. Stakeholders were also shown the biosafety greenhouse at that time. Although more than 100 people were invited, attendance at KARI-NARL was somewhat dampened due to a matatu strike and related street disturbances.
- The clipping service was maintained during 2004 with Picasso Productions. A review was conducted of clips pertaining to GM crops, Bt maize, and the IRMA during the period November 2003-November 2004. In all, it appears that press coverage (print), including news, feature, editorial page pieces on the GM crop issue remained numerically balanced during the period.

10.3. Produce materials to inform diverse audiences about insect resistant maize technologies

10.3.1. Print, audio, and video materials

- Planned activities in this regard were severely curtailed due to lack of funding.
- A compiled IRMA Updates, Issues 1-4, Volume 5, was produced and distributed in hard copy and via the web.
- Two-page, full spread supplements were prepared by IRMA communicators to accompany the launch of the biosafety greenhouse. These appeared in the two major Nairobi dailies (The Nation and The Standard) as well as in Biosafety News (distributed to media and scientific audiences).
- Press release produced and distributed for biosafety greenhouse opening.
- Video clips obtained of news coverage of the biosafety greenhouse opening. (see media relations below)
- Photos commissioned of the biosafety greenhouse opening for future PR use.
- Press release produced for fifth Annual IRMA Stakeholders Meeting (2004).

10.3.2. Media relations

- Outstanding event was the opening of the biosafety greenhouse in June 2004 by H.E. the President of Kenya, Hon. Mwai Kibaki. The importance of the presidential endorsement of genetic engineering for agricultural advancement cannot be overemphasized. Coverage was extensive in local print, TV, and radio news. In addition, a segment on the greenhouse opening also aired at least three times on CNN World News Report. Much credit must go to Picasso Productions (commissioned by IRMA) for airing of broadcast pieces.
- S. Mugo was interviewed on several occasions for the print news pieces cited in 5.2.

10.3.3 Workshops, seminars, and presentations

- IRMA provided a key hands-on component of a USAID funded workshop for potential applicants, regulators for GMOs in confined field trials applications 27th-29th October 2004. S. Gichuki served as a resource person for the workshop. S. Mugo hosted the field visit to IRMA's open quarantine site (OQS) to show the trainees practical isolation strategies during seed production as these are applicable to transgenic crops. The highlight of the workshop, as noted by participants, was the IRMA OQS.
- S. Mugo attended the "Second Annual Meeting of the Program for Biosafety Systems (PBS) Consortium, IFPRI, September 20-24, 2004, Washington DC." The theme was "Biosafety Capacity Development: An International Review of Policies, Practice, and Environmental Risk Assessment," issues that are relevant to the IRMA Project.
- H.S. De Groote, S. Mugo, D. Bergvinson, G. Owuor and B. Odhiambo presented "Debunking the myths of GM crops for Africa: the case of Bt maize in Kenya," at the Biotechnology and Biosafety Workshop, 28 May 2004, Stem Hotel, Nakuru, Kenya; at the Food and Agriculture Organization (FAO), Rome (February 3, 2004); the Institute for Research on Agroforestry (ICRAF), Nairobi (June 15, 2004); and CIMMYT, Mexico (July 8, 2004).
- H. De Groote H., and S. Mugo presented "Can Bt maize alleviate poverty in Africa? at the Regional Consultation on Genetic Engineering/GMOs for Development in Eastern and Southern Africa", Nairobi Safari Club, 20- 22 September 2004, Nairobi, Kenya.

10.3.4 Papers (journals and conferences)

- Mugo S., C. Taracha, D. Bergvinson, B. Odhiambo, J. Songa, D. Hoisington, S. McLean, I. Ngatia, and M. Gethi 2004. Screening Cry proteins produced by Bt maize leaves for activity against Kenyan maize stem borers. In: Friesen, D.K. and AFE. Palmer (eds.). 2004. Integrated approaches to higher maize productivity in the new millennium: Proceedings of the seventh Eastern and Southern Africa Regional Maize Conference. 5-11 February 2002, Nairobi, Kenya: CIMMYT and KARI. Pp. 102-105.
- S. Mugo, H. DeGroote, J. Songa, M. Mulaa, B. Odhiambo, C. Taracha, D. Bergvinson, D. Hoisington, and M. Gethi. 2004. Advances in developing insect resistant maize varieties for Kenya within the insect resistant maize for Africa (IRMA) Project. 2004.. In: Friesen, D.K. and AFE. Palmer (eds.). 2004. Integrated approaches to higher maize productivity in the new millennium: Proceedings of the seventh Eastern and Southern Africa Regional Maize Conference. 5-11 February 2002, Nairobi, Kenya: CIMMYT and KARI. Pp. 31-37.
- Songa, J.M., D. Bergvinson, S. Mugo, and D. Hoisington. 2004. Characterization and quantification of arthropods in two maize production environments in Kenya. In: Friesen, D.K. and AFE. Palmer (eds.). 2004. Integrated approaches to higher maize productivity in the new millennium: Proceedings of the seventh Eastern and Southern Africa Regional Maize Conference. 5-11 February 2002, Nairobi, Kenya: CIMMYT and KARI. Pp. 38-44.
- Songa, J.M., D. Bergvinson, and S. Mugo. 2004. Mass rearing of the stem borers *Chilo partellus, Busseola fusca, Sesamia calamistis, Chilo orichalcociliellus, and Eldana saccharina at KARI Katumani.* Pp 120-124. In: Friesen, D.K. and AFE. Palmer (eds.). 2004. *Integrated approaches to higher maize productivity in the new millennium: Proceedings of the seventh Eastern and Southern Africa Regional Maize Conference.* 5-11 February 2002, Nairobi, Kenya: CIMMYT and KARI.
- Diallo, A.O., J. Kikafunda. Legese Wolde, O. Odongo, Z. Mduruma, W.S. Chivatsi, D.K. Friesen, S. Mugo, and M. Bänziger. 2004. Drought and low-N tolerant hybrids for the moist mid-altitude ecology of eastern Africa. In: Friesen, D.K. and AFE. Palmer (eds.). 2004. Integrated approaches to higher maize productivity in the new ,millennium: proceedings of the seventh Eastern and Southern Africa Regional Maize Conference. 5-11 February 2002, Nairobi, Kenya: CIMMYT and KARI. Pp 206-212.

- S. Mugo, B. Odhiambo, H. De Groote, and D. Hoisington. 2004. Experiences on Regulatory Issues in the Insect Resistant Maize for Africa (IRMA) Project. Presentation made to the Biosafety Capacity Development: An International Review of Policies, Practice, and Environmental Risk Assessment. Second Annual Meeting of the PBS Consortium, *IFPRI, Sept. 20-24, 2004, Washington D.C.*
- De Groote H., S. Mugo, D. Bergvinson, G. Owuor, and B. Odhiambo. Debunking the myths of GM crops for Africa: the case of Bt maize in Kenya. Paper presented at the American Association of Agricultural Economics Annual Meeting, Denver, Colorado, August 1-4, 2004.
- Kimenju S., H. De Groote, J. Karugia, S. Mbogoh, and D. Poland. 2004. Consumer awareness and attitudes toward GM foods in Kenya. IRMA working paper.
- Owuor G., M. Smale, H. De Groote. 2004. Crop biotechnology for Africa: Who will gain from adopting Bt maize in Kenya? Paper presented at the American Association of Agricultural Economics Annual Meeting, Denver, Colorado, August 1-4, 2004.
- Smale, M. and H. De Groote. 2003. Diagnostic research to enable adoption of transgenic crop varieties by smallholder farmers in Sub-Saharan Africa. *African Journal of Biotechnology* 2 (12): 586-595, (available online at http://www.academicjournals.org/AJB)

10.4. Administration

- CIMMYT adopted the strategic plan that created the African livelihoods Program (ALP). IRMA Project was placed under CIMMYT ALP.
- Dr. Shivaji Pandey was the interim Director CIMMYT-ALP Jan – Nov 2004, and he over saw the development of the IRMA II Project Plan and Agreement.
- Dr. Marianne Banziger became the CIMMYT ALP Director from Nov 2004, and is its oversight Director.
- Dr. Simon Gichuki of KARI Biotechnology Center was appointed the IRMA Project Internal Regulator.
- The IRMA Annual Project Meetings were held on 8-10 Dec 2004, at the Hilton Hotel, Nairobi, Kenya as follows:
  - √ Wednesday 8 Dec 2004 - Review and Planning Meeting by Project teams
  - √ Thursday, 9 Dec 2004 - Stakeholders meeting & visit to BGHC
  - √ Friday, 10 Dec 2004 - Steering Committee meetings & Departures
- IRMA II Project Plan for 2004-2008 was developed through a process that emphasized broad participation and transparency, especially when regulatory issues were being considered. Two major meetings were held after scientists within the KARI and CIMMYT institutions and within disciplines had met and developed skeletal plans. The meetings were in May 2003 and Sept 2004. The May 2003 meeting developed the project plan general, while the Sept 2004 meeting incorporated detailed regulatory plan as well as harmonized the budgets, project structure, themes, and responsibilities.
- A 2-day workshop to develop, plan and incorporate regulatory activities in the IRMA II Project Plan was held 14-15 Sept 2004 in Nairobi, Kenya.
- A lot of attention was given to development of the DRAFT AGREEMENT among SFSA, KARI, and CIMMYT concerning Insect resistant maize for Africa: "Delivering products to farmers" ("Project"). D. Hoisington, S. Pandey and S. Mugo visited SFSA Basel in May 2004, Ms Mette Fogt of SFSA met with Mexico staff in August and with Kenya KARI and CYMMYT staff in Sept. 2004. A lot of correspondence was exchanged during the year. S. Mugo presented IRMA project to the SFSA Board of Trustees on 17 Dec 2004 at Basel. The IRMAII agreement was signed by all three parties between December 2004 and January 2005.

Program of the Fifth IRMA Project Stakeholders Meeting, December 9, 2004

Chair: Dr. Mpoko Bokanga, Executive Director, AATF
Rapporteurs: Dr. M. Mulaa (Entomologist, KARI Kitale) and Mr. Paddy Likhayo (Entomologist, KARI NARL).

Wednesday December 8, 2004:

5:00 pm	Arrival and Registration	*Ebby Irungu*

Thursday December 9, 2004:

Visit to the Biosafety Greenhouse Complex

8:45 a.m.	Departure from Hilton Hotel	*E. Irungu*
9:15 a.m.	Visits to Biosafety Greenhouse complex	*C. Taracha / G. Murenga*
11:00 am	Return to Hilton Hotel	*E. Irungu*

Stakeholders Meeting

11:30 a.m.	Welcome and introductions	Chairman
11:45 a.m.	Opening speech	*S. Gichuki (for Director, KARI)*
12:00 p.m.	IRMA Project: Status and Progress	*S. Mugo*
12:30 p.m.	Remarks by Syngenta Foundation for Sustainable Agriculture	*J. Frei*
12:40 p.m.	Remarks by the Rockefeller Foundation	*J. DeVries*
12:50 p.m.	Remarks by AATF	*M. Bokanga*
1:00 p.m.	Remarks by CIMMYT	*A. Diallo (for Dr. M. Banziger)*
1:10 p.m.	Question and answers	*Chairman*
2:00 pm.	Vote of thanks	*J. Danson*
2:10 pm.	Lunch and departures	*E. Irungu*

Visit to the KARI Biotechnology Centre and Biosafety Greenhouse

—Dr. Simon Gichuki and Catherine Taracha

The Stakeholder Tour

The tour to Biotechnology Centre and Biosafety Greenhouse at KARI-NARL started at 9.30 AM, guided by Dr. Simon Gichuki and Ms. Catherine Taracha. Dr. Gichuki welcomed the stakeholders to the centre and requested that participants introduce themselves. He introduced Dr. Stephen Mugo as the IRMA Project Coordinator. Dr. Mugo welcomed the participants to the KARI facility and field site and said he, like them, was also a visitor, but was also a collaborator in the IRMA project. Dr. Gichuki informed the participants that the Biotechnology Centre's main building used to be an office block housing KARI Headquarters, but sections of the building are now being converted into labs and he requested Ms. Taracha to guide the tour to the biosafety greenhouse.

- Ms. Taracha told the participants that the facility was built with funding from the Syngenta Foundation for Sustainable Agriculture, who are also partners in the project, which involves KARI, CIMMYT, and other partners.
- The purpose of the greenhouse is to keep Bt maize under containment according to Kenyan biosafety regulations. It is currently used to increase Bt maize seed and make crosses and also to screen for effective *Bt* genes against stem borer species in Kenya.
- Ms. Taracha said maize stem borer causes average yield loss of about 15%, equivalent to US$90 million.

Chemical control currently used by farmers is expensive and also has other associated environmental effects. She explained the benefits of using Bt maize, how Bt works and the process of introducing Bt genes into the maize embryo through bombardment using gene gun. She also told participants the regulatory process includes applications for import permits for leaf tissue and seed involving other institutions such as NSC and KEPHIS before they are allowed into the country. She explained the methodologies of testing and identifying effective *Bt* genes against different stem borer species. The project has identified potentially effective genes against the Kenyan stem borers and the genes are now in the CIMMYT maize line (CML 216) and have been crossed into the adopted Kenyan maize in the biosafety greenhouse.

Ms. Taracha explained the main features of the biosafety green house to the stakeholders as follows:-

- The main entry is through the Biotechnology Centre main building.
- The main door is coded thereby limiting entry only to authorized personnel.
- The greenhouse has a double door with a fine pollen screen of 50 micron mesh, therefore no pollen or insect is able to enter or escape.
- There is an emergency door that can be used only during emergencies.
- There are bins for storing soil and coolers to regulate temperatures, the soil used is sterilized using an electric soil sterilizer at 200°C, it steams the soil for 2-3 hours, and makes the maize stalks and other materials biologically inactive, then the stalks are burned.
- The seed is securely locked, one has to pass through three locks, thereby minimizing the chances of seed escaping the greenhouse.
- All staff working in the biosafety greenhouse are trained in its operations and management, including security staff.

Ms. Taracha showed the participants the transgenic maize inside the greenhouse and said it looked like the normal conventionally bred maize, but it has to be grown in the biosafety greenhouse to conform to biosafety regulatory requirements.

Questions/Answer Session on Tour of the Biosafety Greenhouse

Question by Mr. Naftali Mungai, Science editor, Nation Newspaper
Looking at the maize plants in the greenhouse, there seem to be reduced vigor in the transgenic plants and they also look shorter compared to the normal maize.

Response by Ms. Catherine Taracha, Scientist, KARI NARL
They happen to be short, but this is an affect of either the growing environment or their stage of development, not because they are transgenic.

Question by Mr. Naftali Mungai, Science editor, National Newspaper
Not all clothing used inside the greenhouse are removed. Are you sure the pollen won't be moved out of the greenhouse?

Response by Ms. Taracha
The overalls give protection and the hands are washed before leaving the greenhouse.

Question by Naftali Mungai
What about the trousers?

Response by Ms. Taracha
You will have to lift your legs up high for that to happen (i.e., to have pollen on the trouser).

Dr. Gichuki gave a brief of other areas of studies being conducted by the IRMA project, such as insect resistance management strategies, consumer acceptability, and screening for resistance to storage pests. All these studies are geared to making sure that the maize produced is accepted by the farmers and consumers. The project also collaborates with other projects, e.g., currently there are scientists searching for local *Bt* genes that could control larger grain borers; two MSc and one PhD students are involved under supervision of IRMA scientists. Dr. Gichuki also explained the functions of the open quarantine area, which is near the biosafety greenhouse. He said the open quarantine is used for field testing transgenic materials, and currently transgenic disease resistant sweet potato germplasm is being tested at NARL, with similar open quarantine sites at Kiboko, Kakamega, and Embu. The open quarantine sites have similar features that include; secure fence, no animals allowed, and 24 hour surveillance.

Question by Naftali Mungai
Are you sure insects will not develop resistance to the Bt maize you are developing?

Response by Regina Tende, MSc student, IRMA
It has been found and reported that resistance has developed to some insecticides, including those with Bt, but we are conducting studies to find out whether Kenyan stem borers can develop resistance to the *Bt* genes in transgenic maize.

Response by Dr. Margaret Mulaa, Entomologist, KARI Kitale
In addition to what Regina is studying, we are also trying to develop insect resistance management strategies suitable for Kenya, for example, 20% refugia in the form of untreated maize is recommended in the USA.

Question by Naftali Mungai
The 20% refugia as un-treated maize you are talking about is suitable for the USA, but the farming systems in the developed countries like the USA are different from those in Africa, e.g., they have large farms and practice monoculture while in Kenya most farms are small and intercropped.

Response by Dr. Mulaa
The IRMA project has conducted surveys to understand the current farming systems and also map the percentage of refugia in the maize growing districts. Most districts have enough refugia (20% or more) but some areas have less than 20%. Field and lab trials have been conducted to identify suitable refugia for the different farming systems, a stakeholder workshop was conducted in the coastal region and farmers were involved in ranking refugia. Similar workshops will be conducted in other maize growing zones to make sure the most suitable and economically viable refugia are used.

Question by farmer
Does Bt control the larger grain borer (LGB)?

Response by Dr. David Bergvinson
Cry 1 currently used for stem borers controls targets of Lepidoptera not Coleopteran insects to which LGB belongs. Storage pests are beetles affected by Cry 3. However screening for resistance to storage pests is one of IRMA's activities following the stakeholders' recommendation. We want the end product to be tolerant to storage pests.

Comment by Dr. Gichuki
Dr. Josephine Songa working within the KARI Biotechnology Centre is starting from scratch to screen for local Bt isolates. She is looking for *Bt* genes that can control LGB. She is supervising two MSc students and one is already registered for a PhD.

Question by Mr. Ndambuki, Breeder, Kenya Seed
CIMMYT/BASF is having another parallel line for herbicide resistance using same inbred lines. Can those genes be put together with Bt genes?

Response by Dr. Bergvinson
It is possible but the problem is the regulatory process, you have to submit a dossier for each gene. If the two are put together, then the regulatory process becomes more complicated.

Question by Mr. Kenneth Kambona, Syngenta East Africa
How long does/will the biosafety trials in the greenhouse take and when shall we be certified with the whole process before the seed is available for farmers?

Response by Dr. Gichuki
We are expecting the first Bt maize variety by year 2008. Between 2005 and 2006, the insect resistance maize developed by conventional breeding will be available for farmers while the transgenic maize will be available between 2008 and 2012 depending on the regulatory mechanisms.

Question by farmer
How will the farmer know that he is planting maize seed with Bt or if the maize in the field has no Bt?

Response by Dr. Bergvinson
There are ways of selecting for Bt maize. It is a dominant trait, you can select plants that have damage if you don't want seed with Bt or non-damaged plants if you planted seed with Bt and you want to keep that trait. If you don't want seed with Bt you can use other methods for stem borer control such as push and pull or chemicals.

Comment by Dr. S. Gichuki
We now know that Bt is used in other countries such as the USA and South Africa. You can use experiences from elsewhere, e.g., if you select Bt maize in the centre of the plot then you will select seed without Bt, in case neighbors are growing Bt maize.

Comment by Regina Tende
Using the word contamination in reference to Bt is misleading because the whole world is dealing with food safety and Bt has been proved to be safe. Bt itself is from the soil and can be found everywhere.

Official Opening Speech

Dr. Simon Gichuki,
Head, KARI Biotechnology Centre
KARI-NARL

As Dr. Romano Kiome, Director, KARI, was not able to attend the IRMA Stakeholders' meeting, Dr Simon Gichuki, Head, KARI Biotechnology Centre chaired the welcome and introductions session, and made the opening remarks on behalf of the KARI Director.

In the welcome and introductions session, Dr Gichuki indicated that the IRMA project, a partnership of KARI, CIMMYT, the Syngenta Foundation for Sustainable Development, and the Rockefeller Foundation had many stakeholders, including farmers, the business community, technology transfer organizations such as AATF and ABSF, and the media. The participants were thereafter invited to introduce themselves to the meeting, each stating their name and affiliation.

In the opening remarks, Dr. Gichuki reminded the audience that in Kenya, maize is synonymous with food, and a maize shortage usually spells famine, as was experienced in many parts of the country during 2004.

Dr. Gichuki recognized IRMA as an interdisciplinary project whose primary objective is maize improvement. He noted that the first phase of the project—IRMA I—had laid down the framework to achieving the goal of stem borer-resistant maize. In that phase, basic lines (plant varieties) were developed and various facilities built. These included an open quarantine testing site at KARI-Kiboko, a biosafety level 2 laboratory at KARI Biotechnology Centre, and the highlight was the June 2004 opening of the biosafety greenhouse complex at KARI Biotechnology Center by His Excellency, President Mwai Kibaki. In addition, during phase-I, implementing personnel were trained on regulatory mechanisms and the handling of genetically modified organisms (GMOs). This training also included some regulators and policymakers. IRMA-I also made major achievements raising awareness on usefulness of the genetic engineering technology and addressing major public concerns about GMOs.

The speaker underlined the importance of Phase II of IRMA, saying that this phase would "get the technology to the farmers." He was gratified by the commitment and support of all the stakeholders, to the humanitarian goal of reducing food insecurity in Kenya.

Dr Gichuki concluded the welcoming speech by indicating that Dr. Kiome, Director, KARI fully supported the IRMA project, and would be attending the Steering Committee Meeting the following day (10 December 2004) as its Chairman.

IRMA Project by 2004: Status and Progress

Dr. Stephen Mugo (CIMMYT)
(and Dr. Benjamin Odhiambo, KARI), Coordinators IRMA Project

Dr. Romano Kiome, Director, KARI,
Dr. Ephraim Mukisira, Deputy Director, KARI
Dr. Jost Frei, Syngenta Foundation for Sustainable Agriculture,
Dr. Mpoko Bokanga, Executive Director, African Agric. Tech. Foundation (AATF)
Dr. Alpha Diallo, Team Leader, CIMMYT Africa Livelihood Program, Kenya
Farmers,
Distinguished IRMA stakeholders, my colleagues, KARI and CIMMYT scientists,

Good morning ladies and gentlemen and welcome.

It is my pleasure to welcome you to the fifth Stakeholders Meeting and to present the status and progress of the Insect Resistant Maize for Africa (IRMA) project as of 2004. We started this journey together to increase maize production in Kenya through the development and deployment of insect resistant maize varieties for Kenyan farmers – a goal that we come closer to achieving with each passing year, as you well see in today's presentation.

Challenges in food production in Kenya

In Kenya, when we talk of feeding the nation, we are talking about maize. Maize remains the most important cereal and food crop in terms of area under production, per capita consumption, and contribution to on-farm employment. Like years past, Kenya had to import maize in 2004 due to poor rainfall. There are essentially two ways we scientists can address address this challenge: create varieties that provide higher yields, and create varieties that reduce yield losses to various factors. Stem borers reduce maize yields by 13.5% in Kenya. This equals about 400,000 tons of maize annually, about the same amount Kenya imports on average. In other words, stem borer resistant maize holds the potential to close the gap between the country's demand and supply of maize. Taking it one step further, around US$ 72 million, could be going to Kenyan farmers rather than to purchase imported maize. As you can see, controlling this small insect pest has very big implications.

The IRMA project focuses on using plant resistance to provide control solutions within the seed itself, one of the most efficient ways to bring enhanced productivity directly to the field. Costs are kept low, environmental and health impacts are negligible, and generally there is no need for extensive training required for farmers to use this technology. We strongly believe that given all the advantages of the host plant resistance approach, it offers farmers and the nation the best option for dealing with the problem of stem borers.

There are basically two sources of resistance to insects for maize. We can look amongst the many maize plants grown in the world, and we can look for resistance in other organisms. The IRMA project is pursuing both courses. In the former case, we have tested large numbers of maize genotypes for insect resistance from KARI and CIMMYT. While screening those plants, we also looked for tolerance to stresses such as drought and low-nitrogen, to destructive plant diseases, and to storage pests including weevils and the larger grain borer, often called "Osama" in Kenya. Of course, the maize must also be well adapted to Kenyan growing conditions. We have produced good hybrid and open pollinated varieties that show superior yields and insect resistance when compared with existing varieties. However, we are still not satisfied and so we continue to pursue other control measures.

The most promising alternative is using insect resistance produced by a soil dwelling bacteria, *Bacillus thuringiensis*, or Bt. Organic farmers have used Bt sprays for years because it is natural and safe. Biotechnology, specifically genetic engineering, allows us to take and modify genes from the bacterium to function in crops. The *Bt* genes work against certain groups of pests, but are harmless to most other insects and to animals and humans. This technology has seen rapid adoption in industrial and developing countries.

Why biotechnology?

Some still ask why IRMA needs to use biotechnology to meet its goals. First, as already mentioned, we use it to take advantage of the benefits of the host plant resistance approach, which carries the technology in the seed itself.

Second, progress in solving pest problems using conventional breeding has been very slow. *Bt* maize, as proven elsewhere in the world, clearly produces more effective control.

Third, most African countries, including Kenya, simply do not have the luxury of following the timeworn footsteps of industrialized countries in developing our agriculture. African agriculture needs to leapfrog to new approaches and new technologies to meet our needs.

In conducting our activities over the years, the IRMA project has abided by several key guiding principles: the project should (1) be a model of good practice, especially its biosafety aspects, from which other countries can learn; (2) serve as a pilot project for public-private partnership and cooperation; (3) employ state of the art technology and methodology; and (4) be transparent and open through ongoing dialogue with various stakeholders. IRMA has adhered closely to these principles, and today, you the stakeholders are helping us keep our pledge on the fourth point, and we thank you for that. The project is also unique in many ways: (1) the use of only publicly produced *Bt* genes, (2) production of plants that are free of the antibiotic and herbicide markers typically used in the genetic engineering process, (3) collection of baseline data on insect ecologies in the five major Kenyan maize agro-ecosystems, (4) development of strategies to keep the insects from becoming resistant to the Bt maize thereby extending its effectiveness, (5) an emphasis on communication and education, and (6) an exceptional capacity building component.

Strides made in 2004

Two-thousand and four has been a year of mixed fortunes for the project. Despite lack of funds for most activities, excellent progress and accomplishments were made in some activities. The highlights of the year were

- Molecular characterization of the genes and products to better target the pests and ensure compliance with the Kenyan regulatory system.
- Completion, approval, and official opening of the biosafety greenhouse complex by His Excellency, the Hon. Mwai Kibaki, President of the Republic of Kenya.
- Introduction of Bt maize seeds to Kenya, testing of Bt maize plants for activity against Kenya stem borers, and the initiation of a backcrossing program into adapted Kenya maize varieties.
- Nomination, entry, and testing of conventional insect resistant maize OPVs in the Kenyan Maize National Performance Trials.
- Advances in the development of the insect resistance management strategy and the holding of the first stakeholder workshop on "Integration of pastures, fodders, and cereal crops as refugia for stem borers" at KARI Mtwapa.

- Baseline and consumer awareness studies to help us better understand the fit of insect resistant germplasm in Kenya's maize farming systems.
- Enhanced training efforts focused on biosafety and relevant regulatory aspects of the technology.
- Pursuance of our commitment to communication through print and electronic materials, presentation of seminars, and engagement of stakeholders.
- Development of a comprehensive project plan, with a feasible regulatory approach.

The rest of my address to you will be on these advances.

1. Molecular characterization of Bt maize

We have continued the search for more effective products and technology that comply with the Kenyan regulatory system. To this end, molecular characterization of the events 127 (*cryIBa* driven by the maize ubiquitin promoter) and event 216 (*cryIAb* driven by the maize ubiquitin promoter) were finalized. New transformation with the Bt *cry IC* gene was done, generating eleven lines for testing, which provided stem borer control but no control for armyworm. A new Bt, *Cry 2A,* was plantlets carrying the gene were produced. This was a demanding activity as there was need to develop new constructs with the new gene.

2. Completion, approval, and official opening of the Level-2 Biosafety Greenhouse Complex

You have just visited this important facility that is not only critical for IRMA's research agenda, but will undoubtedly serve KARI for years to come. The facility is the first of its kind in East Africa and will take Kenya to the forefront of such scientific work here.

Following our guidelines based on good practice, we interacted closely with Kenya's regulatory systems to develop the Biosafety Greenhouse. An initial inspection in July 2003 by the Kenya Standing Technical Committee on Imports and Exports (KSTCIE) and the Kenya National Biosafety Committee (NBC), identified modifications that were required to meet the regulators stringent biosafety standards. I would like to take this opportunity to thank the committee members for their attentive recommendations, which contributed to maintaining the high standards we have set for the project. A subsequent inspection on 6 May 2004 enabled the approval of the greenhouse for growing GM crops.

The biosafety greenhouse complements other infrastructure provided by the project that includes a biosafety level II laboratory, and an open quarantine field site. Taken together, these facilities enable us to evaluate Bt maize for efficacy against stem borers, and the subsequent development of durable resistance to stem borers in improved maize germplasm.

The BGHC provides the internationally required containment for genetically modified material during the experimental stage. It will be used to (1) evaluate the efficacy of *Bt* genes against targeted stem borers and other insects; and (2) to produce additional seed for future experimental studies. Significant efforts have been applied to building KARI's human resource capacity to operate and maintain the facility.

The Level-2 Biosafety Greenhouse Complex was inaugurated by his Excellency the president of Kenya, Hon. Mwai Kibaki in June 2004 in a ceremony attended by senior Government of Kenya officials, Andrew Bennett and Jost Frei of Syngenta Foundation, Masa Iwanaga of CIMMYT, and representatives of African agricultural research, ambassadors from various countries, and members of the donor community. As you can see from the literature we've distributed, the president indicated that expanding area under cultivation is not a viable option for increasing food production. Thus, the need for technologies, such as biotechnology, that can improve yield, reduce poverty, and ensure greater food security for our people. The president acknowledged that GM technology is accompanied by controversy, and reiterated Kenya's stand on applying biotechnology in line with existing biosafety frameworks, national statutes, and international obligations. He added that the new greenhouse represents a great contribution towards the development of high tech research in support of agriculture.

3. Introduction, testing and initiation of backcrossing program from Bt maize seeds in Kenya

In mid-September, the Kenya National Biosafety Committee approved an application to "Introduce Maize Seeds Containing the *Bt* Genes *cry1Ab* and *cry1Ba* for Evaluation, Seed Increase and Crossing into Other Maize Lines under Biosafety Greenhouse Containment." Following approval of the BGHC, a Plant Importation Permit was issued to allow introduction of transgenic maize seed from the International

Maize and Wheat Improvement Center (CIMMYT), Mexico to Kenya for testing in the Biosafety Greenhouse Complex. The transgenic maize seed from nine events arrived in Kenya on Friday 28th May 2004 and were sown on the same day to: (1) evaluate the efficacy and effects of Bt genes against the target stem borer species; (2) production of additional seed for future experimental studies; and (3) initiate conversion of adapted maize germplasm to Bt maize.

As you have seen this morning, seed increase through self pollination of insect resistant Bt maize plants from all 9 events was completed in late November. Likewise, a number of crosses to initiate conversion of adapted maize inbred lines were initiated and seeds will be harvested later this month. Other studies that will enable better targeting of the technology in Kenya are going on in the facility. These include the study to determine the level of tolerance within stem borer populations collected from different agroecological zones of the country. This information will help us to establish the relative rate of resistance development that will be integrated into our Insect Resistance Management strategy.
An "Application for Field Testing Maize Seeds Containing the Bt Genes *Cry1Ab* and *cry1Ba* for Evaluation, Seed Increase and backcrossing into Other Maize Lines Under Field Confinement in the Open Quarantine Site at Kiboko" has been forwarded to the KARI Biosafety Committee for consideration on 15 Dec. 2004.

4. Nomination, entry, and testing of conventional insect resistant maize OPVs in the Kenyan Maize National Performance Trials (NPTs).

The first insect resistant maize cultivars developed from the efforts in the IRMA Project were nominated and accepted for testing in the Kenya maize national variety testing, during this years maize NPT meeting held at Kenya Plant Health Inspectorate Service (KEPHIS) Regional Center in February 2004. The objective of the NPTs is to test all maize varieties from different breeding institutions in common trials at various sites in the particular agro-ecology to identify the best for the region in order to protect the farmers. Nine varieties were nominated for testing in three agro-ecologies, Early maturity represented by Kartuani, the medium maturity represented by Embu and the mid-late maturity represented by Kakamega. The varieties were nominated by Mr. Wilson Muasya, Dr. Charles Mutinda, and Dr. Omari Odongo at KARI Katumani, Embu , and Kakamega, respectively. A serious effort is being made to enter nominations into the humid coastal lowlands NPT next year as well as hybrids for various NPTs.

The insect resistant maize varieties have special features. The breeders, therefore, requested and were granted permission to conduct NPT trials using artificial infestation with the major stem borer species. These trials will be used to ensure resistance is adequate and yields stable under stem borer attack. The KARI and CIMMYT maize breeders worked very closely with KEPHIS to have these trials a success. This included training KEPHIS scientists and technicians involved in NPT to conduct successful insect resistant testing trails. We consider this as one more way to build capacity in Kenyan institutions.

We hope that these varieties will perform well to enable pre-release next year thereby allowing farmers to benefit from our efforts and the insect resistant germplasm.

5. Advances made in the development of the insect resistance management strategy and the first consultative workshop on IRM refugia strategy

The year 2004 saw the completion of farmer surveys to identify suitable alternate hosts and the area they cover, which can serve as a refugia for Bt maize in different Kenyan agro-ecological zones. A return to the coastal zone brought the survey tally to 850 farmers interviewed. Maps of these refugia for the long and short rains were developed to better target where extension efforts should be focused to ensure proper resistance management techniques are used. Farmers were keen to grow insect resistant varieties as they often asked us when these maize varieties would reach them.

The first of a series of planned stakeholder workshops was conducted at KARI Mtwapa in July 2004. The theme was "Integration of pastures, fodders and cereal crops as refugia for stem borers in the farming systems of humid coastal Kenya." The objectives of the workshop were to:

a. Create awareness on the development of insect resistant maize through conventional and Bt gene-based resistance in Kenya,
b. Sensitize researchers, extension officers and farmers on the importance of refugia in the management of insect resistance,
c. Share information on research, adoption, production, utilization, and distribution of pastures/fodders in the Kenyan coastal region,

d. Share information from the field and laboratory trials on refugia,
e. Identify potential refugia species for stem borers and management strategies to be tested on-station and on-farm ,
f. Harmonize researchers, extension and farmer performance and process indicators and develop participatory monitoring and evaluation frameworks.

The workshop was attended by 32 participants, including 12 farmers, nine extension staff and 12 researchers, all of whom made presentations and ranked species based on experimental plots at Mtwapa.

Monitoring of non-target organisms within mock trials planted at the open quarantine site in Kiboko (the first site for outdoor testing of Bt maize) continued in order to establish a baseline to document the impact of Bt maize during the early stages of field planting. This information will be important for the preparation of the regulatory dossier required for future field release of Bt maize in Kenya.

6. Impact assessment -consumer awareness studies to help understand the fit of insect resistant germplasm in Kenya

In collaboration with the Department of Agricultural Economics at the University of Nairobi, a study of urban consumer awareness and acceptability of GM food was conducted in Nairobi. The study showed general acceptance of GM maize provided cost remained comparable to non-GM maize, though more educated and wealthier consumers expressed more reservations. Data gathered about consumers' sources of information will be used to help guide future communication and public awareness activities.

Crop loss data were run through an economic surplus model, which estimated the economic benefit of Bt maize to producers and consumers to be US$ 208 million over 25 years (66% is estimated to go to consumers), representing a 20-fold return on the project investment. The highest returns are expected to be in the high production moist-transitional zone. However, if a gene against *B. fusca* cannot be found, Bt maize would only be effective in the low potential areas, and adoption rates would be fairly low. Nevertheless, the benefits from the project would still exceed its costs.

7. Enhanced training efforts and program that emphasized biosafety and regulatory aspects of our technology.

Training efforts were directed primarily towards biosafety and regulatory aspects. More than 30 KARI and KEPHIS technical staff were trained on Biosafety Greenhouse (BGH) Operations in March 2004. The staff included the BGH core staff (technical and support staff including scientists, technicians, cleaners, and security staff who are involved in the day-to-day running of the BGHC. Training was also offered to staff working at the OQS, and regulatory agents from KEPHIS who will be making regular inspections in the future.

A team of five scientists from CIMMYT, KARI, and KEPHIS attended a two-week course on regulatory issues at Ghent University, Belgium in August 2004. The course, "Biosafety Assessment and Regulation of Agricultural Biotechnology," raised the scientists knowledge and skills related to regulatory issues, thus facilitating IRMA II project planning.

In June 2004, Dr. Willy De Greef, a private consultant from Belgium, was invited to give an overview of regulatory issues in transgenic crops before an extraordinary IRMAII steering committee meeting. The presentation helped orientate our thinking towards the development of a detailed regulatory dossier to ensure the delivery of Bt maize to Kenyan farmers.

8. Continued commitment to communication through print and electronic materials, seminars, and engagement of stakeholders

From its initiation, this project has recognized the need for effective communication to create public awareness, inform key government players, and maintain balanced media coverage. This year, the IRMA project and Bt maize received extensive media coverage with the opening of the biosafety greenhouse by the President of Kenya. The IRMA project designed and distributed two page supplements in major Kenyan dailies and received broadcast coverage by CNN International and the local TV stations. Over the course of the year, reporting and opinion pieces about GM technology and Bt maize remained essentially balanced.

Having reviewed some specific accomplishments of the past year, allow me to now highlight efforts that have set the stage for future accomplishments, specifically, a rigorous external review of the project and the development of a detailed business plan for Phase II.

9. Development of a comprehensive IRMA project plan that include a plausible regulatory approach

A revised project plan for IRMA II, geared to better address regulatory issues related to Bt maize, and to enhance project management was released in October 2004, the culmination of months of intensive planning meetings and workshops. During this process it became clear that the regulatory issues were not exhaustively covered in the original project plan. A two-day workshop to develop, plan and incorporate regulatory activities in the IRMA II project plan was held in Nairobi in September. Twenty-one participants from seven institutions attended the workshop: KARI, CIMMYT, KEPHIS, National Council for Science and Technology (NCST), Syngenta Foundation for Sustainable Agriculture, African Agricultural Technology Foundation (AATF), and IBRS. The objectives of the meeting were to:

a. update the status of Bt maize in the IRMA project;
b. identify information needed for a dossier to release Bt maize,
c. determine sources of this information and identify gaps to be filled through research;
d. determine activities needed to fill the gaps, including resources and assigning responsibilities; and
e. update the IRMA II project plan, specifically on regulatory issues.

The planning process produced ten themes, as shown on the overhead projection.

Each theme is interdisciplinary and involves a team of entomologists, biotechnologists, breeders, economists, communications experts, IP counsels, extension officers, policymakers, regulatory officials, and most importantly, Kenyan farmers.

According to the new timelines, the first testing of Bt maize occurred in the biosafety greenhouse complex (BGHC) in 2004 and field testing proposed for early 2005. OPVs will be pre-released in 2010, with large-scale release in 2011. Hybrids will follow a year behind OPVs. In developing the project plan, probabilities of success and risks, and contingency measures were identified. Milestones were set, against which progress will be measured.

To actualize the milestones and objectives, a new project management structure was developed. Under the new scheme, an Executive Committee (EC) composed of KARI, CIMMYT, SFSA, MOA, and RF Directors, and CIMMYT ALP Director was established with overall responsibility for the project. The position of Project Manager was instituted and given overall responsibility for the projects day-to-day activities and oversight, and reporting to the EC. An advisory board of experts from the public and private sectors will be appointed by the EC to provide expertise in their respective areas and to monitor progress.

I wish to now thank our fully committed partners, the Syngenta Foundation for Sustainable Agriculture and the Rockefeller Foundation, and note that discussions for collaborative work on intellectual property and other issues are underway with the African Agricultural Technology Foundation, whose executive director is chairing this meeting.

Concluding remarks

In conclusion, I wish to reiterate what I said last year. We stand on the verge of making significant advances for Kenyan farmers and for Kenyan agricultural research. We have reached this point, all the while giving great attention to following the prescribed biosafety regulations and protocols and providing Kenyan staff with the training needed to work at the highest professional standards. At all stages of the project, we will continue to assess the impacts of the improved maize on the environment, and on farmers and consumers.

We hope that this project will serve the intended purpose as a positive example to other nations on how to safely and responsibly put this technology to work for the betterment of our people and of Africans generally.

Remarks by CIMMYT African Livelihoods Program

—Dr. Alpha Diallo
CIMMYT African Livelihoods Program

Dr. Diallo thanked the chairman, Dr. Bokanga, Dr. DeVries, Dr. Jost Frei, Dr. Gichuki, Dr. Mugo, colleagues, distinguished farmers, IRMA Stakeholders, KARI and CIMMYT.

He declared that since the time the meeting was started he was sure at least 10 children have died from hunger, it means that if nothing is done by next year, 5 million more people will have died. In sub-Saharan Africa, 200 million people live on less than US$ 1 per day. He said that each time people sit and talk a bout food; let them have in mind the reality of saving lives. The CIMMYT representative said when you have to save lives, you don't ask questions but save lives first then ask questions later. Dr. Diallo expressed his sincere appreciations to participants attending the meeting on behalf of the CIMMYT Director General, the African Livelihood Program director and involved scientists. He informed the participants that the CIMMYT Director General will be attending the Steering Committee Meeting while the African Livelihoods Program Director had attended the IRMA planning meeting the previous day and said they both sent their regards.

Dr. Diallo reminded the participants about the IRMA activities and achievements presented by Dr. Mugo, the most important one being the opening of the biosafety greenhouse by his Excellency, the president of Kenya and many local and foreign dignitaries. The significance of the occasion cannot be overstated; it clearly shows that the Kenyan government is committed and that IRMA will continue to save lives.

Dr. Diallo told participants that a strong foundation has been made by IRMA this year making a turning point to focus on having improved maize in the farmer's fields and that we all hope the goal will be achieved. Dr. Diallo said IRMA II still has several years of hard work and will count on stakeholders to keep the project on track and give support. On behalf of CIMMYT, Dr. Diallo thanked the government of Kenya for the excellent support to KARI and CIMMYT, and the Syngenta Foundation for their collaboration and funding of the project. He also thanked partners including the Rockefeller Foundation and AATF and said if you have a partner who can help you to get your technology to the farmers then you have a true partner who will help you make impact and save lives. He concluded by thanking everybody and said the remarks given by the Syngenta and Rockefeller Foundations and other partners were very encouraging and that IRMA project was looking forward to further collaboration.

Remarks by Syngenta Foundation for Sustainable Agriculture

—Dr. Jost Frei, Syngenta Foundation for Sustainable Agriculture

Mr.Chairman, Dr.Simon Gichuki for Dr.Romano Kiome, Dr. Alpha Diallo, Dr.Stephen Mugo, Dr. Joe Devries, colleagues from CIMMYT Mexico and Kenya and KARI, ladies and gentlemen,

On behalf of the Syngenta Foundation for Sustainable Development, I would like to welcome all of you gathered here to attend the fifth IRMA Stakeholders Meeting, where you have been briefed about the developments and achievements of the ongoing IRMA project work, as well as the planned activities for 2005.

The year 2004 has seen some significant developments—above all in the field of regulatory issues and biosafety. You all recall the highlight of this year, viz. the opening ceremony of the Biosafety Greenhouse by the President of the Republic of Kenya in June. In addition, 2004 has seen the revision of the project plan for IRMA II with the inclusion of all regulatory issues and the presentation of the work plan for 2005. The management structure has been strengthened with the nomination of Dr. Simon Gichuki as the IRMA internal regulator and of Dr. Stephen Mugo as the project manager.

For us as the principal donor for the project, these are significant steps due to the fact that regulatory compliance is a prerequisite for funding in line with Kenya's commitment to meet all the requirements as stipulated in the Cartagena Protocol, which Kenya has fully endorsed.

You also recall that the IRMA project is following a dual strategy of technologies to be developed and adapted, viz. the conventional breeding avenue and the modern Bt avenue and even a combination thereof. As you have heard, by next year the first pre-releases of conventionally bred resistant maize will be available.

At this stage I would like to offer our special thanks to all the colleagues who have been involved in the IRMA II project work this year for their hard work and dedication to help in our endeavors to develop resistant maize for Kenya's farmers and to make it available to them.

For the coming year I wish you all much success in your project work, and for the farmers I hope that you will be blessed with sufficient rainfall in order to reap a rich harvest of maize.

Thank you for your attention.

Remarks by The Rockefeller Foundation

—Dr. J. DeVries, Deputy Director,
Food Security, The Rockefeller Foundation

In his remarks, Dr. Joseph DeVries, the Deputy Director, Food Security, Rockefeller Foundation, said that, relative to the Syngenta Foundation for Sustainable Development, the Rockefeller Foundation was a newcomer to IRMA, and a more minor player in terms of the level of funding. The Rockefeller Foundation's support to KARI and CIMMYT towards the IRMA project commenced in July 2004.

He said that since IRMA's inception, The Rockefeller Foundation has appreciated the project's work on valuable technologies with the potential to change the lives of farmers, and been impressed by the spirit of transparency and good communication efforts. He said he believed that the value of a public sector-based project which aimed at benefiting the poor with such a high-impact technology would be proven in the medium term.

The Rockefeller Foundation believes that promising or proven technologies must be shared with poor farmers with the same, or even greater urgency as they are with the rich; the IRMA project presents a great opportunity for Kenyan scientists to assess novel technologies under their own conditions, in order to decide for themselves if they are relevant and safe within the context of their country's farming conditions. Dr DeVries said that after hearing the presentations made so far, he believed that IRMA's work was on track. He said he was also please with the research on the use of the combination of *cry1Ba* and *cry1Ab* genes, which will confer maize with dual resistance—to *Chilo partellus* and *Busseola fusca*.

Dr. DeVries narrated a true story of a maize farmer from Iowa, USA, who was vacationing in Florida in the middle of the growing season, to illustrate the labor-saving benefits of Bt maize. By adopting the technology, farmers elsewhere have become richer, and food prices have gone down.

Dr. DeVries said he was pleased with the restructuring of the IRMA project as it enters its second phase, to address strict government regulations relating to deployment. He noted that Bt maize was a technology that had proven itself in large parts of the developed world, so far with only positive impacts, and hoped that external forces would not create new barriers to needy farmers receiving this technology. In conclusion, Dr DeVries expressed the hope that the Kenya government would weigh carefully the costs of stepping up the regulations, making it more expensive (in time and money) to deploy Bt maize in the country, against the potential benefits to those dealing with hunger on a daily basis.

Questions and Answers with Stakeholders (Hilton Hotel)

Dr. M*po*ko Bokanga,
Executive Director AATF,
Chair of Fifth Annual IRMA Stakeholders Meeting

Welcome Remarks by chair, Dr. M*po*ko Bokanga

The chairman said he was honored by being asked to chair. As a newcomer on the scene it was a particularly great honor. Dr. Bokanga said AATF was proud to be associated with the IRMA project because they shared the same goals that is harvesting advanced technologies and bringing them to Africa to solve the farmer's problem. IRMA II is building on the foundation of IRMA I. There is need to increase our concern on intellectual property right, and AATF is currently building capacity in this area. The chairman said he would like to see the project come to a successful conclusion in future.

Dr. Bokanga said communication and awareness creation should be done vigorously by the project because there are institutions and people who may not want the project to succeed and are bent on derailing the technology in the country. He gave examples of institution such as ABSF and ISAA which are involved in creating a conducive environment for biotechnology and advised IRMA to try a more systematic way of involving those institutions who can be able to move the technology faster to the farmers. He concluded by stating that IRMA project is on solid ground moving to the right direction and we are all hoping that by year 2010/2011 the technology will have reached the farmers. He said the process will be very demanding requiring IRMA stakeholders to help mobilize and prepare farmers for the technology.

Question and answer session

Comment by Professor Norah Olembo , ABSF

I want to appreciate the work CIMMYT and KARI have done; ABSF is pleased with their partnership with CIMMYT and KARI and would like to collaborate more. We would like to offer training services to extension; we have had experience in training journalists. As the IRMA project moves to farmers you will need the right type of information to reach farmers. I would like to comment on IPR issues, the capacity in intellectual property rights is enormous, there is a database easily available at KIPI and IRMA can use it. Not all IPR are protected in Kenya, after getting the relevant information on IPR you can then work with AATF to move the technology forwards.

Comments by Mr. Paul Okongo, farmer representatives Tatro Central Farmers Group, Yala

I want our appreciation to go on record for the IRMA project, for inviting farmers each year so that farmers can know where we were and where we are going rather than doing the work behind our backs and behind the fence; then you call us to eat food whose origin we don't know. I am not asking a question because I have been involved right from the beginning, therefore I know where we came from and where we have reached. On behalf of the farmers I represent, I wish to record our appreciation to the partners who are joining us today to enable the product land into the hands of the farmers.

Comment by Jacob Odondi, PDA Coast Province
I appreciate the wonderful work done by IRMA project, I have listened to Dr. Mugo's presentation and the only comment I have is once the technology is developed, it should be handed over to the extension officers to transfer to the farmers. Unfortunately several of our extension officers don't know what GMOs are and they will need to be sensitized.

Question by Jacob Odondi
In the Kenyan production systems, there are more challenges when it comes to post harvest pests. Is there anything IRMA is doing on post harvest pest resistance in addition to stem borer resistance? Are the varieties you are developing also resistant?

Response by Dr. Stephen Mugo
Let me ask Paddy Likhayo and David Bergivnson to stand up. They are the champions on post harvest pests in Kenya and CIMMYT. Yes, pest harvest is being addressed through conventional breeding. The materials screened for stem borer are also screened for storage pests to ensure that they have acceptable resistance. We have a breeding nursery at Kiboko; the germplasm is tested against other stresses such as drought, low soil fertility, and diseases such as maize streak and turcicum.

Question by Dr. Joe DeVries, Rockefeller Foundation
You have mentioned that Bt. products will be available in 2010, but have not given us the level of conventional resistance in the materials you have. My experience is that the conventional varieties are not very resistant and it is hard to get resistance through conventional breeding. Can we wait for the Bt maize we are sure of?

Response by Dr. Mugo
We have found conventional resistance to be low (4-5) and that is why the Bt option is being approached. The project was prepared in such away that we don't leave farmers disillusioned as they wait for Bt maize, which has to go through a lot of biosafety regulations.

Comment by Dr. Alpha Diallo
I agree with Joe that it has been difficult to use conventional resistance to develop resistant varieties. CIMMYT used a conventional strategy to improve populations but when we moved to developing inbreds that are resistant we were more successful. The new varieties used in the IRMA project are from those insect resistant lines and I guess the difference is quite remarkable.

Comment by Dr. David Bergvinson
The synthetics formed are composed of lines selected from stem borer and army worm resistance; they have the ability to tolerate insect feeding on the plants and still produce high yields. We are talking about synthetics, i.e., population improvement to line improvement and their crosses

Comment by Jost Frei, Syngenta Foundation
Having been associated with the IRMA project since 1999, the project was designed to offer farmers with a choice; Conventional with medium resistance or Bt with very good control. The better option is not yet delivered to the farmers.

Comment by Dr. Bokanga, Chairman 5th IRMA stakeholders meeting
We have had response on storage issues. We know the entomologists are taking care.
We saw in Dr. Mugo's presentation that the stem borer reduces yield by 13.5%, but remember yields are already very low even if we have insect resistant varieties. With low soil fertility you will still have low yields. To get good yields we need to improve soil fertility and the farmers need to generate income so that they can buy the inputs.

Question by Dr. Bokanga
In the stewardship of this product how are we going to produce Bt maize? I guess it will be the local seed companies, but how are we going to involve them?

Response by Dr. S. Mugo
As regards low soil fertility, the IRMA project is tackling it in two ways: (1) during our screening process we screen the materials against different stresses. KARI and CIMMYT have collaborated in developing maize with low nitrogen, and the two institutes have other projects to address other stresses from genetic and crop management view and other efforts complement the IRMA project, and (2) IRMA will try to put good backgrounds into all of the materials we release, i.e., combining good and good and see that the two institutes have other projects to address other problems related to maize production.

Comment by Dr. Alpha Diallo
I hope that among the stakeholders we have policymakers because we are discussing an important component—fertilizer. If we look at the whole chain of technology development, policymakers have an important role to play. You need to have an input to have an output, so let us not try to get outputs without putting inputs. CIMMYT is developing good seeds but we also need to use fertilizers. China tried to use organic fertilizers (cattle farmyard manure) to produce food for one billion people, they found that using that route for that population, they would need to move out of China and leave the country to raise cattle.

If we have a technology, we should encourage our farmers to produce if they can sell, otherwise you may increase yields while farmers have no market and then farmers get discouraged to continue producing what they can't sell. There is need to seek market for cheaper fertilizers and seed produced. The approach used by Rockefeller Foundation; of combining in one package, good varieties, fertilizers, and markets for farmers produce is excellent and we should congratulate Rockefeller for that.

Question by Gabriel Uri, student Jomo Kenyatta University of Agriculture and Technology
I am interested in genetics and biotechnology. I am told only God is perfect, are there any disadvantages to these technology?

Response by Dr. Stephen Mugo
There are some limitations; one biggest risk is the possibility of insect resistance developing. There are concerns that there could be potential effects to human health (in terms of toxicity, allergenicity, nutritional value) and environmental issues, e.g., could it reduce biodiversity or cause weediness, and of course ethical concerns that only God is perfect and people should not tamper with genes. These were the questions that were asked at the beginning during the first stakeholders meeting. The project has tried to familiarize the people with genetic engineering technology, and there is information available. ABSF and other institutions also try to pass the information to the public.

Comment by Dr. Bokonga, AATF
Biotechnology is dominated by a few big companies and the public have the impression that it is risky. Multinational organizations should work together with private companies and other organizations for the benefit of the small-scale farmers.

Comment by Peter Kataka, farmer, Kakamega
IRMA is a very useful project. We have been using a lot of labor for stem borer control, and if the technology is in the seed it will be very good for farmers because they will use less labor. The issue of inputs is very important. Farmers would like access to cheap fertilizers, although some mechanism should be put in place to have farmers get inputs on credit not for free because free things make people lazy. I liked Professor Olembo's comments at the beginning of the Question / Answer session; it is Professor Olembo who made it possible for me to get training on Bt at Chiromo Campus, University of Nairobi. The training was conducted by Professor Ochanda. Professor Olembo also had other biotechnology projects in Kakamega. I am requesting that Prof. Olembo be incorporated in the IRMA project and also continue involving farmers at all of its stages.

Comment by Mr. Francis Ndambuki, Kenya Seed Company
Kenya Seed Company appreciates the efforts IRMA project has taken to involve the seed producers because they have a big role to play in seed production and marketing. We have been monitoring the activities of IRMA and have been working very closely with KARI. When KARI is on the project's Steering Committee we feel the seed company is there too. We sell a lot of seeds that KARI produces and we hope the seed company will produce the seed for farmers once it is developed.

Dr. Bokanaga, Chairman of the Stakeholders Meeting
At the end of the question/ answer session the chairman thanked all participants and requested those who were not able to ask their questions or give their comments to contact Dr. Stephen Mugo or the IRMA project with their questions, comments, and suggestions.

Vote of Thanks

—Dr. Jedidah Danson

Dr. Danson said her task was simple because she had only one key word: **THANKS.** Thanks to the Chair for giving us a successful day guiding the session to finish on time and all participants were happy. She thanked all the participants for their presence and contributions, the Syngenta Foundation represented by Jost Frei for continued support and funding; and Dr. Joe DeVries Deputy Director Rockefeller Foundation for becoming a new partner. She also thanked all those institutions represented at the meeting, e.g., KEPHIS, universities, ABSF, Ministry of Agriculture (all the way from Mombasa), the media and the most distinguished of participants—the farmers. She expressed the hope that the media would get an accurate message out to the public. She also thanked NCB, seed companies, KIPI, ICIPE, KARI, and CIMMYT. She appreciated the presence of scientists and students. Dr. Danson commented on the question from the university student by saying that we are coming from the unknown; wouldn't we rather eat the Bt maize than eat and die from maize with aflatoxins, which we know? She concluded by wishing all participants a safe journey home and good luck.

EMBARGO UNTIL 2 PM, THURSDAY, 9 DECEMBER 2004

9 December 2004
For more information contact: Dr. Stephen Mugo (s.mugo@cgiar.org)

Project Stakeholders See Bt Maize at Work First Hand

Nairobi—The Insect Resistant Maize for Africa (IRMA) project held its annual Stakeholders Meeting on Thursday, 9 December, during which participants got their first view of transgenic Bt maize at work in KARI-NARL's biosafety greenhouse complex.

Stakeholders were told that this was a watershed year for the IRMA project with the President of Kenya, Hon. Mwai Kibaki, officially opening the biosafety greenhouse complex, the first of its kind in sub-Saharan Africa outside of South Africa, last June. The biosafety complex allows project scientists to conduct experiments under strict containment conditions to

- determine the effectiveness of various Bt genes against Kenyan stem borers,
- assess the impact of Bt maize on non-target insects and organisms,
- initiate the process of converting maize varieties adapted to Kenyan conditions to Bt maize, and
- to multiply seed for additional experiments.

Stem borers destroy approximately 13.5 percent ($5.4 billion KSh) of the maize crop annually and have been cited by farmers as the most destructive insect field pest they have to deal with.

The opening address for the meeting was given by Dr. Romano Kiome, Head of KARI who welcomed invited stakeholders including representatives from farmers', women's, environmental, and religious organizations, government agencies, NGOs, seed companies, and others. Stakeholder involvement, a hallmark of the IRMA project, has been maintained through annual Stakeholders Meetings since 2000, farmer participatory surveys, and interactions with the media on noteworthy occasions.

"This is a very exciting event for us," said IRMA project manager Dr. Stephen Mugo. "After more than five years of work, Kenyan farmers and the public will be able to see for themselves what this technology can do—allow maize to protect itself against stem borers without the need for costly and sometimes dangerous insecticides."

Aside from viewing progress on Bt maize, stakeholders were updated on the status of the project's efforts to use conventional breeding to impart insect resistance to maize. On-farm testing in five Western Kenya districts showed that the IRMA insect resistant maize varieties were superior to normal varieties. Results from six open pollinated varieties (OPVs) entered in the National Performance Trials will be made available in February, and superior candidates can be pre-released at that time. Six insect resistant hybrids will also be entered into the 2005 NPTs next February.

After viewing the Bt maize in the biosafety greenhouse complex, and hearing Dr. Mugo's presentation on progress in 2004 and plans for 2005, stakeholders were invited to question project scientists and representatives of the implementing organizations (KARI and CIMMYT).

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