Insect Resistant Maize for Africa (IRMA) Project

Annual Report 2006

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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 (IRMA II) 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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Cover Photo: A team of scientists visit the Open Quarantine Site at KARI, Kiboko.

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I. EXECUTIVE SUMMARY

The IRMA project is aimed at producing stem borer resistant, locally adapted maize varieties for various Kenyan agro-ecological zones using conventional and biotechnology-mediated approaches, particularly Bt technology. Transgenic maize containing Bacillus thuringiensis (Bt) genes is a focal point of the project. Public involvement and awareness, through events such as the annual stakeholder meetings, are emphasized in the project's activities.

The IRMA project is currently in its second phase (2004–2008), following the first phase in 1999–2003. In its maize improvement efforts using conventional breeding and genetic technologies, IRMA will strive to

- be a model of good practice,
- serve as a pilot project for public-private partnership and cooperation,
- employ state of the art technology and methodology, and
- be transparent and open through ongoing dialogue with stakeholders.

An external review of IRMA I was conducted in early 2003 to assess the project's progress, shortcomings, and lessons learned, and to set the stage for formulating a business plan that would be presented to development partners with an interest in participating in the project after 2003. The review team commented that "achievements of IRMA I have been remarkable, and excellent work has been done by a highly motivated team." It cited many examples of scientific work performed to very high standards. However, the review noted that the target product had not yet been delivered, which it attributed in large part to delays in the Kenyan biosafety regulatory process.

The review team strongly endorsed a continuation of the project, as IRMA II, and stressed several points, among them increased KARI involvement in project management, and a greater share by KARI of the fundamental work, under the scientific leadership of CIMMYT.

An IRMA II Project Plan was developed through a process that emphasized broad participation and transparency, especially when regulatory issues were being considered in 2003 and 2004. Ten themes were developed, which will be actualized by multidisciplinary and inter-institutional groups.

This report is a record of activities of the project in 2006. The highlights for 2006 are:

1. Confined field trials of the nine public sector Bt maize events was completed
2. Two insect resistant maize OPVs were released by the NPT committee and nine insect resistant maize hybrids were nominated into NPT testing for 20006/2007
3. Second level of testing for effects on non-target organisms were initiated in the BGHC.
4. A draft IRM strategy was made that includes refugia using non-maize food crop and fodder species and takes into account wild hosts.
5. Kenya developed a biotechnology policy and is getting closer to developing a biosafety bill
6. Negotiations towards access of a private sector Bt maize event that targets the African stem borer *Busseola fusca* were advanced with a trait integration agreement being signed.
7. An analysis of seed maize sale by stockists in Kenya was done that helped in seed maize market segmentation and seed producers to package seed in accordance with farmers' preferences. A study was started to measure the attitudes of maize sellers, processors and millers towards Genetically Modified (GM) foods in Kenya, building on an earlier one to IRMA consumer survey conducted in Nairobi to determine consumers' awareness, attitudes and willingness to pay for GM crops focusing on supermarkets, kiosks and posho mills.

8. Seed was produced for various trials, while descriptors were developed for the new hybrids in the NPT.
9. Farmer evaluations were done to maize varieties in the NPT to review criteria in selection of maize varieties and constraints to maize production, and use the identified criteria to determine farmers preferred maize varieties.
10. Communication strategies were revamped with issue management matrix, presence in agricultural shows, and maintained print and electronic outputs.

Detailed accounts of these activities are included in this report. Also included are brief summaries of presentations and discussions during the IRMA Project annual review and planning meetings of 2005 and 2006.

The support of the Syngenta Foundation for Sustainable Agriculture and the Rockefeller Foundation are gratefully acknowledged.

II. LIST OF ACRONYMS

AATF	African Agricultural Technology Foundation
ABSF	African Biotechnology Stakeholders Forum
ACTS	African Center for Technology Studies
ALP	African Livelihoods Program (CIMMYT)
ASARECA	Association for Strengthening Agricultural Research in East and Central Africa
BGHC	Biosafety greenhouse complex
Bt	Bacillus thuringiensis
BTA	Biotechnology Trust Africa
CD	Centre Director
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo
CIRAD	Centre for International Cooperation for the Development of Agronomical Research
CISA	Catholic Information Services in Africa
CML	CIMMYT maize line
CORAF	Conference for West and Central African Agricultural Research Directors
DC	Double cross hybrids
DNA	Deoxyribonucleic acid
DUS	Distinctiveness, uniformity and stability
ELISA	Enzyme linked immune serological assay
EMBRAPA	Brazilian Agricultural Research Corporation
FAO	Food and Agricultural Organization
FTO	Freedom-to-operate
GIS	Geographical information system
GLS	Gray leaf spot
GMO	Genetically modified organism
HPLC	High performance liquid chromatography
HPR	Host plant resistance
IBC	Institutional Biosafety Committee (KARI)
ICIPE	International Center for Insect Physiology and Ecology
ICRAF	World Agroforestry Centre (International Centre for Research in Agroforestry)
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ILRI	International Livestock Research Institute
IPR	Intellectual property rights
IPM	Integrated pest management
IPTT	International Progeny Testing Trial
IRM	Insect resistance management
IRMA	Insect Resistant Maize for Africa Project
ISAAA	International Service for the Acquisition of Agri-biotech Applications
ISNAR	International Service for National Agricultural Research
JKUAT	Jomo Kenyatta University of Science and Technology
KARI	Kenya Agricultural Research Institute
KBC TV	Kenya Broadcasting Service Television
KEPHIS	Kenya Plant Health Inspectorate Service
KIPI	Kenya Industrial Property Institute
KNA	Kenya News Agency
KSTCIE	Kenya Standing Technical Committee on Imports and Exports
LGB	Larger grain borer
MBR	Multiple borer resistant
MOA	Ministry of Agriculture, Kenya
MSV	Maize streak virus
MTA	Material transfer agreement

NARL	National Agricultural Research Laboratories (KARI)
NBC	National Biosafety Committee (Kenya)
NCST	National Council of Science and Technology (Kenya)
NEMA	National Environmental Management Agency (Kenya)
NPT	National performance trials
OCED	Organization for Economic Co-operation and Development
OPV	Open pollinated variety
OQS	Open quarantine site
PBS	Program for Biosafety Systems
PCR	Polymerase chain reaction
PRA	Participatory rural appraisal
QPM	Quality protein maize
SADC	Southern African Development Community
SC	Single cross hybrids
SFSA	Syngenta Foundation for Sustainable Agriculture
SWIFTT	Strategic World Initiative for Technology Transfer
TAIL	Thermal asymmetric interlaced polymerase chain reaction
TWC	Three-way cross hybrid
UNEP-GEF	United Nations Environmental Program – Global Environmental Fund
UNIDO	United Nations Industrial Development Organization
UON	University of Nairobi
USAID	United States Agency for International Development
USDA-ARS	United States Department of Agriculture - Agricultural Research Service

III. INTRODUCTION

The Insect Resistant Maize for Africa (IRMA) project focuses on delivering stem borer resistance to farmers in a convenient and easy-to-use form—the maize seed that they plant. During the first phase (IRMA I, 1999–2003) IRMA produced source lines of the key Bt genes Cry1Ab and Cry1Ba, which are effective against the target pests *Chilo partellus*, *Chilo orichalcocillielus*, *Sesamia calamistis*, and *Eldana saccharina*. The source lines are the starting material needed to transfer the Bt genes to target maize 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 stem borer resistance were identified, and these varieties are progressing toward delivery to farmers. The baseline information required for proper targeting of insect-resistant maize, developing appropriate insect resistance management strategies, and conducting ex ante impact assessments is now available. Communication via various media has been established, and educational materials on Bt maize for a broad spectrum of stakeholders are under development.

The second phase of the project, IRMA II (2004–2008), builds on the successes of IRMA I. The project's design is based on a business model that ensures that the products developed will be delivered in a timely manner, and will address the needs of the Kenyan farmer. The plan employs a two-pronged approach: (1) development and release of conventional insect resistance in Kenya-adapted open pollinated varieties (OPVs) and hybrids, and (2) development and release of Bt-based insect-resistant OPVs and hybrids. Ten project themes run concurrently within IRMA II:

- Development of Bt maize event, Bt source line, and human health safety assessment
- Development of conventional and Bt products and compositional analysis
- Environmental impact assessment
- Insect resistance management and contingency plans
- Biosafety and regulatory issues
- IPR/Licensing
- Seed production
- Market assessment and analysis
- Economic impact assessment
- Communication, promotion, and capacity building.

Each theme is interdisciplinary and involves various teams of entomologists, biotechnologists, breeders, economists, communications experts, IP counsel, extension officers, policy makers, regulatory officials, and farmers.

The principal output of IRMA II will be the delivery of maize germplasm containing conventional and Bt-based insect resistance to Kenyan farmers.

Although IRMA II's primary emphasis is on delivering products, the project was to 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, and environmental safety assessment data for the Cry1Ab and Cry1Ba gene products, (4) an insect resistance management strategy for small scale farmers, and (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 establishing the first level 2-biosafety greenhouse and laboratory in East Africa, during IRMA I.

Of these "firsts", (1) the first Bt maize seed was introduced in 2004, (2) the first Bt maize confined field trials (CFTs) carried out in 2005-2006, (3) sections of the dossier of human health safety assessment, and environmental safety assessment data for the Cry1Ab and Cry1Ba gene products are now available, (4) a draft insect resistance management strategy for small scale farmers is being developed, and (5) extensive experience for Kenyan scientists, officials, stakeholders, and farmers in the development, delivery, and stewardship of Bt-based insect resistant maize varieties have been developed through the project life.

A number of milestones have been set against which progress will be measured. These are classified into four broad categories: (1) facilities & permits, (2) breeding, (3) environmental safety assessments, and (4) socio-economic impacts.

The total five-year budget for the project was initially estimated to be 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 (Appendices 1 and 2). The highlights of IRMA in 2006 are presented under the 10 themes listed above (Section V). In addition, very important discussions held during IRMA Annual Preview and planning meeting 2005 that were not reported during that years Annual Report are included here (Section VI). Concise progress reports by themes for 2005 are also included here (Section VII). Finally, the reviewed workplans for 2006 (Appendix 3) and the workplans and budgets 2007 (Appendices 4 and 5) are also included here.

IV. REPORTS BY PROJECT THEMES

Theme 1: Development of Bt maize Events, Bt Source Line & Human Health Safety Assessment

S. Mugo, , M. Murenga, C. Taracha, J. Songa, and D. Bergvinson

The major work was the testing of Bt maize in the CFT at OQS Kiboko. The second season was harvested. A detailed report on evaluation of Bt maize in the lab, BGH and CFTs appear below.

1.1 Screening of Bt maize public events for resistance to Kenyan stem borers

Summary

In Kenya, stem borers destroy an estimated 400,000 metric tons or 13.5% of farmers' annual harvest of maize costing over 72 million dollars. Bt maize developed using modified genes from the soil bacterium Bacillus thuringiensis, controls stem borers without harming humans, livestock, or the environment, and is now sown to 90m ha globally. Various public Bt maize events of cry1Ab, cry1Ba, and cry1E genes were tested in biosafety laboratory, biosafety greenhouse, and in confined field trials (CFTs) for the control of five major Kenyan stem borer species. Leaf area consumed and mortality rates among stem borers were the traits in the leaf bioassays, while leaf damage score, number of exit holes and tunnel length were the traits used in the field evaluations. First generation Bt maize events showed control of *C. partellus*, *C. orichalcociliellus*, *C. saccharina*, *S. calamistis* by δ-endotoxin from cry1Ab, cry1Ac, cry1Ba and the fusion cry1AB-cry1Ba genes but no control by toxins from cry1E. Bt maize δ-endotoxin from cry1Ab and cry1Ba from Bt maize grown in the greenhouse also controlled *C. partellus*, *C. saccharina*, and *S. calamistis*. Leaf damage scores in the field showed that Bt maize effectively controlled *C. partellus* with mean scores of 1.2 against 2.7 for the non-Bt CML216 control. Laboratory bioassays using leaves from the same plants showed control for *C. saccharina* and *S. calamistis*), with mean larval mortality of 64% and 92%, respectively. However, complete control was not observed in the laboratory, greenhouse or field for *B. fusca*. These results show that Bt maize will control three of the four major stem borers in Kenya, and demonstrate the great specificity of Bt maize δ-endotoxin even to different stem borer species. Additional Bt genes or events will need to be sought and tested for effective stem borer control in all maize growing ecologies in Kenya.

Introduction

With the advent of genetic engineering, genes that confer resistance to pest organisms have been inserted into various crop plants (Bennett, 1994; USDA, 1995). Among the biological pesticides, bacteria have been the most successful group of organisms identified as a source of biological insecticide for commercial crops. The best example comes from the soil bacterium, Bacillus thuringiensis (Bt) (Gill et al., 1992). Insecticidal crystal proteins, called δ-endotoxins, produced by Bt are highly toxic to specific pests; yet cause no harm to humans, to animals, or other non-target organisms such as beneficial insects (Croft, 1990).

Field studies confirmed that the abundance and activity of parasitoids and predators were similar in Bt and non-Bt crops (Dutton et al. 2002, Dutton et al., 2003, Dutton et al. 2005, Romeis et al., 2006, Obrist et al., 2006). After being activated by midgut proteases, the Bt proteins bind to epithelial brush border membrane vesicles, creating pores that result in cell lyses (Gill et al., 1992). Incorporation of genes encoding δ-endotoxins into maize has provided astonishing levels of resistance to insect pests (Koziel et al., 1993).

Bt transgenic plants containing insecticidal proteins have featured prominently in agricultural systems in both developed and developing countries (James, 2005). The global area of approved transgenic crops in 2005 was 90 Mha with 21.2 Mha grown to transgenic maize varieties. The benefits accruing to farmers growing Bt crops are substantial across a number of geographies and economic strata, especially in developing countries. These benefits include increased crop yields, reduced pesticide use, less environmental damage, less fungal contamination, and reduced labor (Huesing and English, 2004). Because transgenic varieties can lead to substantial reductions in insecticide use in some crops, they can contribute to IPM systems with a strong biological control component (Romeis et al., 2006).

CIMMYT acquired Bt genes from the private and public sectors. Various Bt cry genes (*cry1Ab*, *cry1Ac*, *cry1B*, *cry1E*, *cry1Ca*, and *cry2Aa*) have been used to develop constructs carrying the maize ubiquitin and rice actin promoters (Bohorova et al., 2001). These constructs have been used to transform embryos from a CIMMYT maize hybrid (CML216xCML72), thereby developing various Bt maize events (Bohorova, 1999). Backcrosses were made to CML216 to develop an inbred line carrier of the Bt genes, resulting in a number of useful Bt maize events, and the lines have shown high levels of resistance to pyralid stem borers. As the transformation program at CIMMYT matured and in light of public concern regarding the use of selectable markers, such as herbicide or antibiotic resistance to assist in the identification of events, CIMMYT strived to develop "clean events" that do not carry the selectable Basta herbicide resistance (the bar gene) marker, thus addressing some of the concerns raised earlier about this technology (Mugo et al., 2005).

Bt maize was introduced in Kenya following the national rules and regulations (Mugo et al., 2005). Cut leaves from Mexico were introduced in 2002 but were followed by seeds in 2004 once biosafety facilities for growing were developed (Mugo et al., 2005). The expression of cry1Ab Bt toxin has been shown to be influence by the environment in which the maize plants are growing (Dutton et al 2004). These studies aimed at assessing the control of major Kenyan stem borers by public Bt maize events in a biosafety level 2 laboratory, biosafety level 2 greenhouse, and in confined field trials (CFTs) in an open quarantine site (OQS).

Objectives

- Screen first generation Bt maize events in lab bioassays to identify their effectiveness against Kenyan stem borers.
- Test nine second generation public events of Bt maize in biosafety greenhouse for the control of major Kenyan stem borer species.
- Test nine second generation public events of Bt maize in confined field trials (CFTs) for the control of four major Kenyan stem borer species.

Materials and Methods

First generation Bt maize events that carried selectable marker genes were used for the laboratory, leaf bioassays to test the efficacy of Bt δ-endotoxins against Kenyan stem borers. These were developed as described by (Bohorova et al, 1999) and carried selectable markers. The lines are all derivates of CML216 backcrosses to the transformed CML216 x CML72 hybrid. The plants were grown in a biosafety greenhouse in CIMMYT-Mexico and introduced in Kenya following approvals of applications to the Kenya national biosafety committee. The Bt maize leaf tissues that were introduced were from six transgenic lines and a non-transgenic near isogenic line (Table 1).

Greenhouse and confined field testing were done using second generation Bt maize events that carried only the trait of interest and no selectable markers. The Bt maize events used in the biosafety greenhouse were used for evaluation in the confined field trial at Kiboko during 2005B (March planting) and 2006A (October planting) seasons. This was accomplished through co-transformation of the Bt gene and selectable markers that allows segregating out the selectable marker genes. The second-generation Bt maize events seeds that were introduced were from nine transgenic lines and a non-transgenic near isogenic line.

Table 1: First Generation By maize Events tested for Efficacy against Kenyan stem borers

	Event
1	T4 plants containing Event 5207 [cry1Ac::ubi]
2	T4 plants containing Event 5601 [cry1Ba:: actin]
3	T1 plants containing Event 1835 [cry1B::ubi]
4	T2 plants containing Event 602 [cry1E:: act]
5	T1 plants containing Event 7 [cry1B-1Ab::act]
6	Plants containing Event 176 [cry1Ab::PEP]
7	CML 216

Leaf tissue from maize plants planted in the CIMMYT Applied Biotechnology Center's Biosafety Greenhouses in Mexico were brought to Kenya following biosafety regulations that require proper phytosanitary certificates, 3-tier packaging, hand carriage, and inspection by the Kenya Plant Health Inspectorate Service (KEPHIS) officials. The leaf bioassays were done in a biosafety level 2 laboratory designed to restrict access, double door system, and that restricts inadvertent escape of insect or plant materials.

A special biosafety level-2 greenhouse complex (BGHC) was constructed. Important biosafety features of the BGHC were pollen screens, soil traps, restricted access with 24-h security, double door system into greenhouses, a sterilizer for soil and plant material, and a disposal system for plant materials.

An open quarantine field site (OQS) was developed and approved for research in genetically modified crops at KARI Kiboko. The OQS was been developed within the national biosafety framework, and meets biosafety level II international standards. The major biosafety features present at the OQS include isolation distance of 400 m from other maize fields, secure perimeter fencing to restrict access to people and animals, and locked gate with disinfectant-treated stepping mat and drive-through. Other features are 24-hr security, signs stating access restrictions and safety measures, proper destruction and disposal of plant material and other waste, and staff trained in biosafety.

Bioassay protocols included cutting the leaves into three cm square sections across the leaf blade. Each section was placed in a five centimeter diameter Petri-dish containing moistened filter paper with the abaxial side facing up. Ten neonate larvae of one of the five stem borer species were placed on the leaf tissue using a camel hair brush. The Petri-dish was then sealed with parafilm. Ten replicates were set up for each of the six events, for the non-transgenic tropical hybrid from Mexico (CML216), a local maize hybrid (H614D), and for each target stem borer: *C. partellus C. orichalcociliellus*), *S. calamistis*, *C. saccharina*), and B. fusca. The Petri-dishes were kept at room temperature and total darkness in the biosafety laboratory. After five days, the mortality of the larvae was assessed and recorded by counting the number of live and dead larvae. Leaf damage was assessed and recorded by measuring the leaf area consumed using a millimeter grid. After these evaluations, all larvae, leaf tissue, the Petri-dishes and other reusable equipment were autoclaved and disposal by burning and burying the ashes (Mugo et al 2004).

Ten replications (10 plants) of each of the nine events and the non-transgenic CML216 near isogenic line were sown into the small pots. The media consisted of one part of topsoil, one part sand, and one part coconut peat. No fertilizer will be applied at sowing. Watering pest control and temperatures were done to ensure healthy plants. Day/night temperatures were maintained at 18^{0}C and 22^{0}C, respectively. Each of the 10 plants was infested with 20 *C. partellus* stem borer larvae at the 4-leaf stage. Leaf damage scores were taken seven and 14 days after infestation, using a scale of 1-9 (1 no damage, 9=extensive leaf damage). The plants and other materials were disposed off by sterilizing with a steam sterilizer and burning as in those from the leaf bioassays reported above.

The seeds were counted and packaged in a three tier system. Seeds in plastic zip-lock bags were then packaged in a small metal urn, which was then carried in a locked metal box, escorted by KEPHIS plant inspectors from the secure seed store in Nairobi to the OQS at KARI Kiboko. The Ziploc bags and other disposal materials were destroyed by burning and burying the ashes in the trenches within the OQS. Kiboko is located at 02^0 15′ S and 37^0 75′ E at an elevation of 975 masl, with sandy clay soils and 530mm annual rainfall, spread over two very short rainy seasons.

The experimental trial had three replications with two five meter long rows for each plot. The row spacing was 75cm while the plant spacing was 25cm giving a plant density of 53,000 plants ha^{-1}. Fertilizers applied to give 60kgN and 60kgP_2O_5 ha^{-1}as recommended. Nitrogen was applied in two splits, including 30kgN basal application at planting and 30kgN top dressing at the 5-leaf stage. Supplemental irrigation was applied when needed. The fields were kept free of weeds by hand weeding.

At the four-leaf stage, every plant in the first row was infested with 40 black head eggs of the *C. partellus* by placing two egg mass of 20 eggs each in the plant funnel. The second row was neither treated nor infested. Stem borer damage on each plant in the infested row was assessed two weeks after infestation using the same scale as in the BGHC. To assess responses to other major stem borer species in Kenya, leaf bioassays were done for B. fusca, *C. saccharina*, and *S. calamistis*. One leaf was harvested from each of the representative plants from the non-infested row at the time of infestation. The leaves were packaged and transported to the BGH following biosafety procedures. There, bioassays were performed with larvae from the three stem borer species following the procedure described for the bioassays of first generation events above.

Data from leaf bioassays and on insect resistance and agronomic traits from the confined field trials were analyzed using PROC ANOVA of SAS (SAS, 2003)) program and the Duncan multiple range test and LSD used to separate means

Results

There were highly significant differences between the cry proteins, and stem borers for both leaf area consumed and percent of dead insects recovered (Table 2, Table 3). There was extensive damage in all replications in the controls of the non-transformed CML216 and H614D by all stem borers. This was shown by the large area of leaves consumed and by the low larvae mortality on the leaves from these plants. The cry1Ab protein was the most effective against all species as shown by the least area of leaves consumed and by the low percentage of larvae that were killed. On the other hand, the cry1E protein was not effective against any of the species tested except for some small effect against *C. orichalcociliellus*.

Among the stem borer species: all cry proteins, except cry1E, affected *C. partellus*. *C. saccharina* was the least affected by of the any cry proteins, although cry1Ab, cry1Ba and cry1Ab-1Ba proteins gave some effect against this species. *C. saccharina* was unique in that the larvae did not consume significant amounts of any cry leaves except cry1E. B. fusca was affected more than *C. saccharina*, but less than the other species. The cry1Ab protein was the most effective against B. fusca than all others. *C.*

orichalcociliellus was most affected by cry1Ab and cry1Ba proteins, and moderately by cry1Ab-1B protein. *S. calamistis* was affected by cry1Ab and cry1Ab-1B proteins.

The event E176 was the best in controlling all insect species over all. Events E5601 and E1835, both with cry1Ba but driven by the rice actin and the maize ubiquitin promoters, respectively, showed nearly similar control pattern for all insect species.

Table 2. Mean leaf area consumed by different species of stem borer larvae after feeding on Bt maize leaves for 5 days

			Area eaten (mm^2)				
	Gene	Event	*Chilo partellus*	*Chilo orichalcociliellus*	*Eldana saccharina*	*Sesamia calamistis*	*Busseola fusca*
1	cryIAb-PEPcar	176	0.3	0.3	0.0	1.4	11.7
2	cry1Ac-ubiquitin	5207	11.8	22.2	4.1	32.9	69.2
3	cry1B-actin	5601	0.6	1.0	14.7	44.1	43.9
4	cry1B-ubiquitin	1835	0.5	0.9	4.7	53.8	66.6
5	cry1Ab-1B-actin	7	0.3	0.3	0.4	1.6	35.4
6	cry1E-actin	602	92.0	46.0	75.8	85.7	76.6
7	CML216	Control 1	89.0	56.8	69.1	87.5	79.7
8	H614D	Control 2	52.5	43.5	37.1	44.9	47.7
	Significance		**	**	**	**	**

*** Significant at the 99% level of probability*

Table 3. Mean stem borer larvae mortality after feeding on Bt maize leaves for 5 days

			Percent Dead larvae				
	Gene	Event	*Chilo partellus*	*Chilo orichalcociliellus*	*Eldana saccharina*	*Sesamia calamistis*	*Busseola fusca*
1	cryIAb-PEPcar	176	97.9	81.0	26.6	95.8	59.2
2	cry1Ac-ubiquitin	5207	84.9	41.4	8.0	30.8	30.4
3	cry1B-actin	5601	100.0	58.8	9.5	19.0	46.4
4	cry1B-ubiquitin	1835	98.8	82.0	23.8	7.5	26.4
5	cry1Ab-1B-actin	7	98.8	51.4	23.8	86.3	34.7
6	cry1E-actin	602	14.1	29.1	6.6	11.3	9.5
7	CML216	Control 1	13.1	20.9	1.2	8.8	10.9
8	H614D	Control 2	7.6	24.4	9.2	4.7	18.5
	Significance		**	**	**	**	**

*** Significant at the 99% level of probability*

Evaluations of the second-generation “clean events” in the BGHC demonstrated the efficacy of the Bt toxins from cry1Ab and cry1Ba when compared with the non-transformed CML 216 (Table 4). All events, except event 6, showed very low leaf damage scores of nearly unity when compared with CML216, which had four-fold leaf damage scores with scoring made one week after infestation with *C. partellus* larvae two weeks after plants emerged.

Leaf damage scores in the field show Bt maize control of *C. partellus* with mean scores of 1.2 against 2.7 for the non-Bt CML216 control (Table 5). A score of unity indicates no visible damage on the leaf. All Bt maize events showed significantly lower damage compared to the check.

However, event 6 displayed more damage than the other events as the score was 1.6 as observed in the BGHC studies above. A similar trend was observed on the number of exit holes, where Bt maize showed only 1.2 exit holes compared to 10.5 exit holes for the check. All Bt maize events showed significantly fewer holes compared to the check. Much shorter tunnel lengths 2.7 cm were observed in Bt maize plants, compared to 18.6 cm observed in the check. All other traits measured i.e. ear height in the artificially and naturally infested rows, days to 50% anthesis, plant stand in the artificially and naturally infested rows showed no significant differences from the check (Table 6).

Table 4: Leaf damage scores from spotted stem borer (*Chilo partellus*) for second-generation Bt maize events and a non-Bt control

	Bt Maize Event	Leaf score damage (1-9)*
1	Event 3:cry1Ba::Ubi	1.3c
2	Event 6::cry1Ba::Ubi	1.05c
3	Event 10::cry1Ba::Ubi	1.05c
4	Event 58::cry1Ba::Ubi	1.05c
5	Event 93::cry1Ba::Ubi	2.2b
6	Event 127::cry1Ba::Ubi	1.05c
7	Event 216::cry1Ab::Ubi	1.05c
8	Event 223::cry1Ab::Ubi	1.05c
9	Event 396::cry1Ab::Act	1.05c
10	CML216	3.9a
	Mean	**1.48**
	LSD	**0.522**
	Significance	**

*Means followed by the same letter are not significantly different, ** Significant at the 99% level of probability*

Table 5: Stem borer traits in evaluation of nine Bt maize public events in confined field trials during 2005B and 2006A seasons at Kiboko, Kenya

Entry	Pedigree	Leaf Damage	No. of Exit Holes	Tunnel Length
		(1-9)	No.	Cm
1	Event 3:cry1Ba::Ubi	1.2	1.9	2.8
2	Event 6::cry1Ba::Ubi	1.6	1.8	4.2
3	Event 10::cry1Ba::Ubi	1.0	0.2	0.1
4	Event 58::cry1Ba::Ubi	1.1	1.5	2.9
5	Event 93::cry1Ba::Ubi	1.4	2.2	7.1
6	Event 127::cry1Ba::Ubi	1.1	0.6	1.4
7	Event 216::cry1Ab::Ubi	1.1	0.8	2.2
8	Event 223::cry1Ab::Ubi	1.2	0.7	1.5
9	Event 396::cry1Ab::Act	1.3	1.2	2.4
	Mean Bt	1.2	1.2	2.7
10	CML216	2.7	10.5	18.6
	Mean	**1.4**	**2.1**	**4.3**
	CV	**25**	**14**	**19**
	LSD	**0.39**	**5.25**	**7.08**
	Significance	**	*	**

Stem borer control in the laboratory bioassays using leaves from the CFT was assessed by the leaf area consumed by the stem borer larvae and the mortality rate observed among larvae infested to the leaves (Table 7). B. fusca and *C. saccharina* larvae feeding on the Bt maize consumed as much area as on the non-Bt check. However, the *S. calamistis* larvae feeding on Bt maize leaves consumed an average 8.8 mm^2, which is much lower compared with the 57.7 mm^2 consumed on the non-Bt CML216 check. Larval mortality of *C. saccharina* and *S. calamistis* were 64% and 92%, respectively, which were significantly higher than for the control. However, larval mortality for B. fusca was the same as the mean of Bt maize plants, except for event 3, which had 27% mortality.

Table 6: Agronomic traits in evaluation of nine Bt maize public events in confined field trials during 2005B and 2006A seasons at Kiboko, Kenya

Entry	Pedigree	Ear Height	Ear Height	50%	Plant	Plant
		cm	cm	days	No.	No.
1	Event 3:cry1Ba::Ubi	73	74	74	11	12
2	Event 6::cry1Ba::Ubi	70	74	74	12	13
3	Event 10::cry1Ba::Ubi	81	79	76	14	16
4	Event 58::cry1Ba::Ubi	72	80	75	12	15
5	Event 93::cry1Ba::Ubi	74	75	76	14	14
6	Event 127::cry1Ba::Ubi	71	68	78	10	11
7	Event 216::cry1Ab::Ubi	70	72	79	13	14
8	Event 223::cry1Ab::Ubi	60	62	75	13	16
9	Event 396::cry1Ab::Act	79	82	72	13	14
	Mean Bt	72	74	76	12	14
10	CML216	71	82	74	14	13
	Mean	**72**	**75**	**75**	**12**	**14**
	CV	**15**	**21**	**7**	**45**	**44**
	LSD	**-**	**-**	**-**	**-**	**-**
	Significance	**ns**	**ns**	**ns**	**ns**	**ns**

Table 7: Results of leaf bioassays on nine Bt maize public events in confined field trials during 2005B and 2006A seasons at Kiboko, Kenya

		Area (mm²)			**Mortality (%)**		
Entry	**Pedigree**	***Busseola fusca***	***Eldana saccharina***	***Sesamia calamistis***	***Busseola fusca***	***Eldana saccharina***	***Sesamia calamistis***
1	Event 3:cry1Ba::Ubi	78.5	8.2	15.2	26.8	68.9	87.9
2	Event 6::cry1Ba::Ubi	59.3	13.0	13.2	56.9	39.1	82.9
3	Event 10::cry1Ba::Ubi	51.4	4.4	2.6	61.2	76.4	95.3
4	Event 58::cry1Ba::Ubi	66.0	14.0	18.9	39.5	57.6	83.0
5	Event 93::cry1Ba::Ubi	49.4	11.0	6.7	67.5	58.8	96.3
6	Event 127::cry1Ba::Ubi	43.3	5.6	8.1	65.3	72.7	93.7
7	Event 216::cry1Ab::Ubi	44.0	8.1	6.5	43.4	51.3	95.0
8	Event 223::cry1Ab::Ubi	49.4	7.2	3.5	55.3	81.8	95.5
9	Event 396::cry1Ab::Act	38.1	10.2	4.3	62.0	71.9	99.1
	Bt Mean	53.3	9.1	8.8	53.1	64.3	92.0
10	CML216	55.3	33.9	57.7	48.7	44.8	30.1
Mean		**53.5**	**11.5**	**13.7**	**52.7**	**62.3**	**85.8**
CV		**50**	**124**	**94**	**36**	**27**	**13**
LSD		**-**	**-**	**15.0**	**21.9**	**19.9**	**13.2**
Sign.		**ns**	**ns**	**	**	**	**

Large leaf area consumed and the low larval mortality rated observed for B. fusca point to very low resistance among the Bt maize events against this pest. However, *C. saccharina* and *S. calamistis* were well controlled by both cry1Ab and cry1Ba delta-endotoxins. These results also agree with those by (Mugo et al., 2005) and (Mugo et al, 2004) who found that Bt cry 1Ab, cry1Ba and other tested proteins were not effective in the control of *B. fusca*, and that *S. calamistis* was affected by cry1Ab, cry1Ba and other tested proteins.

Discussion

In the bioassays of the first generation events, cryIE protein was ineffective against any of the insects species tested. This could be due to fact that the cryIE protein did not target the insects, or the event did not produce a large amount of the cryIE protein. Other events of *cry1E* could be tested to determine their effectiveness.

The results from bioassays among the fist and second generation Bt maize events showed that a prospective control was identified for *C. partellus*, the most destructive stem borers and the most widely distributed stem borer in Kenya. The cry proteins controlled *C. orichalcociliellus*, *C. saccharina* and *S. calamistis* as well. These results are in agreement with those from (Mugo et al, 2004) and (Mugo et al, 2005) who found complete control for *C. partellus* from cut leaves expressing cry1Ab and cry1Ba δ-endotoxin of maize grown in CIMMYT-Mexico. Therefore, leaf bioassays of cut leaves with fist generation events in biosafety level 2 laboratory and on seedlings carrying second-generation events in the BGHC showed that Bt maize technology was effective against Kenya stem borers. However, tests remained to be performed on the stem borer species under field conditions and in the major maize growing areas of Kenya.

Similarly, the cry1Ab and cry1Ba δ-endotoxins from Bt maize effectively controlled the *C. partellus* in the field. These results are also in agreement with observations made in the lab and greenhouse above. (Greenplate, 1999; Coviella et al., 2000) reported that both genetic and environmental factors explain variation in protein expression. For crops expressing genes coding for Bt-toxins, changes in protein production have shown to be affected by factors including growing plants in different environments, nitrogen fertilization and/or atmospheric CO_2 concentrations among others. These results shown that expression of δ-endotoxins in the tissues tested was adequate for control of the three stem borer species. Amount of Bt-toxin in transgenic plants can also differ according to plant age (Onstad & Gould, 1998; Archer et al., 2000). However, infestations in the field at tissue harvests for the tests were done before the 6-leaf stage, which may explain the similar level of control observed in the greenhouse and field conditions. (Dutton et al., 2003) reported that different commercial varieties of Bt-maize have shown to express variable amounts of toxin in different plant parts. All these tests were done in the CML216 genetic background and cultivar differences were not expected.

None of the tested Bt proteins in the lab, greenhouse, and field conditions was effective in the total control of B. fusca. Additional Bt genes or events will need to be sought and tested for effective stem borer control in all maize growing ecologies in Kenya

Not all Bt toxins are effective against all lepidopteran pests, and the results obtained support this fact. Therefore, bioassays must be conducted to determine which toxins are active and which ones should be combined to ensure an effective level of pest control for years to come. These results also indicated the specificity of Bt toxins even among lepidopteran stem borer insects.

Conclusions

Importation of the first Bt maize leaves and seeds were carried out successfully, which demonstrated that transgenic materials could be safely imported and handled in the biosafety laboratory, greenhouse, and open quarantine sites in Kenya. Results from bioassays of cut leaves of first generation Bt maize events provided critical information regarding the effective of various Bt genes against several important stem borer maize pests. Specifically, cry1E was not effective against any stem borer, while *cry1Ab*, *cry1Ac* and the fusion gene *cry1Ba-1Ab* provided varying control of stem borers.

Likewise, of plants growing in the biosafety greenhouse provided information on the control of stem borers in Kenya. The evaluations of the second-generation Bt maize events under field conditions in confined field trials conformed the findings from the lab oratory and greenhouse conditions.
All these results indicated that a prospective control was identified for the most destructive borer, the spotted stem borer (*C. partellus*), which is the most widely distributed stem borer in Kenya. Similarly, cry proteins to control *C. orichalcociliellus*, *C. saccharina* and *S. calamistis* stem borers were identified. None of the tested Bt proteins was effective in the total control of B. fusca. The tests showed that Bt maize would control three of the four major stem borers in Kenya under field conditions. Additional Bt genes or events will need to be sought and tested for effective stem borer control in all maize growing ecologies in Kenya.

Not all Bt toxins are effective against all lepidopteran pests, and the results obtained support this fact, indicating the specificity of Bt toxins even among lepidopteran stem borer insects.

1.2 Details of Bt Maize Confined field trials

The second season of the evaluation of the Bt Maize confined field trial (CFT) at the Open Quarantine Site (OQS) at KARI Kiboko was harvested in 22 Feb 2006 when the plants were at the equivalent of grain filling stage. Leaves were stripped off the plants and the number of stem borer moth escape holes counted. The stems were then split and the cumulative tunnel length measured. The materials from the trial were disposed off by uprooting and drying on site for two weeks, followed by burning and covering the ashes in the trenches within the OQS. Charcoal and some kerosene and diesel were used to successfully burn all plant materials on the same day. Leaf damage scores showed that Bt maize effectively controlled *C. partellus* with mean scores of 1.2 against 2.7 for the non-Bt CML216 control.

Laboratory bioassays using leaves from the same plants showed control for *C. saccharina* and *S. calamistis*), with mean larval mortality of 64% and 92%, respectively. However, complete control was not observed in the laboratory, greenhouse, or field for *B. fusca*. These results show that Bt maize will control three of the four major stem borers in Kenya. It was concluded that additional Bt genes or events would need to be sought and tested for effective stem borer control in all maize growing ecologies in Kenya.

Post harvest monitoring was initiated by marking out the site with permanent concrete beacons and irrigating the site. Monitoring was done by scouting was done by plot areas, borders, and the isolation. Post harvest monitoring of the four trial sites in the OQS continued by scouting for maize seedlings by plot areas, borders, and the isolation. No volunteer maize seedling was found in the trials one area in both 2005B and 2006A seasons as the crop was harvested prior to seed maturity (Figure 1). The one-year monitoring period for trial 1 in 2005B ended on August 2006, while the one for 2006A will end in April 2007. These observations are consistent with the biology of maize. Maize kernels have no dormancy period and germinate readily when conditions are right after physiological maturity. Hence, any immature kernels that may have been in trial 1 could not have germinated since they had not reached physiological maturity. Other factors, however, come to play in trial 1. First, all test plants and border rows were detasseled and hence very little seed set. Only five seeds were found in this whole trial area. Maize seeds do not dehisce and stay on the cob unless shelled manually. This data will be shared with NBC to reduce the post harvest monitoring period in future trials.

As part of the IRMA-Monsanto Collaboration efforts, A. Ateka, S. Gichuki and S. Mugo adjusted the "Application to introduce maize Hybrids DKC8073YG and DKC8053YG (with Bt event MON 810 containing *cry1Ab* gene) to carry out greenhouse containment trials to evaluate the efficacy of the Bt δ-endotoxin against maize stem borers in Kenya". The purpose was to reshape the application for introduction and testing of Mon810 to reflect the new testing location, and research objectives that will include comparison of efficacy with the IRMA public events. The NBC considered the application on 25 May 2006 with Dr. S. Gichuki, Dr. S. Mugo, and Dr. E. Ateka in attendance. The application was not approved and the following recommendations made: 1) The application be prepared on the old form, 2) a report on the already approved application be made, 3) the BGHC be re-inspected by KSTCIE to ascertain suitability for the proposed research, and 4) the application be submitted to NBC as a new application through KARI IBC.

The application was been adjusted and presented to the IBC by. J. Ininda and S. Mugo on 10 Nov 2006. Proposed changes were made and will be presented to the NBC when the meeting is called.

1.3 Human Health Safety Assessment

No specific activities were carried out to address human health safety assessment during 2006.

Theme 2: Development of Conventional and Bt Products and Compositional Analysis

S. Mugo, J. Ininda, D. Bergvinson, ST. Gichuki, M. Gethi, C. Mutinda, O. Odongo, V.W. Woyengo, G. Gethi, M. Oyoo, G. Murenga, and J. Songa

2.1. Conventional breeding

Development of insect resistant maize varieties for the major insect pests found in Kenyan maize production systems is the main objective of the IRMA project. Research activities geared towards this were initiated in 2000 mainly to identify putative germplasm to which Bt maize inbred lines would be crossed. Such would be elite germplasm for grain yield and other agronomic traits but that are susceptible to stem borers. This objective is still being pursued. However, in 2001, additional emphasize was put to develop stem borer resistant maize germplasm that farmers can use as they await availability of Bt maize in Kenya. Such germplasm would have resistance developed using conventional methods. Such germplasm would also be useful in pyramiding genes for resistance to insect pests. This strategy ensures that stem borers do not develop resistance to Bt endotoxins readily.

Data for 2006 with abit of overlap from 2006A (short rains 2005 and–2007A short rains 2006) seasons is presented in Mugo et al 2006). The volume of data presented could not allow detailed analysis and discussions and the breeders will further examine the data to make conclusions and recommendations for their specific trials and environments. However, the data indicates that we now have superior insect resistant maize germplasm; especially three way cross hybrids as finished products for resistance to stem borers in all maize growing areas in Kenya. Some of these are in the NPT testing and we are highly hopeful that some will be released. This will enable us measure up to the challenge thrown to us in IRMA II to ensure that farmers have maize with conventional resistance.

Conventional insect resistant maize development germplasm involved the search for sources of resistance from CIMMYT and KARI, mainly through screening for insect resistance among elite and non-elite sources. It also involved the search for elite germplasm to backcross to Bt maize source lines. This was done through evaluation of Kenyan germplasm for stem borer resistance and through characterization of germplasm in CIMMYT international maize trials. Finally, there was need to develop new source germplasm for insect resistance and finished products, insect resistant hybrids and OPVs.

Germplasm development and testing involves a central nursery at Kiboko where seeds are produced through crossing, selfing, and germplasm advancement. This germplasm is then tested at selected sites where varying stresses are imposed. These include *C. partellus*, low-N, and drought at the Kiboko site, random drought at Katumani; *B. fusca*, *C. partellus* and MSV at Embu; *Exerohilum turcicum*, and *Puccinia sorghi* at Muguga; low-N at Kakamega, and grain yield evaluation at Kitale. Desirable germplasm should be superior in its resistance to stem borers. In addition, its grain yield evaluation as well as other special traits like quality protein maize (QPM) and disease resistance should remain high.

A large number of inbred lines and OPVs have been screened mainly from CIMMYT entomology activities in Mexico as well as from KARI. Inbred lines from the multiple borer resistant (MBR) populations have been found to contain good levels of resistance and have been used to develop other source populations and finished products. Some OPVs from this screening process were found to contain good levels of resistance and have completed three years testing in the Kenya maize national performance trials (NPTs) and may be released in early 2006.

Neither Kenyan commercial nor CIMMYT elite germplasm in international trials showed good resistance to stem borers, but germplasm that was good in other traits was identified and formed the set to be converted to Bt.

Among the finished products available are the six OPVs and nine double top cross hybrids that have been tested in the early, medium and mid–late maturity maize NPTs by KEPHIS, and double cross hybrids (DC) and various TWC hybrids that are being tested at various locations during 2007A season. The superior ones will be nominated to the NPTs in February 2006.
The highlights of this report are:

1. Development of insect resistant germplasm progressed in 2006 with 91 trials grown at the various locations during the 2006A, 2006B, and 2007A seasons. The major activities have been developing stem borer and LGB resistant maize varieties for the various maize growing ecologies in Kenya. This involved testing new sources of resistance, developing new sources through crossing germplasm and evaluation of OPVs and TWC cross hybrids as finished products.

2. New and adapted elite insect resistant germplasm is being made by crossing insect resistant inbred lines with adapted and MSV resistant inbred lines including CML312, CML395, CML442, and CML444. Three-way cross hybrids from these crosses are being evaluated for resistance to *C. partellus* at Kiboko, *B. fusca* at Embu, random drought, and natural stem borer infestation at Mtwapa and Katumani, and grain yield potential at Kakamega.

3. Twenty (20) kits of an international stem borer resistant variety Trial EIWH0597 IRMA-SB-VT comprising of stem borer resistant varieties of mid-altitude adaptation and intermediate maturity and offered to collaborators were distributed. The trial was composed of 20 entries including 18 insect resistant maize and 2 local checks. The trial was to be grown under artificial infestation with the relevant stem borer species or planted under natural infestation in hotspots for stem borers. Data is still coming in, but new varieties are showing superiority in grain yield, insect resistance, lodging resistance, while being as good as checks in foliar diseases.

4. Eighteen (18) early, medium, and mid–late insect resistant OPVs and hybrids were grown in NPTs by KEPHIS at diverse locations in the country. These comprised of three OPVs and three TWC hybrids for each ecology. These were also harvested and data analysis is underway by KEPHIS and will be presented to the NPT meeting in February 2007.

5. Participatory farmer evaluations were done on three sets of ten entries each of those in the NPT (including three insect resistant hybrids, three insect resistant OPVs, and four checks) at each of the early, medium, and mid-late maturity ecologies in Kenya. At each ecology, two sites were on-farm, and one on-station. The on-station one was infested with the respective major stem borer in the ecology, while the on-farm ones were left under natural stem borer infestation. The objective was to evaluate insect resistant TWC hybrids and OPVs for resistance to *C. partellus* and *B. fusca.* Farmer evaluations were done at harvesting. Data is in for Kiboko where CKIR04003, CKIR04005, CKIR06007, CKIR06008, and CKIR06009 were superior in insect resistance and in grain yield.

6. Fifty (50) SC hybrids were made among CML312, CML395, and CML442 and insect resistant inbred lines from entomology in Mexico to incorporate local adaptation. These were evaluated for resistance to *C. partellus* stem borer at Kiboko and Embu during 2006B season and TWC hybrids from these lines were formed at Kiboko during 2006B season. These are being evaluated for resistance to *C. partellus* at Kiboko, *B. fusca* at Embu, random drought, and natural stem borer infestation at Mtwapa and Katumani, and grain yield potential at Kakamega

7. Screening for LGB resistance for the first lot of larger grain borer (LGB) resistant synthetics that were evaluated for agronomic performance at five locations - Kiboko, Mtwapa, Embu, Katumani, and Kakamega were harvested was done in weevil warehouses at the various locations and from grains at the Kiboko central location. Data from weight loss data for three sites (Embu, Kiboko and Mtwapa) showed significant differences for both *P. truncatus* (p=0.007) and *S. zeamais* (p=0.0001). The new OPVs showed moderate resistance levels to *P. truncatus* compared to commercial checks, with Cuba/Guad C3 S2/CML204 F2 B-183 and Cuba/Guad C3 S2/MBR C5 BC F4-1-2-2-B-F2-B-220 being the best. For *S. zeamais*, Cuba/Guad C3 S2/CML444 F2-B-1 and Cuba/Guad C3 S2/MBR C5 BC F4-1-2-2-B-F2-B-220 showed good resistance.

8. Nearly one hundred (100) three way cross hybrids of LGB resistant inbred lines were made using CML202 and CML204 during 2006A season and were tested at all centers during 2006B season. All LGB resistant materials were screened for resistance in the laboratory.

9. Gene flow study trials were harvested at Mtwapa, Kiboko, Embu, and Kakamega, thereby leaving only Katumani site without the full set of Geneflow study data sets. This has been planted during 2007A season and data analysis is under way.

However, the level of resistance in conventional resistance is still low if compared with the near immunity offered by Bt-based resistance. The rate of increment of such resistance from breeding efforts is slow, indicating the need for Bt maize technology for effective control of stem borers in Kenya.

2.2 Development of Bt-based insect resistant maize germplasm

S. Mugo, C. Taracha, J. Ininda, J. Gethi, J. Songa, and S. McLean

The second season planting of the backcrossing activities to convert Kenyan germplasm was done on 3 Nov 2005, pollinations were successful. BC_2F_1 crosses from the donor Bt maize events and the recurrent non-Bt inbred lines made Harvesting, seed transport, and disposal of plant materials was done on 4 April 2006 in exactly the same way as in 2005.

Harvesting was done at full maturity and dry-down of the plants. The BC_2F_1 ears were harvested individually, shelled, counted, and packaged into labeled cob envelopes (primary container). This was done over two days. The cobs and undesirable kernels were collected into a garbage can and later burnt together with other plant materials. The seeds were then packaged into polythene Ziploc bags (secondary container) and packed into a metal box (tertiary container) that was locked and transported under escort by a KEPHIS plant inspector Mr. Abed Kagundu to the BGHC at KARI NARL. The seed envelopes were re-counted and packaged into net bags and hanged inside the double door spaces of GH-1, GH-2, and GH-3 for further dry down before storage in the secure seed store. The number of seed from each ear. 125,257 seeds were harvested (Appendix 6). These seeds will be used to advance to the next generation of backcrossing and for other studies. A list of seed from the BC_1F_1 generation is also included here (Appendix 7).

As the plant materials were mostly dry, they were destroyed the same day in the following manner. Plants were uprooted by pulling. Whole plants from among the Bt females, non-Bt recurrent parent males and the hybrid border plants were placed in small bunches at a time into the trenches and burning continued using alternating layers of plant material and a bag of charcoal together with diesel fuel as a starter. Later all leaves and seeds were recovered including by sweeping the trial area. The ashes were then buried in the trenches.

The trial site was marked with concrete beacons. The trial area was then irrigated the following day 5 April 2006 to germinate any volunteer seeds, which may have fallen during harvest. Twenty one (21) seedlings were found during the first two week but none other has been found to date (Figure 1). These were uprooted and destroyed as with the trial materials during the post harvesting monitoring for volunteers, which has been done every 2 weeks for 6 weeks and later once per month over a period of 12 months after 5 April 2006.

Mr. Murenga Mwimali's Master's degree thesis research in plant breeding at the University of Nairobi focusing on the expression of Bacillus thuringiensis (Bt) ä-endotoxins in successive generations of crosses involving tropical Bt maize inbred lines breeding continued. Inbred lines, F_1, F_2 and F_3 generations of Bt x Bt, Bt x non-Bt and non-Bt x non-Bt plants will be compared for expression using insect bioassays, protein analysis using dot blots, ELISA, western blotting and PCR to determine the levels of expression. The non-Bt lines being used are CML144 and CML159, while the Bt lines are Events 216 and 223. At the time of reporting, all the generations required for the insect-leaf bioassays and (Bt) ä-endotoxins' expression analysis have been developed and currently, the generations have been infested with *C. partellus* larvae, insect resistance data taken and samples for molecular analysis for the gene and ELISA for the Bt toxins taken awaiting analysis.

2.3 Compositional analysis

The generations of Bt maize being developed will be used for determination of compositional content of the Bt maize seeds. For such determination, it is typical to backcross the Bt maize event to three different genetic backgrounds.

Theme 3: Environmental Impact Assessment

J. Songa, D. Bergvinson, and S. Mugo

3.1. Impacts of Bt –maize on non-target arthropods in a confined field site at the KARI – Kiboko in semi-arid Eastern Kenya, during the period November 2005 – March 2006

Introduction

Lepidopteran stem borers are a major constraint to maize production in Kenya. One of the favorable options of reducing losses due to stem borers in maize is through the development of Bt maize, which has resistance to this pest. Utilization of genetically modified crops such as Bt maize in improving food production requires that the associated biosafety concerns be addressed. As part of the process of deployment of Bt-maize to Kenyan farmers, there is, need to address the potential biosafety issues, one of which is the effects of Bt-maize on non-target arthropods. Non-target effects are defined as the unwanted effects of Bt-maize on arthropods living in or around the maize field that are not targeted for control. Effects on non-target arthropods could affect natural control of the target pests, through possible effects on their natural enemies, have implications on biodiversity, pollination, and possibly interfere with essential soil processes such as the decomposition of organic matter. Deployment of Bt maize to Kenya requires that information be generated on the impacts on non-target arthropods through a three-tiered testing scheme, which involves a succession of tests of increasing scale of complexity and realism, as follows: i) controlled studies in the biosafety laboratory and green house, 2) studies in an open quarantine field and then 3) large scale field evaluations.

Studies in the biosafety green house / laboratory makes it possible to get information on the direct effects of the Bt protein on the beneficial arthropods, a situation that may be difficult to obtain in the field where there are many uncontrolled variables. Studies in the confined field trial would provide information on the effects of the Bt proteins on populations of the non-target arthropods, within specific agroecological conditions.

The objectives of this study were to:

1. Determine the impacts of Bt –maize on populations of major non-target arthropods (predators) and on the general arthropod diversity in the confined field site at Kiboko.
2. Establish a reference collection of the arthropods found in the confined field site.

Materials and methods

This study was conducted at a confined field site at Kiboko, which is located in Makueni district of eastern Kenya during the period November, 2005 – March 2006. This study focused on sampling of the above-ground arthropods associated with the maize cropping system, and did not include trapping of below-ground macro- and micro-organisms. Different sampling methods were used for trapping of the arthropod groups.

The soil crawling arthropods were trapped by use of pit-fall traps. A pit-fall trap consisted of a large plastic cup of diameter 9.5 cm and depth 11.5cm, and a smaller cup of diameter 9.0cm and depth 10 cm. The small cup was fitted into the larger one, and were both fitted into a hole in the ground, such that the lip of the inner cup was level with the ground surface. To preserve the catch (arthropods), 250 ml of an aqueous solution of 4% formaldehyde was put into the inner cup. 20 ml of detergent was also added in order to break the surface tension of the preservative solution. A 15 x 15cm wooden cover was supported above each trap to prevent entry of rain water, reduce evaporation, and deter vertebrates from falling into the trap.

The flying arthropods were trapped by placing a water trap about 2 m diagonally from the side of each pit-fall trap. The water trap consisted of a yellow basin containing a preservative and detergent solution (1 liter of 4% formaldehyde + 50 ml detergent), and then positioned 1.5 m above ground. Catches from the various traps, were recovered on a weekly basis and preserved separately in 70% alcohol, to await identification. Arthropods from the pit-fall traps and those from the water traps were recovered by passing the respective preservative solutions through a sieve.

Results and discussion

Arthropods recovered from the traps

A total of 42 and 40 different arthropod families were recovered from the Bt –maize and non-Bt –maize plots, suggesting that there was no significant difference in the biodiversity of arthropods between the Bt and non-Bt maize plots during the five- month trapping period at the Kiboko field site (November 2005 – March 2006) (Table 8). A large group of generalist arthropods was recovered, and out of this, four categories of non-target arthropods of interest were identified, including predators, parasitoids, and pollinators.

The most commonly recovered predator groups were the ants (formicidae), ladybird beetles (coccinelidae), carabid beetles (Carabidae), spiders, and the ear wigs (forficulidae) (Figure 1). These predators have been reported feeding on the following respective life stages of stem borers: ants (on stem borer eggs and larvae) (Dwumfour, 1990; Dwumfour et al 1991), earwigs (on eggs and larvae) (Dwumfour et al., 1991), spiders (on larvae) (Dwumfour, 1990), lady birds (on eggs) (Dwumfour et al., 1991). The number of some of the predators groups (such as the carabids lady birds and earwigs), appeared to be much lower than that of others such as the ants. However, in most field situations, ants occur in much higher numbers than the other arthropods.

Table 8. List of arthropods recovered from pit-fall and water traps, in the confined field trial at KARI-Kiboko - From Bt and non-Bt maize plots during the period November, 2005 – March 2006

Arthropod Order/ Family)	Common name	Bt maize	Non-Bt maize
DIPTERA			
Tachinidae	Tachinid flies	11	45
Sarcophagidae	Flesh flies	56	142
Syrphidae	Hover flies	34	3
Calliphoridae	Blow flies	52	3
Dolichopodidae	Long-legged flies	9	3
Stratiomyidae	Soldier flies	4	2
Phoridae	Humpbacked flies	11	41
Tephritidae	Fruit flies	1	15
Asilidae	Robber flies	2	1
Muscidae	Muscid flies	35	129
Agromyzidae	Leaf miner flies	19	30
Pteromalidae		2	0
ORTHOPTERA			
Gryllidae	Crickets	12	5
Acrididae	Short-horned grasshoppers	3	0
DERMAPTERA			
Forficulidae	Common earwigs	9	9

Arthropod Order/ Family)	Common name	Bt maize	Non-Bt maize
HYMENOPTERA			
Formicidae	Ants	162	57
Apidae	Honey bees	19	32
Ichneumonidae	Ichneumons	5	5
Vespidae	Vespid wasps	10	13
Pompilidae	Spider wasps	6	10
Specidae	Sphecid wasps	28	14
Eumenidae	Potter wasps	3	1
Braconidae	Braconid wasps	2	7
Megachilidae	Leafcutting bees	31	4
Halictidae	Halictid bees	2	
COLEOPTERA			
Coccinellidae	Lady bird beetles	12	78
Carabidae	Ground beetles	6	36
Staphylinidae	Rove beetles	2	1
Mordellidae	Tumbling flower beetles	12	2
Curculionidae	Maize weevil	17	5
Meloidae	Blister beetles	12	61
Tenebrionidae	Darkling beetles	33	45
Scoliidae		18	3
Conopidae		2	2
HEMIPTERA			
Reduviidae	Assasin bugs	4	5
Pentatomidae	Stink bugs	2	1
Cynipidae		1	1
HOMOPTERA			
Cicadellidae	Leafhoppers	46	20
ISOPTERA			
Termitidae	Termites	33	80
LEPIDOPTERA	Moths*	79	64
ARANEIDA	Spiders	72	75
DIPLOPODA		7	2
SORPIONIDAE		9	5

The relative number of predators in the Bt and non-Bt maize fields was variable. The number of ants was higher in the Bt maize than in the non-Bt – maize plots, while the populations of ladybirds and carabid beetles was higher in the non-Bt maize than in the Bt maize. There were no significant differences between the Bt and non-Bt maize in the number of spiders and earwigs.

The most commonly trapped pollinators at the Kiboko site was the honey bee (apidae). Most of the parasitoids recovered from the traps, were of the generalist category, and they included the tachinid flies, muscid flies and the flesh flies. Other more specific parasitoids of stem borers such as Cotesia flavipes that have been recovered from stem borers in the Kiboko area were not recovered in this study because of the mode of sampling used. No destructive sampling of the plants was conducted as these were breeding materials.

Reference collection

One of the major activities in the arthropod characterization process at the Kiboko field site was the establishment of a reference collection, which comprises of voucher specimens of the various specific

arthropod taxa collected from the field site. The different groups of taxa were preserved using appropriate preservation methods, and at Katumani, two preservation methods were used:
Dry collection: this comprises of dry pinned insects accompanied by labels with information on the name of the country, province, and location of collection, the method of collection, the host crop from which the organism was collected, and the taxonomic identification of the organism.

Wet collection: this comprises of arthropods that have been preserved in 70% ethanol in a tightly closed bottle, bearing a label with the same information as that fore the dry collection.

The main objective of establishment of the reference collection was to serve as technical reference during the monitoring phase in Bt-maize fields.

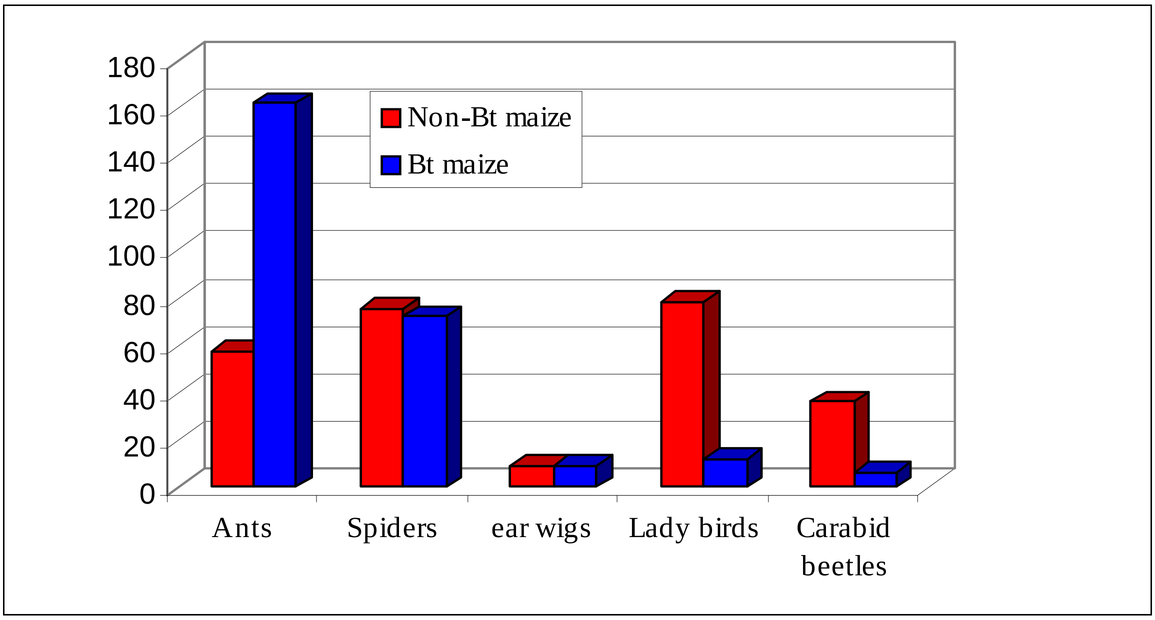

Figure 1. Relative abundance of predators recovered from traps in Bt maize and conventional maize plots at the confined field site at KARI- Kiboko in Eastern Kenya during the period November, 2005 – January, 2006

Recommendations and way forward

1. Monitoring of non-target arthropods will continue in the Bt – and non-Bt plots in Kiboko
2. Controlled studies will continue to be conducted in the BSGH for a better understanding of the direct effects of the Bt proteins on some of the key natural enemies such as on the larval (*C. flavipes*, *C. sesamiae*) and pupal parasitoids (*Dentichasmias busseolae*).
3. Monitoring of arthropods along the edges of farmers' maize crops to determine the potential impact of pollen on non-target arthropods.
4. Depending on availability of adequate Bt- maize grain, we will liaise with the University to conduct ecotox studies (impacts on fish and small mammals).

3.2. Greenhouse/laboratory studies on- Impacts of Bt maize on the development of stem borers and on the Bionomics of key parasitoids of stem borers Cotesia flavipes and Cotesia sesamiae.

Studies were conducted to determine the effects on stem borer larvae of *C. partellus* and *S. calamistis* reared exclusively on Bt maize (event 223) (exposed at 1st instar) on stem borer development. Results of the study showed that the duration of the first instar was shorter (by 19% in *C. partellus* and 25% in *S. calamistis*) on Bt reared maize. Larval, pupal, and overall development times on control plants were consistently higher in *S. calamistis* as compared to *C. partellus*. Pupal weights however appeared significantly greater for *S. calamistis*. Plans for analysis of this data are underway.

A study was conducted to determine the effect of partial exposure to Bt maize (exposed at third instar) on stem borer (*C. partellus*) development. For each replicate, 60 *C. partellus* larvae were exposed to non-Bt maize up to the end of the second instar after which 30 were transferred onto Bt maize and another 30 continuously reared on non-Bt maize (as control). Results of the study showed that 97% of the larvae that had been transferred to Bt maize died within about 8 days. An experiment was then later set up (explained below) in which the larvae will be exposed to Bt maize at later instars.

A study was set up to determine the effect of partial exposure to Bt maize (exposed at fourth and fifth instars) on stem borer (*C. partellus*) development. This study has three treatments: i) Control (larvae reared exclusively on non-Bt maize ii) Larvae reared on non-Bt maize and transferred to Bt maize at beginning of fourth instar iii) Larvae reared on non-Bt maize and exposed to Bt maize at beginning of fifth instar. The data being collected is on the following: stage specific development, pupal weights, fertility, and fecundity. The results thus far indicate high mortalities for the earlier instars than when the Bt maize is given to the later instars. These findings suggest that the effect of Bt on parasitoid life history parameters can only be evident when stem borer larvae are feed on Bt maize at later instars. This finding was used to determine some of the protocols used below.

Choice and non-choice studies were conducted in the greenhouse to determine the effects of Bt maize on the oviposition preference of *C. partellus*. This was the third (and last) replicate. Data analysis on data collected in this study is underway. Preliminary findings indicate that when stem borers were introduced into the cages as pupae, the number of egg batches and overall egg load was marginally higher for the control plants. When stem borer introductions were made as moths the number of egg batches on Bt plants were 15% higher than on non-Bt plants with about 55% of the total eggs laid on Bt plants. Under non-choice conditions, there was considerable variation in oviposition responses between Bt and non-Bt plants, most likely due to egg load variations amongst individual moths.

Studies were conducted to determine the impacts of stem borer larvae reared partially on Bt maize (before and after exposure to Bt), on the host acceptance and development of *C. flavipes*. This involved rearing *C. partellus* larvae on non-Bt maize leaves up to the late second larval instar, and then transferring them to Bt maize stems, reared up to the late third instar, and then exposed to *C. flavipes*. Initial results indicated that 56% of the control larvae were successfully parasitized, while all the Bt fed larvae died before parasitoid emergence. Consequently, a third treatment was included whereby larvae parasitized 7 days before exposure to Bt maize (Previous studies have shown that if larvae are parasitized prior to exposure to Bt maize they are likely to consume sub-lethal doses of the toxin. However, in this replicate 10, 91 and 100 % of parasitized control larvae, larvae parasitized before exposure to Bt and larvae parasitized after exposure to Bt respectively died before parasitoid emergence. The preliminary results indicate that parasitoid development time was about shorter for Bt reared larvae as compared to control larvae. However, the average number of cocoons were 56% more than those of Bt reared larvae (31.3 for control and 20 for Bt). Cocoon weights were also higher (by 48%)

for control larvae. Parasitoid sex ratios were female biased for both control and Bt reared larvae with 63% of the parasitoid offspring being females in the control and 68% for the Bt reared larvae. Average numbers of parasitoid progeny were 58% lower in the Bt treatment.

3.3 Fate of pollen – Impact on non-target insects.

Farms where the trapping of arthropods that may be potentially exposed to Bt maize pollen, were identified in three maize growing regions: Kitui, Masii, and Mombasa. Five farmers were selected in each region, and two types of traps – water traps and pitfall traps were set up within a 10m distance along the edges of farmers' maize/bean fields. The trap catches are collected once every two weeks and identification of arthropods collected form these fields is on-going

Theme 4: Insect Resistance Management and Contingency Plans

4.1 Development of appropriate insect resistance management (IRM) strategies for resource poor farmers in Kenya

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Post Release Resistance Management

One concern regarding the use of Bt maize technology is the likelihood of resistance development to the Bt toxin(s) by the targeted stem borer species. Transgenic insecticidal crops are more likely to expose a larger proportion of the insect populations to selection than foliar insecticides because foliar applications never contact all individuals in the population (Expert Report, 1998), therefore there is need to look for insect resistance management strategies to prolong the efficiency of Bt maize. The rate of evolution of resistance can be slowed or stopped with appropriate resistance management strategies.

The most practical strategy for management of resistance will be use of 20% refugia next to 80% Bt maize with high dose expression of the effective toxin that will kill all homozygous susceptible borers. Based on exit holes, yield and farmer preferences, suitable crop species have been identified as suitable refugia such as sorghum, maize and improved Napier varieties (Tables 9, 10 and 11). Refugia areas can be provided in two possible ways: 1) only part of the field is planted with the transgenic crop and another part as close as possible is maintained as a conventionally treated area or 2) only part of the field is planted with transgenic crop and another part (relatively smaller) as close as possible is maintained as untreated.

Table 9: Summary means for different damage and plant performance parameters for four maize growing environments (Kitale. Kakamega, Embu and Mtwapa 2001-2005).

Crop	Damaged Plants	Dry Matter Yield T/Ha	Exit Holes	Foliar Rating	Larvae /Plant	Leaf Width (Cm)	Stem Diameter (Cm)	No Tillers	Tunnel Length (Cm)	Grain Yield T/Ha
Bana	17.90	12.85	0.45	1.67	0.01	3.51	6.48	30.11	1.75	0.00
Clone13	15.20	11.43	0.47	1.81	0.02	2.87	6.54	45.60	1.95	0.00
Ex-Matuga	7.28	9.15	0.56	1.64	0.03	3.01	3.80	33.67	1.63	0.00
French cameroon	18.39	12.95	0.33	1.72	0.01	2.71	5.27	30.82	1.75	0.00
Gold coast	19.37	11.06	0.68	1.52	0.02	2.74	6.97	26.31	2.07	0.00
Kakamega 1	22.16	18.65	0.50	1.88	0.16	3.32	10.16	23.08	1.37	0.00
Kakamega 2	20.10	13.78	0.51	1.87	0.01	3.55	10.42	28.62	1.60	0.00
Kakamega 3	15.89	14.36	0.69	1.75	0.02	3.22	10.61	30.88	1.33	0.00
Mariakani	14.81	12.76	0.73	1.70	0.00	3.87	11.87	31.77	1.93	0.00
Napier 16798	12.43	9.89	0.52	1.77	0.06	3.45	9.55	31.78	1.81	0.00
Napier 16837	6.45	10.47	0.36	1.55	0.00	3.37	10.79	37.57	1.57	0.00
Napier hybrid	18.26	6.08	0.34	1.74	0.02	2.53	7.46	28.46	2.98	0.00
Pakistan hybrid	20.40	11.32	0.18	1.64	0.00	2.38	8.66	45.93	1.24	0.00
Uganda boarder	11.69	13.24	0.77	1.81	0.01	3.11	6.61	29.81	2.03	0.00
Mean	**15.74**	**12.00**	**0.51**	**1.72**	**0.03**	**3.12**	**8.23**	**32.46**	**1.79**	**0.00**
P-value	**0.47**	**0.53**	**0.30**	**0.67**	**0.34**	**0.00**	**0.41**	**0.70**	**0.36**	**0.00**
CV (%)	**60.89**	**40.51**	**67.20**	**14.16**	**247.71**	**5.77**	**43.42**	**32.55**	**43.74**	**0.00**
R2	**0.65**	**0.74**	**0.79**	**0.79**	**0.41**	**0.96**	**0.81**	**0.90**	**0.89**	**0.00**
LSD (5%)	**13.72**	**8.17**	**0.43**	**0.35**	**0.11**	**0.41**	**6.05**	**23.90**	**0.99**	**0.00**
Guatemala Embu	9.04	12.67	0.07	1.50	0.02	3.59	2.36	31.07	0.27	0.00
Guata Mala Kitale	5.71	8.08	0.17	1.47	0.01	4.34	3.86	10.64	0.68	0.00

Crop	Damaged Plants	Dry Matter Yield T/Ha	Exit Holes	Foliar Rating	Larvae /Plant	Leaf Width (Cm)	Stem Diameter (Cm)	No Tillers	Tunnel Length (Cm)	Grain Yield T/Ha
Moths	7.68	6.75	0.32	1.37	0.01	2.62	2.54	36.95	1.28	0.00
Mean	**7.48**	**9.17**	**0.19**	**1.45**	**0.01**	**3.51**	**2.92**	**26.22**	**0.74**	**0.00**
P-Value	**0.42**	**0.50**	**0.05**	**0.88**	**0.62**	**0.64**	**0.58**	**0.63**	**0.17**	**0.00**
CV (%)	**35.47**	**47.94**	**47.55**	**23.67**	**119.67**	**31.88**	**51.64**	**74.79**	**63.54**	**0.00**
R2	**0.72**	**0.56**	**0.95**	**0.71**	**0.49**	**0.81**	**0.90**	**0.78**	**0.93**	**0.00**
LSD (5%)	**5.21**	**18.91**	**0.14**	**0.62**	**0.04**	**14.23**	**5.29**	**249.17**	**0.83**	**0.00**

Table 10: Summary means for different damage and plant performance parameters for four maize growing environments (Kitale. Kakamega, Embu, and Mtwapa 2001-2005)

CROP	Damaged Plants	DM Yield t/ha	Exit Holes	Foliar Rating	Larvae /Plant	Leaf Width (Cm)	Stem Diameter (Cm)	No Tillers	Tunnel Length (Cm)	Grain Yield T/Ha
Columbus Grass	24.35	4.80	0.56	1.70	0.14	2.58	1.78	7.81	4.16	0.92
G. panicum Embu	10.34	2.93	0.27	1.52	0.01	2.33	1.73	47.32	1.49	
G. panicum Kitale	11.72	1.67	0.34	1.33	0.01	1.98	1.22	18.07	2.26	
Giant Setaria	11.27	1.82	0.36	1.36	0.01	2.48	4.19	30.05	1.11	
Guinea Grass	11.73	3.29	0.28	1.58	0.01	3.45	2.35	19.99	1.76	
Oats	9.12	7.13	0.18	1.49	0.04	2.19	1.13	5.42	0.00	0.58
Sudan Grass	24.05	7.78	0.52	1.79	0.04	2.06	1.25	17.52	3.48	3.20
Mean	**13.63**	**5.01**	**0.33**	**1.52**	**0.04**	**2.62**	**1.94**	**21.20**	**1.82**	**2.51**
P-Value	**0.18**	**0.30**	**0.13**	**0.62**	**0.04**	**0.32**	**0.10**	**0.40**	**0.29**	
CV (%)	**72.87**	**73.94**	**70.85**	**23.87**	**103.01**	**25.45**	**57.16**	**78.26**	**149.47**	
R2	**0.66**	**0.61**	**0.84**	**0.44**	**0.69**	**0.65**	**0.81**	**0.67**	**0.65**	
LSD (5%)	**14.97**	**8.77**	**0.31**	**0.54**	**0.07**	**1.63**	**2.00**	**40.60**	**3.69**	
L Sorghum 1 White	16.74	6.94	1.66	2.36	0.19	2.31	2.14	5.22	11.37	1.21
L Sorghum 2 Brown	23.81	5.05	1.69	2.39	0.28	2.86	3.12	4.60	10.84	2.50
L Sorghum 3 Red	20.43	3.57	2.34	2.22	0.10	2.52	2.87	4.48	13.28	1.71
L Sorghum 4 Brown	18.78	3.35	2.34	2.25	0.10	3.18	3.00	4.32	14.08	1.51
Pearl Millet	17.47	7.68	1.38	1.79	0.00	1.97	1.96	5.58	0.00	0.45
Sorghum Seredo	14.84	3.26	1.57	2.21	0.16	2.21	2.27	5.65	11.97	1.17
Mean	**18.37**	**4.97**	**1.62**	**2.14**	**0.14**	**2.51**	**2.58**	**4.98**	**10.49**	**1.43**
P-value	**0.62**	**0.54**	**0.14**	**0.06**	**0.00**	**0.50**	**0.09**	**0.10**	**0.00**	**0.27**
CV (%)	**32.48**	**57.83**	**54.25**	**9.63**	**32.94**	**25.07**	**17.66**	**9.06**	**24.70**	**41.85**
R2	**0.74**	**0.50**	**0.85**	**0.72**	**0.88**	**0.98**	**0.97**	**0.81**	**0.94**	**0.93**
LSD (5%)	**9.11**	**7.39**	**1.17**	**0.31**	**0.09**	**1.62**	**0.84**	**1.16**	**3.43**	**1.66**
Maize - Coast Comp.	17.57	5.00	1.04	1.61	0.11	7.43	6.17	1.00	5.42	3.13
Maize- H513	15.32	5.30	1.45	1.76	0.14	9.02	4.46	1.00	5.51	4.77
Maize- H614d	16.76	6.16	1.64	1.86	0.14	9.27	5.16	1.00	5.63	5.42
Maize- H622	16.02	4.20	1.32	1.86	0.37	9.47	5.24	1.00	5.16	3.01
Maize-Mungido	9.19	6.96	0.47	2.08	0.01	8.40	6.17	1.00	2.44	3.09
Maize-Ph1	18.10	4.26	0.91	1.87	0.12	8.34	6.17	1.00	3.76	3.04
Maize-Ph3253	16.73	4.67	1.27	1.84	0.07	9.98	5.14	1.00	3.92	4.48
Maize-Ph4	16.91	6.27	1.16	1.88	0.04	8.37	5.85	1.00	3.92	3.80
Maize Mzihana	16.58	6.23	1.78	2.32	0.01	8.09	6.54	1.00	5.92	3.84
Mean	**15.91**	**5.35**	**1.24**	**1.90**	**0.13**	**9.22**	**5.54**	**1.00**	**4.64**	**3.84**
P-Value	**0.48**	**0.05**	**0.03**	**0.38**	**0.56**	**0.18**	**0.69**		**0.21**	**0.10**
CV (%)	**24.36**	**9.36**	**26.63**	**12.63**	**157.15**	**5.56**	**18.06**		**31.51**	**25.79**
R2	**0.92**	**0.97**	**0.95**	**0.66**	**0.40**	**0.92**	**0.95**		**0.93**	**0.86**
LSD (5%)	5.78	1.14	0.44	0.36	0.36	1.42	1.89		1.93	1.50

Table 11. Life cycle and reproductive potential for Busseola fusca and Sesamia calamistis reared on different classes of alternate hosts under Laboratory conditions, Kitale, 2002-2003.

	Busseola fusca			*Sesamia calamistis*		
Crop type	Life Cycle (days)	Percent Survival	Egg Production	Life Cycle (days)	Percent Survival	Egg Production
Napier Grass	64.5	2.8	5.0	60.9	3.3	93.0
Local Sorghum	60.3	37.8	184.8	56.5	13.3	67.0
Maize	53.2	18.5	246.6	51.7	27.5	629.3

Use of natural refugia like in China could be used in Kenya. Surveys conducted in several districts in Kenya indicate that most districts have enough refugia, for example, the coast region had 18%, a level comparable to the 20% recommended for commercial maize in the USA. Some districts had less than 20% refugia. Such regions will require structured or augmented refugia to attain 20% refugia and frequent monitoring for resistance. This is due largely to an almost exclusive planting of maize and very little area planted to alternate hosts, including sorghum.

Other key issues to be addressed will be how to maintain the Bt gene in the seeds especially where farmers grow open pollinated varieties from recycled seed. Some farmers neighboring Bt maize growers might not want the Bt trait in their maize, which can be pollinated by neighboring Bt maize varieties (i.e. gene flow). Recycling and gene flow can create a situation whereby seed, which is heterozygous for the Bt gene, will be produced and planted in the subsequent cropping season. In a segregating population of Bt maize plants, some plant will not contain a copy of the Bt gene while other will be heterozygous or homozygous for the Bt gene. This then creates an ideal selection environment in which neonate larvae are able to initiate feeding on a Bt maize plant but then spin off the plant in search of a non-toxic plant as larvae able to detect the toxin within 3 minutes of initiating feeding. Such a selection environment can lead to resistance breakdown. To minimize this, farmers will need to be educated on the selection of resistant plants to serve as future seed sources. Farmers using the Bt maze technology will be advised not to recycle seed but to purchase new certified Bt seeds every season. They will also be advised to scout their farms often and de-tassel damaged plants to both mark susceptible plants and to reduce the probability of these plants crossing to Bt maize plants, thereby increasing the probability of maintaining the plant in a homozygous state.

To reduce effects of gene flow resulting to contamination of Bt maize by pollen from non Bt maize, which may be planted by neighbors, farmers will be advised to harvest seed from plants within the center of their plot. Gene flow studies on maize in Kenya have indicated that most of the pollen (70%) falls within 10 meters from the source (Mugo et al, 2001), so farmers who don't want any Bt in their maize should be advised to also select seed from the center of their plots to minimize crossing to Bt hybrids and varieties.

Growers' acceptance and participation in the implementation of the IRM strategy will depend on the success of the initial attempts to sensitize those involved in the Bt technology and the type of IRM strategy being developed for Kenya. Success of the IRM strategy will depend on a wide range of stakeholders: from the Bt technology provider (i.e. seed companies) through to seed merchants and farmers who will grow the improved seed containing the Bt trait. Education of all those involved with the Bt crop will therefore be a priority in the IRM strategy for Kenya. Those involved include farmers, extension agents, traders, seed stockists, regulators, policy makers, news reporters, and researchers. Several workshops will be conducted to educate stakeholders on the importance of refugia, suitable refugia plans, how to establish and locate refugia in relation to Bt. maize plots, and its management to get maximum benefits from its use. To be effective, the IRM strategies must be implemented when resistance allele frequencies are low within the target pest population, in this case maize stem borers.

Deployment of IRM strategies after resistance is detectable may be too late to realize its maximum benefits (Expert panel report, 1998). As it is not possible to conduct large-scale experiments using Bt maize to verify the planed IRM plan, monitoring in the early stages of deployment will be critical to ensure any reported incidences of breakdown are dealt with quickly and effectively.

Post Release Resistance Monitoring and Contingency Plans

It is important that the Kenya Plant Health Inspectorate Service (KEPHIS), which is mandated to verify seed quality, check for homozygosity of the Bt gene in commercial seed using standard immunoassay kits that are commercially available. Farmers and extension staff will be encouraged to scout and report any changes observed in the efficacy of the Bt technology and report any damages observed on the Bt crop to the seed companies supplying the seed. Careful field scouting of Bt maize plots will also be done by experienced entomologists to detect occurrence of crop damage which may be due to resistance or failure of control and conduct detailed investigations on cause of pest survival including rearing surviving insects in the laboratory and conducting bio-assays using an appropriate single discriminatory dose (LC99) which kills all the susceptible insects leaving the resistant ones in order to confirm presence of resistant individuals. More surveys that are intensive will be conducted in areas where damage is observed and a discriminatory dose used to test and detect for resistant individuals. Diagnostic or discriminating assays have been used successfully in the USA (Roush, 1994 a, b; Roush and Miller, 1986).

Using GIS maps on distribution of refugia to identify areas with less than 20% refugia will enable a focused monitoring campaign in these areas as well as promote alternate hosts or conventional sources of maize resistance to increase the effective refugia to 20%. Base line susceptibility for each borer species in the major agroecological zones will be determined in order to establish a discriminatory dose before the introduction of the Bt maize. Each registrant of Bt maize will be requested to keep an annual record of Bt and non-Bt seed sales in all locations, and the list of farmers and acreage grown which should also be submitted to regulators. This data will assist in determining where refugia is not adequate and where monitoring efforts should intensify. In cases were incidences of resistance to the Bt trait is confirmed, farmers will be advised to contain the resistant biotype using chemical strays. The IRMA team as developed a list of compatible control strategies as part of an Integrated Pest Management Program to reduce the selection pressure from a single control intervention (i.e. Bt toxin) to prolong the life-span of the Bt technology for future generations.

Recommendations for Further Research

To avoid confusing farmers with different IRM strategies, and because the same strategy is likely to be used in other African counties, it will be necessary to have a regional multidisciplinary working group meeting of experts in Africa, with assistance of consultants to modify the planned IRM strategy based on scientific facts, experiences and lessons learned by those who are already using the technology. There is also need to have a coordinated effort among all those who are likely to be involved in the Bt technology such as multidisciplinary teams of researchers, seed company representatives, universities, regulatory bodies, policy makers, seed stockists and farmers to create a national IRM stewardship technical committee which will develop a uniform IRM plan for the region in association with the regulatory bodies in the region. There will be need to incorporate the growers concerns in the different regions while developing a proper refuge to be used on-farm. These will increase the possibly of growers complying with the recommended IRM plan when Bt maize is eventually released. Surveys on grower's awareness and adoption should be conducted before and after release of Bt maize. Followed by similar annual surveys to assess growers' adherence to the recommended IRM strategies and find out reasons for non-compliance so that appropriate modifications are made to the IRM plan to increase its effectiveness. Educational programs should be designed to further education programs and topics in order to strengthen grower stewardship. It might be necessary to start discussing the type of agreements that may be necessary between growers and seed companies to enhance compliance in the proper use of the Bt technology. Clear guidelines explained using simple diagrams would be required to ensure language barriers do not pose an impediment to the understanding and use of refugia. From the start, the IMRA project has looked at minimizing the disturbance within the existing cropping system for a given season in order to meet refugia targets.

Experiments will be necessary to fill in gaps in knowledge, for example it is necessary to determine the effectiveness of various Bt maize varieties that are likely to be marketed in Kenya to confirm the high dose strategy against common Kenyan stem borers and related pest complex, there is also need to determine the discriminatory dose in collaboration with seed companies who are likely to be involved in the marketing of the Bt maize or develop simple molecular methods to detect changes in insect populations over time. Previous work by CIMMYT has shown that pupal weight is the most sensitive indicator for testing the increased in stem borer populations to the Bt toxins.

Theme 5: Biosafety and Regulatory Issues

S. Mugo and S.T. Gichuki

Biosafety and regulatory activities related to the inspection and launching of biosafety facilities are reported in section 1.1. Other activities were in training, as reported in section 10.2. Still others related to participation at meetings and workshops, reported in section 10.1.

KEPHIS plant inspectors were involved on various occasions as detailed below:

- Supervision of the second planting of Bt maize CFT at Kiboko on 3 Nov 2005.
- The observations of harvesting leaves from the CFT for bioassays with the African stem borer (*Busseola fusca*), the sugarcane borer (*Eldana saccharina*), and the pink stem borer (*S. calamistis*) on 8 Dec. 2005.
- Observations of harvesting of transgenic Bt maize seeds in the BGHC on several occasions during the reporting period. At each occasion, the harvested seed were shelled, treated, and stored in the appropriate biosafety seed cabinet in the secure seeds store.
- Harvesting of the evaluation of the Bt Maize confined field trial (CFT) at the open quarantine site (OQS) at KARI Kiboko on 22 March 2006.
- The harvesting of BC2F1 seeds from backcrossing of Bt and non-Bt maize germplasm at the CFT Kiboko on 4 April 2006. This included disposal of plant materials on site.

An "Application to introduce maize Hybrid DKC8073YG and DKC8053YG (with Bt event MON 810 containing Cry1Ab gene) to carry out greenhouse containment trials to evaluate the efficacy of the Bt δ-endotoxin against maize stem borers in |Kenya" was presented to the NBC on 25 May 2006 by S. Gichuki, S. Mugo and E. Ateka.

Global Multimedia & PR Ltd interviewed S. Gichuki G. Murenga including footage of the BGHC. S. Mugo and Director KARI Dr. E. Mukisira were interviewed separately. This was for a video commissioned by AHBFI for use to drum up support for the biotechnology policy and biosafety bill when the bill comes up in the Kenyan parliament.

S. Gichuki sent Mercy Mbogori, a scientist at Biotech center to represent him during a visit by a group of Kenyan parliamentarians to Bt cotton confined field trials at KARI Mwea on 20 June 2006.

The IRMA Internal Regulator and his team have continued to follow the developments in biosafety and bio-regulation in the Kenyan legislative system, as the draft Biosafety Bill continues to be debated by stakeholders. The ministry of Research, Science and Technology through NCST is committed to moving the Biotechnology Policy and Bill to parliament. The Kenya cabinet adopted the Biotechnology Policy on 28 Sept 2006. The biotechnology Policy does not need to pass through Parliament. The biosafety Policy was also accepted and has now been forwarded to the Attorney General to format for publishing in the Kenya Gazette. The public will thereafter have 14 days to respond before it is tabled in Parliament. This is good news indeed and a positive move on the part of the Government of Kenya in support of biotechnology. A lot more work is however, needed to drum up support among the members of parliament.

Theme 6: Intellectual Property Rights (IPR) and Licensing

S. Mugo, D. Bergvinson, H. DE Groote, and S.T. Gichuki

The 2005 annual IRMA project review and planning meetings, which were combined with a mini-review by the IRMA Technical Advisory Board (TAB), recommended to the IRMA Executive Committee (EC) that private technology providers be approached for access to Bt events that are effective against *Busseola fusca* and *C. partellus*, and already commercialized elsewhere (i.e., have a completed and accepted regulatory dossier). Draft. The IRMA – EC approved the plan during their meeting on 3 Feb 2006. A licensing specification sheet was prepared and letters requesting Monsanto, DuPont, and Syngenta for Mon810, TC1507 and Bt11 were sent. Monsanto welcomed the request for negotiations. Syngenta declined to offer BT11 due to SFSA support of IRMA project, and since Bt11 event is under license from Monsanto. No response has been received from DuPont.

An IRMA Project negotiating team to be led by M. Banziger and to include J. Danson, S. Mugo, and S. Gichuki was formed. When negotiations started, this team sought the inputs of H. DeGroote and M. Odendo, while the IRMA-EC was kept informed and has been resourceful as well.

An initial meeting was held on 27 Feb 2006 where general acceptance for collaboration was agreed on. A follow up meeting was held on 10 March 2006 to fine tune the agreement. Confidentiality considerations will not allow details to be presented here, but all meeting have been positive and there is high likelihood of sealing a general contractual agreement on how to share MON810 by August 2006.

Meetings for negotiations with Monsanto were held on 27th Feb, 10th March, 6 April, 25 April, 11 May, and 16th June. The initial meeting was attended by Marianne Banziger, Stephen Mugo, Jedidah Danson, and Simon Gichuki from IRMA, and Andrew Bennett, Kinyua M'Mbijjewe, Kobus Lindeque, Natalie DiNicola, Philippe Castaing, Rob Horsch, and Tara Smith all of Monsanto. Subsequent meetings were attended variously by K. M'Mbijjewe and A. Bennett of Monsanto, and M. Banziger, S. Mugo, H. DeGroote, S. Gichuki, and Martins Odendo from IRMA. The ExCo had a teleconference with Monsanto on 26 June 2006.

A draft agreement on trait integration and a draft of "Key components of a contractual agreement between CIMMYT, KARI, and Monsanto for sharing the use of MON810 in Kenya" were prepared and are being studied by both parties. Confidentiality considerations will not allow details to be presented here. However, all meeting have been positive. Obviously, the general contractual agreement on how to share MON810 was not sealed by August 2006 but this may be possible before year end.

The IRMA Executive Committee (IRMA-EC) met on 26 June 2006 and decided that IRMA project to write to University of Ottawa to the effect that CIMMYT wishes to retain their events for research only.

Theme 7: Seed Production

S. Mugo, W. Muasya, and O. Odongo

All seed increases of inbred lines and OPVs and nurseries were grown at KARI Kiboko. A total of 74.73 Kg inbred lines and 541.5 kg OPV seeds were produced during 2006A and 2006B seasons. These included 67.73 kg inbred lines and 541.5 kg OPVs increased during 2006A season from trials (Table 12). During 2006 B season, a total of 7 kg inbred line seeds were produced. These seeds were used to maintain the germplasm, generate new germplasm through crossing and for various evaluation trials.

Table 12: Summary of seed increases and development of new germplasm during 2006A and 2006B seasons

		2006A		**2006B**		
	Generation	**Number**	**Seed Weight (Kg)**	**Number (No.)**	**Seed Weight (Kg)**	**Totals (Kg)**
1	Inbred Lines	42	68	6	7	75
2	S1	-	-	96	80	80
3	OPVs	26	542	-	-	542
4	Single Cross Hybrids	80	44	9	21	65
5	Three Way Cross Hybrids	199	242	50	156	398
6	Backcrosses	24	50	-	-	50
	Totals	**371**	**945**	**161**	**265**	**1,210**

Descriptors of IR Maize inbred line, single cross hybrids and OPVs of insect resistant Hybrids together with the hybrids themselves of the new hybrids entered in the NPT were done at Kiboko. This data was sent to KEPHIS to support the DUS observations.

The 2006 NPT meeting was held in November 2006. Two of the insect resistant OPVs tested 2004-2006 were given full release status due to their superior performance (Tables 13-15).

Table 13: Means of grain yield and stem borer for maize NPT for the Moist Mid-Altitude region tested across three years

			YIELD(t/ha)												
											COUNT(%)		EAR PARAMETERS(%)		
VARIETY	TYPE	SOURCE	MEAN	% ABOVE BEST CHECK	% ABOVE MEAN OF CHECKS	LEAF DAM.	EXIT HOLES	TUNNEL LENGTH	TUNNEL L_EHT RATIO	EHT	HARV.	THINN.	BT	DE	UE
H26M1	HYBRID	KENYA SEED	6.54	40.33	50.80	3.46	1.96	8.17	0.06	148.17	88.89	97.78	6.85	6.55	93.45
MU03-022	HYBRID	KARI MUGUGA	5.53	18.65	27.51	3.15	1.45	2.51	0.02	129.88	95.56	97.78	24.54	2.38	97.62
PAN63	HYBRID	PANNAR	5.09	9.23	17.37	3.80	2.80	6.97	0.06	117.35	86.67	97.78	7.47	7.47	92.53
PAN7M-97	HYBRID	PANNAR	5.03	7.89	15.94	3.26	1.03	4.17	0.03	135.81	88.89	97.78	30.95	0.00	100.00
CRN3549	HYBRID	MONSANTO	5.00	7.28	15.28	3.09	1.31	2.82	0.03	117.86	95.56	100.00	36.67	0.00	100.00
MU03-036	HYBRID	KARI MUGUGA	5.00	7.24	15.25	4.16	3.51	11.62	0.08	146.81	93.33	95.56	11.20	6.25	93.75
SC715	HYBRID	SEEDCo	4.98	6.84	14.81	2.45	1.71	4.52	0.03	145.63	95.56	100.00	0.00	2.56	97.44
H24M1	HYBRID	KENYA SEED	4.96	6.44	14.38	3.72	4.21	11.57	0.09	139.53	97.78	100.00	0.00	0.00	100.00
MZ51	HYBRID	KENYA SEED	4.88	4.76	12.57	2.80	1.23	5.23	0.04	124.63	100.00	100.00	9.52	2.38	97.62
MU03-025	HYBRID	KARI MUGUGA	4.79	2.84	10.51	3.61	2.00	5.47	0.05	121.58	95.56	97.78	16.53	6.30	93.70
MU03-010	HYBRID	KARI MUGUGA	4.74	1.76	9.36	3.80	2.26	3.92	0.03	117.86	97.78	100.00	25.71	18.89	81.11
MZ602	HYBRID	KENYA SEED	4.57	-1.99	5.33	2.34	0.77	3.10	0.02	142.75	95.56	95.56	4.76	4.31	95.69
MZ603	HYBRID	KENYA SEED	4.45	-4.44	2.69	3.90	2.50	8.22	0.06	126.49	88.89	100.00	11.11	4.60	95.40
MU03-019	HYBRID	KARI MUGUGA	4.32	-7.29	-0.37	3.17	1.75	4.57	0.05	103.97	82.22	91.11	15.38	5.13	94.87
MZ601	HYBRID	KENYA SEED	4.18	-10.29	-3.60	2.86	1.21	5.02	0.04	137.33	91.11	100.00	10.71	8.93	91.07
PAN69	HYBRID	PANNAR	4.07	-12.75	-6.24	3.91	2.47	7.33	0.06	121.92	91.11	100.00	7.01	2.22	97.78
PAN57	HYBRID	PANNAR	4.02	-13.68	-7.24	3.40	1.07	3.83	0.03	120.06	88.89	100.00	2.22	5.00	95.00
H517	HYBRID	KENYA SEED	3.62	-22.22	-16.42	3.75	2.27	5.20	0.04	131.74	91.11	97.78	0.00	5.00	95.00
WH0406	HYBRID	WESTERN SEED	3.22	-30.83	-25.66	3.12	1.36	4.82	0.04	112.61	71.11	73.33	22.54	0.00	100.00
MZ401	HYBRID	KENYA SEED	2.86	-38.54	-33.95	3.28	2.97	8.07	0.06	126.83	88.89	88.89	21.65	0.00	100.00
SC637	HYBRID	SEEDCo	2.77	-40.47	-36.03	3.89	2.16	5.77	0.05	117.52	84.44	91.11	2.78	2.78	97.22
EMB-220	HYBRID	KARI EMBU	5.07	30.87	30.87	3.77	2.37	7.90	0.06	126.66	91.11	97.78	2.22	2.22	97.78
EMB-219	HYBRID	KARI EMBU	4.18	7.90	7.90	3.36	0.99	2.71	0.02	121.75	80.00	100.00	4.60	2.22	97.78
EMB-216	HYBRID	KARI EMBU	4.01	3.49	3.49	2.58	1.17	3.10	0.02	131.40	91.11	91.11	16.59	0.00	100.00
WS303	OPV	WESTERN SEED	3.95	2.04	2.04	3.66	1.51	3.27	0.03	106.85	95.56	97.78	7.33	0.00	100.00
EMB-215	HYBRID	KARI EMBU	3.81	-1.54	-1.54	2.52	0.67	2.73	0.02	129.20	91.11	100.00	6.55	0.00	100.00
EMB-218	HYBRID	KARI EMBU	3.66	-5.45	-5.45	3.37	0.49	2.14	0.02	120.57	93.33	93.33	8.12	2.78	97.22
EMB-217	HYBRID	KARI EMBU	3.39	-12.55	-12.55	3.51	0.77	3.27	0.03	134.28	86.67	91.11	6.83	7.17	92.83
EMB-214	OPV	KARI EMBU	3.36	-13.28	-13.28	3.70	1.31	2.77	0.03	115.65	93.33	100.00	13.03	5.59	94.41
EMB-211	OPV	KARI EMBU	3.30	-14.80	-14.80	2.69	0.66	0.62	0.01	113.28	88.89	100.00	19.96	2.56	97.44
OCD04-2	OPV	OCD	3.20	-17.51	-17.51	3.13	1.46	4.12	0.04	154.26	95.56	100.00	12.22	10.00	90.00
EMB-213	OPV	KARI EMBU	3.07	-20.69	-20.69	2.47	0.70	2.93	0.03	114.47	91.11	100.00	7.35	2.56	97.44
EMB-212	OPV	KARI EMBU	2.89	-25.31	-25.31	3.46	1.94	4.76	0.04	114.64	88.89	95.56	7.14	2.38	97.62
OCD04-1	OPV	OCD	2.69	-30.62	-30.62	3.84	2.53	7.77	0.07	131.74	95.56	97.78	19.09	6.36	93.64
H513	HYBRID	CHECK	4.66			2.38	1.57	3.67	0.03	121.24	93.33	97.78	6.83	4.60	95.40
WH403	HYBRID	CHECK	4.33			3.30	2.44	7.32	0.07	112.44	88.89	93.33	11.93	2.38	97.62
PHB3253	HYBRID	CHECK	4.02			2.50	0.87	2.35	0.02	103.12	88.89	91.11	2.56	7.99	92.01
WS909	OPV	CHECK	3.87			2.57	0.97	4.27	0.04	118.87	93.33	95.56	5.56	3.33	96.67
		MEAN	4.16			3.26	1.69	4.96	0.04	125.18	90.94	96.43	11.20	4.02	95.98
		P-VALUE	0.13			0.54	0.04	0.08	0.49	0.09	0.65	0.04	0.00	0.54	0.54
		CV(%)	31.02			27.57	64.81	67.44	74.93	14.92	10.95	7.32	95.04	165.02	6.92
		R2	0.62			0.43	0.51	0.47	0.37	0.45	0.41	0.45	0.51	0.35	0.35
		LSD(5%)	2.10			1.46	1.79	5.46	0.05	30.36	16.20	11.48	17.30	10.80	10.80
				ONFIDENCE INTERVA											
	MEAN OF CHECKS-H		4.34	3.55	5.12										
	MEAN OF CHECKS-O		3.87	2.39	5.36										

Table 14: Means of yield and stem borer parameters for Mid-late (Kakamega) maize NPT 2006

			YIELD(t/ha)								COUNT(%)		EAR PARAMETERS(%)		
VARIETY	TYPE	SOURCE	MEAN	% ABOVE BEST CHECK	% ABOVE MEAN OF CHECKS	LEAF DAM.	EXIT HOLES	TUNNEL LENGTH	TUNNEL L_EHT RATIO	EHT	HARV.	THINN.	BT	DE	UE
X1403YW	HYBRID	PIONEER	5.49	13.27	61.79	1.34	0.30	0.53	0.00	111.00	88.89	91.11	4.04	23.71	76.29
ZR601	HYBRID	KENYA SEED	5.38	11.02	58.58	1.14	0.00	0.00	0.00	158.33	95.56	100.00	22.41	25.74	74.26
ZR603	HYBRID	KENYA SEED	5.14	6.05	51.47	1.77	0.20	0.21	0.00	170.10	100.00	100.00	44.44	34.39	65.61
H26ML1	HYBRID	KENYA SEED	5.01	3.45	47.77	1.57	0.04	0.28	0.00	171.77	77.78	95.56	15.56	17.78	82.22
ETZ012	HYBRID	PANNAR	4.92	1.48	44.95	1.48	0.07	0.10	0.00	137.13	97.78	97.78	27.88	19.23	80.77
MU03-011	HYBRID	KARI MUGUGA	4.75	-1.98	40.00	1.31	0.00	0.00	0.00	123.43	97.78	100.00	34.07	21.81	78.19
SC715	HYBRID	SEEDCo	4.68	-3.48	37.86	1.23	0.16	0.47	0.00	139.67	93.33	97.78	38.44	21.49	78.51
MU03-019	HYBRID	KARI MUGUGA	4.66	-3.88	37.30	1.31	0.05	0.37	0.00	116.57	93.33	95.56	20.79	13.65	86.35
X4A149W	HYBRID	PIONEER	4.58	-5.47	35.02	1.37	0.02	0.06	0.00	149.77	97.78	97.78	6.14	12.29	87.71
KM20119	HYBRID	KARI KAKAMEGA	4.45	-8.09	31.28	1.34	0.05	0.12	0.00	142.87	68.89	73.33	39.09	5.16	94.84
ZR3	HYBRID	KENYA SEED	4.16	-14.05	22.77	1.33	0.14	0.47	0.00	137.77	80.00	82.22	28.59	26.52	73.48
PAN8M-95	HYBRID	PANNAR	4.16	-14.18	22.58	1.42	0.23	0.95	0.01	125.53	93.33	95.56	30.17	30.28	69.72
KM0404	HYBRID	KARI KAKAMEGA	4.12	-14.89	21.57	1.13	0.00	0.00	0.00	128.13	91.11	91.11	25.86	24.01	75.99
ESZ101	HYBRID	PANNAR	4.11	-15.08	21.30	1.63	0.15	0.40	0.00	128.20	82.22	84.44	12.96	20.37	79.63
KM0405	HYBRID	KARI KAKAMEGA	3.88	-19.83	14.51	1.29	0.05	0.14	0.00	146.67	95.56	100.00	13.08	11.29	88.71
KM20115	HYBRID	KARI KAKAMEGA	3.77	-22.10	11.27	1.46	0.19	0.98	0.01	136.90	60.00	62.22	9.05	17.50	82.50
ZR602	HYBRID	KENYA SEED	3.72	-23.16	9.75	2.00	0.00	0.20	0.00	165.23	75.56	84.44	38.40	27.39	72.61
MU03-017	HYBRID	KARI MUGUGA	3.41	-29.69	0.42	1.72	0.00	0.00	0.00	109.90	91.11	95.56	26.36	6.67	93.33
KM0406	HYBRID	KARI KAKAMEGA	3.11			1.30	0.00	0.00	0.00	131.77	97.78	100.00	39.43	29.10	70.90
SC637	HYBRID	SEEDCo	2.30			1.63	0.53	1.76	0.01	134.20	97.78	97.78	33.44	21.15	78.85
H25ML1	HYBRID	KENYA SEED	1.21			1.69	0.00	0.00	0.00	139.70	24.44	24.44	50.00	23.33	76.67
KM0403	OPV	KARI KAKAMEGA	3.59	17.80	36.36	1.71	0.17	0.57	0.00	120.53	88.89	91.11	23.70	23.13	76.87
KM0402	OPV	KARI KAKAMEGA	2.33			1.31	0.04	0.07	0.00	130.37	91.11	95.56	17.03	21.98	78.02
KM0401	OPV	KARI KAKAMEGA	2.19			1.39	0.13	0.57	0.01	119.20	88.89	91.11	20.60	16.90	83.10
H516	HYBRID	CHECK	4.84			1.24	0.00	0.35	0.00	143.33	95.56	97.78	21.11	12.78	87.22
H623	HYBRID	CHECK	3.85			1.60	0.31	1.22	0.01	156.10	100.00	100.00	15.85	30.99	69.01
WH505	HYBRID	CHECK	3.20			1.60	0.00	0.00	0.00	127.90	73.33	73.33	45.37	26.85	73.15
PHB3253	HYBRID	CHECK	2.68			1.53	0.03	0.06	0.00	122.45	91.11	92.22	15.67	27.45	72.55
H513	HYBRID	CHECK	2.38			1.38	0.16	0.26	0.00	118.77	68.89	80.00	14.95	27.50	72.50
KSTP94	OPV	CHECK	3.05			1.50	0.18	0.69	0.01	137.17	93.33	97.78	21.35	24.08	75.92
WS909	OPV	CHECK	2.22			1.09	0.63	2.57	0.02	115.33	73.33	80.00	30.36	15.60	84.40
		MEAN	3.79			1.45	0.12	0.43	0.00	135.35	85.95	89.21	25.36	21.29	78.71
		P-VALUE	0.00			0.38	0.15	0.43	0.41	0.00	0.00	0.00	0.00	0.32	0.32
		CV(%)	23.92			20.66	186.93	226.23	238.30	8.17	15.04	13.02	52.16	54.65	14.79
		R2	0.75			0.46	0.40	0.36	0.37	0.76	0.67	0.71	0.54	0.35	0.35
		LSD(5%)	1.48			0.49	0.38	1.59	0.01	18.02	21.08	18.94	21.57	18.97	18.97
				CONFIDENCE INTERVA											
	MEAN OF CHECKS-H		3.39	2.95	3.83										
	MEAN OF CHECKS-O		2.64	2.00	3.27										

Table 15: Means of yield and stem borer parameters for Mid-Altitude Early maturity maize NPT 2006.

			YIELD(t/ha)								STAND COUNT(%)		EAR PARAMETERS (%)		
VARIETY	TYPE	SOURCE	MEAN	% ABOVE BEST CHECK	% ABOVE MEAN OF CHECKS	LEAF DAM.	EXIT HOLES	TUNNEL LENGTH	TUNNELL_EHT RATION	EHT	HARV.	THINN.	BT	DE	UE
DH06	HYBRID	KENYA SEED	6.96	-2.28	18.10	1.71	1.58	3.72	0.03	117.66	100.00	100.00	6.67	2.22	97.78
EDH206	HYBRID	KENYA SEED	6.15	-13.66	4.34	1.42	1.89	3.21	0.02	135.82	97.78	100.00	6.41	2.22	97.78
KAT2006-1	HYBRID	KARI KATUMANI	6.09	-14.53	3.29	1.22	1.66	4.02	0.03	124.39	100.00	100.00	28.47	2.08	97.92
ETA134	HYBRID	PANNAR	5.88			1.58	0.62	1.24	0.01	91.62	100.00	100.00	22.22	0.00	100.00
KAT2005-2	HYBRID	KARI KATUMANI	5.71			1.76	1.52	2.50	0.03	94.49	100.00	100.00	21.41	2.38	97.62
KAT2006-2	HYBRID	KARI KATUMANI	5.69			1.34	0.76	2.28	0.02	120.26	93.33	97.78	58.82	0.00	100.00
ETA102	HYBRID	PANNAR	5.36			1.20	0.73	4.36	0.05	84.79	97.78	100.00	34.09	7.97	92.03
KAT2006-3	HYBRID	KARI KATUMANI	5.31			1.16	0.25	1.15	0.01	114.16	93.33	97.78	10.07	0.00	100.00
KAT2005-3	HYBRID	KARI KATUMANI	5.24			1.66	2.04	5.95	0.05	113.34	95.56	97.78	8.89	4.04	95.96
KAT2005-5	HYBRID	KARI KATUMANI	5.16			1.47	1.22	3.21	0.03	94.90	100.00	100.00	11.11	0.00	100.00
KAT2005-4	HYBRID	KARI KATUMANI	4.86			1.70	1.46	3.80	0.04	104.84	93.33	100.00	12.30	0.00	100.00
KAT2005-1	OPV	KARI KATUMANI	6.14	21.57	36.92	1.89	1.24	3.26	0.03	98.51	100.00	100.00	18.80	1.75	98.25
CKIR04003	OPV	KARI KATUMANI	6.09	20.57	35.80	1.29	0.82	2.18	0.02	108.66	97.78	100.00	11.85	0.00	100.00
CKIR04002	OPV	KARI KATUMANI	5.79	14.53	28.99	1.33	0.96	2.58	0.02	107.46	95.56	100.00	18.98	0.00	100.00
CKIR04005	OPV	KARI KATUMANI	4.72	-6.55	5.25	1.24	0.71	2.11	0.02	107.64	100.00	100.00	42.51	0.00	100.00
SC DUMA 41	HYBRID	CHECK	7.12			1.47	1.33	2.93	0.03	103.16	97.78	100.00	4.76	2.08	97.92
DH01	HYBRID	CHECK	4.67			1.78	0.89	2.05	0.02	91.29	97.78	100.00	17.63	0.00	100.00
WS103	OPV	CHECK	5.05			1.50	1.39	5.07	0.05	101.85	100.00	100.00	10.91	0.00	100.00
KCB	OPV	CHECK	3.92			1.34	1.38	4.82	0.05	98.28	100.00	100.00	9.13	2.08	97.92
		MEAN	5.58			1.48	1.18	3.18	0.03	105.95	97.89	99.65	18.69	1.41	98.59
		P-VALUE	0.00			0.71	0.43	0.09	0.04	0.00	0.20	0.56	0.00	0.16	0.16
		CV(%)	14.38			29.36	67.40	57.14	54.22	7.15	3.87	1.52	77.65	208.60	2.99
		R^2	0.78			0.35	0.47	0.54	0.58	0.81	0.39	0.30	0.61	0.44	0.44
		LSD(5%)	1.33			0.72	1.32	3.00	0.03	12.51	6.25	2.49	23.98	4.87	4.87
				CONFIDENCE INTERVAL											
	MEAN OF CHECKS-H		5.89	4.61	7.17										
	MEAN OF CHECKS-O		4.49	3.25	5.73										

Theme 8: Market Assessment and Analysis

M. Odendo, C. Bett, J. Okuro, H. De Groote, J. Wanyama, and K. Danda

The purpose of this theme is to assess potential demand for Bt maize by different consumers and identify marketing constraints and opportunities in the maize sub sector. Primary and secondary data are collected to facilitate the analyses.

8.1 Analysis of seed maize sale by stockists in Kenya

Stockists are the main agricultural input suppliers to smallholder farmers in Kenya. A survey of stockists was conducted in the six major maize growing regions in Kenya. A sample of 51 stockists was surveyed. The objective of the study was to assess the quantities of seed maize varieties sold by stockists and the related package sizes. The survey shows that the most sold variety was H614 in the Kenyan highlands (Figure 2).. In dry transitional zone, pioneer varieties were the ones sold in large quantities. The highland tropics is the major consumer of improved seed. The quantity of seed of a particular variety sold, ceteris paribus, is a proxy for the popularity of the variety.

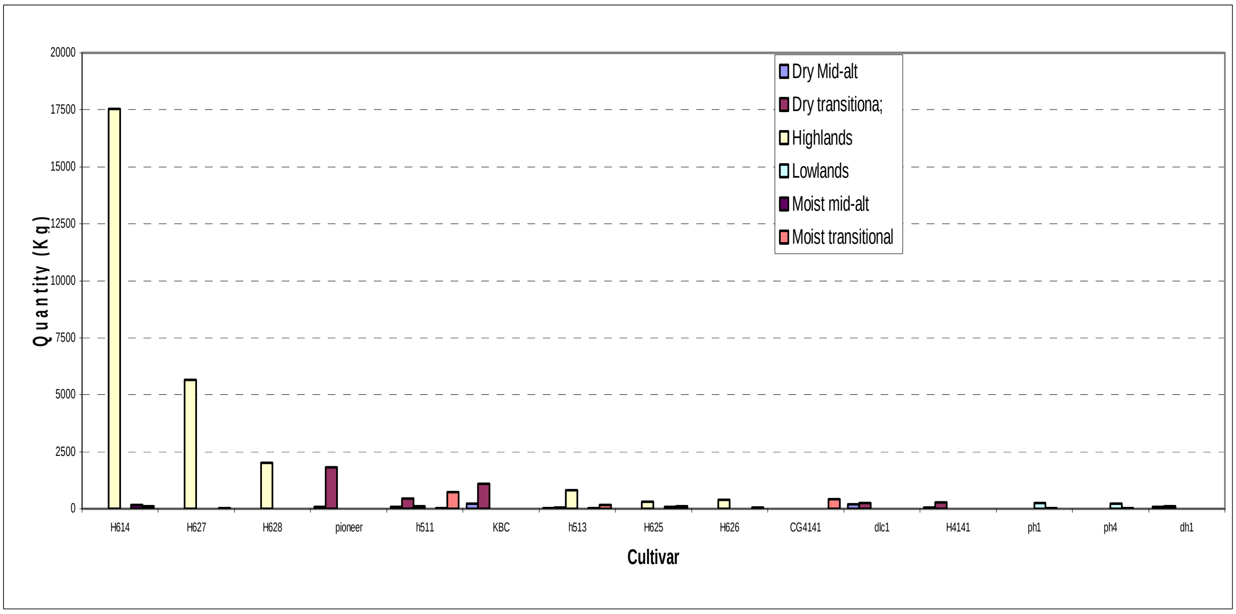

Figure 2. Quantities of seed maize sold by selected stockists in Kenya

Considering the package sizes, the survey shows that the most popular package size was 2 kg packages. The 2 kg packages were the most popular across the agro ecological zones. However, the 5, 10 and 25 kg packages were only popular in the highland tropics (Table 16).. The findings of this study helps in seed maize market segmentation and seed producers to package seed in accordance with farmers' preferences.

A study has been designed to measure the attitudes of maize sellers, processors and millers towards Genetically Modified (GM) foods in Kenya. This study builds on an earlier IRMA consumer survey conducted in Nairobi to determine consumers' awareness, attitudes, and willingness to pay for GM crops focusing on supermarkets, kiosks and posho mills (Kimenju, et al. 2005).

Table 16. Seed maize package numbers sold by selected stockists in Kenya

	Agro ecological zone							
Package size (kg)	**Low Tropics (Coast)**	**Moist Mid-Altitude (Kakamega)**	**Dry Transitional**	**Dry mid-altitude**	**High Tropics**	**Moist transitional south west**	**Moist transitional north west**	**Total**
1	5	0	0	0	0	0	0	5
2	29	21	38	44	47	17	10	206
5	0	0	0	0	18	0	0	18
10	0	0	1	0	33	0	0	34
25	0	0	0	0	17	0	0	17

Note: Moist transitional southwest and moist transitional northwest are presented separately for clarity.

8.2 Measuring the attitudes of maize sellers, processors and millers towards GM foods in Kenya

The objective of the study is to determine and evaluate the awareness, knowledge and attitudes of various maize stakeholders (millers, processors, sellers) towards biotechnology and GM foods/products in major urban centers in Kenya. The study is planned to be conducted the mandate areas of KARI centers in Kakamega, Katumani, Kitale and Embu on the pilot basis. A questionnaire has been designed focusing on characterization of stakeholders (millers, processors, and sellers), identification, and quantification of products processed, purchased and sold, and assessing markets for the products. In addition, the study will assess stakeholders' awareness and knowledge of GM foods. This includes investigating whether the stakeholders have read, heard or known scientific concepts related to GM foods and their willingness to try GM products. Issues of raw materials, segregation and labeling of GM are also addressed.

In addition, the study evaluates farmers' attitudes, concerns and regulations regarding GM foods. An innovative aspect of this study is that respondents and interviewers will learn together during the interviews because the study is designed in such a manner that the interviewer will provide information to farmers with regard to GM organisms in the course of the interviews depending on demand. The concepts, principles and practice of GM technology are defined and explained in the Appendix of the questionnaire for the interviewers' use for this purpose.

Theme 9: Economic Impact Assessment

J.O. Ouma; M. Odendo; C. Bett; J. Wanyama; K. Danda & H. De Groote

9.1 Participatory evaluation of insect Resistant Maize varieties

Introduction

In developing improved genetic material, classical plant breeding faces two major obstacles. First, new varieties can be disappointing to farmers where undesirable traits go undetected during the breeding process (De Groote *et al,* 2003). Secondly, breeders necessarily discard many crosses and varieties during the selection process because of traits considered undesirable; however, these traits may actually be of interest to farmers. It is against this understanding that there has been considerable interest in, and research into, alternatives based on participatory approaches (see for example Chambers, 1989; Okali and Sumberg, 1991; Maurya, 1988).

These participatory ideas and the associated rhetoric form a major component of what has been described as the 'new development" paradigm. Currently there is a body of research and documentation of practical field experience that provides considerable documentation on farmer participation in technology research and development (see for example Maurya, 1988; Chambers *et al.*,1989; Sperling *et al*., 1993; Ouma *et al*., 1996, 2002; De Groote *et al*., 2002). The aim of participatory approaches is to improve communication between farmers and breeders so that farmers's concerns and preferences are incorporated in the research process; research accelerated; and adoption improved (Sperling *et al*. 1993).

Insect Resistant Maize for Africa Project (IRMA) aims at developing and deploying insect resistant maize varieties to reduce losses due to stem borers. As part of the breeding process, greet attention is put in involving farmers in the evaluation of new maize germplasm. In long rains 2006, several new insect resistant maize varieties developed under conventional breeding were planted in three maize growing zones namely Kakamega, Embu and Katumani and evaluated by farmers at harvest stage.

Objectives

The objectives were to: 1) review criteria in selection of maize varieties and constraints to maize production, and 2) use the identified criteria to determine farmers preferred maize varieties

Methodology

Sites and varieties tested

The trials were planted in long rains 2006 in Embu, Kakamega and Katumani, representing four maize growing zones. Two of the trials were planted on-station, while the rest were on-farm (Table 17). A number of insect resistant maize varieties were planted alongside the commercial varieties in three replications under recommended husbandry practice (Table 18).

Table 17: Sites where the varieties were grown

	District	**Site**	**On-farm/On-station**
1	Makueni	Kambi Ya Mawe	On-farm
2	Makueni	Kiboko	On-station
3	Machakos	Katumani	On-station
4	Nyeri	Wambugu	On-farm
5	Meru Central	Kaguru	On-farm
6	Kakamega	Bukura	On-farm
7	Bungoma	Bumula	On-farm

Table 18: Varieties that were evaluated at different ecologies

	Sites	Insect resistant varieties	Commercial check varieties
1	Katumani	CKIR06007, CKIR06008, CKIR06009,CKIR04002, CKIR04003, CKIR04005	KCB, DLC1, DH01, WS103
2	Embu	CKIR06001, CKIR06002, CKIR06003, CKIR06004, CKIR06005, CKIR04002, CKIR06006, CKIR04006, CKIR04005	Pannar 5243, SC Simba, PH3253, 614D & EMCO
3	Kakamega	CKIR06001, CKIR06002, CKIR06003, CKIR06004, CKIR06005, CKIR04002, CKIR06006, CKIR04005	KH633A

Farmer's evaluations

Group discussions were conducted to review the criteria for selection of the maize varieties prior to the evaluations. The criteria were then used to score the varieties on a questionnaire. Before going to the field, farmers filled in the first section of a questionnaire, indicating their age, gender, level of education, and experience, as well as the size of their farm and the area under maize. Next, they were invited to visit the trial for the evaluation (Table 19). At the site, they filled in the evaluation, consisting of a row for each treatment and a column for each criterion they had mentioned. Farmers then scored each treatment for each criterion, according to a scale of 1 (very poor) to 5 (very good), and gave overall score for each variety. 110 farmers participated in the evaluations conducted at harvest stage at Katumani and Embu at vegetative stage and harvest stage at Kakamega (Table 19).

Table 19: Number of farmers during evaluations

	District	Site	On-farm/ On-station	Number of female farmers	Number of male farmers	Total number of farmers
1	Makueni	Kambi Ya Mawe	On-farm	8	28	36
2	Makueni	Kiboko	On-station	17	21	38
3	Machakos	Katumani	On-station	12	24	36
4	Nyeri	Wambugu	On-farm	na	na	na
5	Meru Central	Kaguru	On-farm	13	10	23
6	Kakamega	Bukura	On-farm	3	18	21
7	Bungoma	Bumula	On-farm	19	8	27
			Total			

Data Analysis

Scores are ordered categorical data, for which the appropriate analysis is ordinal regression (Coe, 2002). Means brings biased results since it assumes that scores are continuous numeric values. Therefore, the proportional odds regression model was used, which calculates the cumulative probabilities that a response variable Y falls in category *i* or below, for each possible *i,* where *I* refers to ordered categories. The estimate arrived at is the log odds ratio which equals to the log (odds of one treatment being high verses low/odds of another being high verses low) (Coe, 2002). The following short model was estimated: Yj = f(Xj) where Y is overall farmer evaluation, score from 1-5 of treatment Xj.

Results of evaluations

At Kiboko, all the new maize varieties were preferred to the commercial variety, Dryland composite1 (DLC1). The differences were significant for the first five new maize varieties ($p \leq 0.01$ & $p \leq 0.1$) (Tables

20-21). Among the commercial varieties, DH01 was the most preferred. In terms of tolerance to pests, CKIR06007 was preferred 8 times more to DLC1 and the difference was significant (p≤0.01). At Kambi ya Mawe, the commercial variety, DH01 was the most preferred to the insect resistant varieties followed by CKIR06009, CKIR06007, CKIR06008 and CKIR04002. The results in Katumani were mixed with some hybrids and OPVs occupying the first six positions. CKIR06009, DHO1, KCB, CKIR06007, CKIR04005 and WS103 were preferred in that order.

The trial in Kambi ya Mawe was on-farm and the rains (LR2006) were below normal and this may explain the reason why DH01 was the most preferred because it was bred for such conditions, however the new varieties performed strongly too.. In Kiboko, the trial was on-station and under irrigation and under these conditions the new varieties outperformed the commercial varieties. In Katumani, the trial was on-station but rainfed. During the season, there was a storm that caused severe lodging and this caused distortions making it difficult for the farmers see the differences in the varieties. This may explain the mixed results reported despite all this, the new varieties under normal conditions outperformed the checks or the popular varieties in the region in general.

Table 20: Overall evaluation at Kiboko

	Variety Name	Coefficient (log-odds ratio)	Exp (coeff.)	Std. Error	Sig.
1	CKIR04002	5.404	222	0.651	0.00
2	CKIR06009	4.796	121	0.637	0.00
3	CKIR06008	3.501	33	0.616	0.00
4	CKIR04005	1.763	6	0.617	0.00
5	CKIR06007	1.182	3	0.633	0.06
6	CKIR04003	0.979	3	0.639	0.13
7	DH01	5.472	238	0.653	0.00
8	WS103	5.157	174	0.644	0.00
9	Katumani	4.244	70	0.628	0.00
10	DLC1	0		.	.

Table 21: Evaluation for tolerance to stem borer at Kiboko

	Variety Name	Estimate coefficients	Exp (coefficient)	Std. Error	Sig.
1	CKIR06007	2.094	8	0.52	0.00
2	CKIR06009	0.376	1	0.503	0.46
3	CKIR04002	0.376	1	0.503	0.46
4	CKIR04005	0.376	1	0.503	0.46
5	CKIR06008	0.132	1	0.513	0.80
6	CKIR04003	-0.292	1	0.542	0.59
7	Katumani	1.803	6	0.507	0.00
8	WS103	1.348	4	0.494	0.01
9	DH01	1.135	3	0.491	0.02
10	DLC1	0		.	.

Table 22: Overall evaluation (Kambi ya Mawe and Katumani)

Order	Kambi ya Mawe	Katumani
1	DH01	CKIR06009
2	CKIR06009	DHO1
3	CKIR06007	KCB
4	CKIR06008	CKIR06007
5	CKIR04002	CKIR04005
6		WS103.

At Kaguru, Embu region (Table 22) five of the new insect resistant maize were preferred 3 to 5 times overall to PHB 3253, the commercial maize variety used as the base of comparison. The differences were significant. None of new varieties were superior to hybrid H513 and SC samba. Among the commercial varieties, if follows that the two varieties were the most preferred overall. In terms of tolerance to stem borer, CKIR06004 was preferred 4 times more to the PHB 3253. The difference was significant ($p \leq 0.01$). Among the commercial varieties, Hybrid H513 was the most preferred against tolerance to stem borer.(Tables 23 and 24)

In Kakamega site, none of the new varieties were preferred to the commercial variety against all the criteria identified as important in the evaluation and selection of maize varieties.

Table 23: Overall farmers' assessment, Embu

Variety Name	Coefficients(log-odds ratio)	Std. Error	Sig.	Exp (coefficient)
CKIR06001	1.673	0.554	0.003	5.33
CKIR06006	1.31	0.55	0.017	3.71
CKIR06005	1.156	0.548	0.035	3.18
CKIR06003	1.155	0.548	0.035	3.17
CKIR06004	1.142	0.548	0.037	3.13
CKIR04002	0.555	0.541	0.305	1.74
CKIR06002	0.07289	0.537	0.892	1.08
CKIR04006	-0.03908	0.537	0.942	0.96
CKIR04005	-0.858	0.54	0.112	0.42
H513	2.733	0.584	0	15.38
SC SIMBA	1.764	0.555	0.001	5.84
614D	0.869	0.545	0.111	2.38
Panner5243	-0.832	0.539	0.123	0.44
EMCO	-0.838	0.539	0.12	0.43
PHB 3253	0	.	.	
Loglikehood		185.203		

Table 24: Farmers evaluation against stem borer

	Variety Name	Coefficients(log odds ratio)	Std. Error	Sig.	Exp(coefficient)
1	CKIR06004	1.419	0.568	0.01***	4.13
2	CKIR06001	0.631	0.549	0.25	1.88
3	CKIR06003	0.625	0.549	0.26	1.87
4	CKIR04006	0.301	0.546	0.58	1.35
5	CKIR06005	0.276	0.546	0.61	1.32
6	CKIR06006	0.2	0.545	0.71	1.22
7	CKIR04005	-3.40E-02	0.544	0.95	0.97

	Variety Name	Coefficients(log odds ratio)	Std. Error	Sig.	Exp(coefficient)
8	CKIR04002	-5.77E-02	0.544	0.92	0.94
9	CKIR06002	-0.685	0.541	0.21	0.50
10	H513	1.342	0.565	0.02**	3.83
11	SC SIMBA	0.364	0.547	0.51	1.44
12	614D	8.89E-02	0.545	0.87	1.09
13	Panner5243	3.41E-02	0.544	0.95	1.03
14	EMCO	-8.82E-02	0.544	0.87	0.92
15	PH 3253	0	.	.	
	Loglikehood		179.705		
	x^2		25.263		

****significant at 1%,**significant at 5%,*significant at 10%*

Conclusions
The methodology developed, together with ICRAF, is theoretically correct and works well with farmers for on-station evaluation. However, there is need to harmonize criteria for analysis across sites. For instance, there is need to split disease and pest resistance Evaluation for disease resistance is not possible at harvest. On-farm analysis still needs to be developed (need a fair numbers of farmers to evaluate). Need further analysis, using the best control as base. There is also need to distinguish hybrids and OPVs.

9.2 Baseline data

Data cleaning, aggregation and merging of plot level and variety level data, and analysis of data of previous baseline surveys and literature review were done.
On poverty analysis, the baseline data were used to compare the situation of the poor and non-poor about the use of improved maize technologies. H. De Groote presented an analysis on how insect resistant maize can contribute to poverty alleviation using decomposition of economic surplus at the CIMMYT's Science Forum Mexico, Jan 23-27 2006.

9.3 Students' research

Our collaborator Kengo Danda finished his MSc course work in Agricultural Economics and is now concentrating on his thesis research. He started the literature review and the preliminary analysis of the distribution of local OPVs at the coast. Collaboration with Oklahoma State University for the analysis is under way. Data was cleaned and preliminary analysis done on the distribution of local OPVs at the coast. The purpose was to quantify gene flow and develop control methods.

Simon Kimenju successfully defended his thesis and started a position as a research fellow at the Tegemeo Institute, a policy research institute of Egerton University, working in close collaboration with international partners such as the Michigan State University, Department of Agricultural Economics.

9.4 Project proposals

A concept note was prepared to organize more writing workshops to finalize the different papers, culminating in a scientific conference "Maize in Kenya", with published proceedings. Contacts with Michigan State University and the Food and Agriculture Organization have been initiated.

A pre-proposal entitled "Risk Assessment and Management of Bt Maize in Kenya" was submitted by CIMMYT, KARI, and ICIPE and was accepted by USAID. A workshop was organized and a full proposal submitted, which was unfortunately not accepted.

9.5 Reports and conferences

Three IRMA collaborators attended the Conference of the International Association of Agricultural Economics, Aug. 12-18 in Gold Coast Australia and presented two papers on the adoption of improved maize varieties and the effect of the liberalization.

IRMA collaborators worked together with Melinda Smale at IFPRI to edit a series of briefs on biotechnology for small holders in East Africa (See section 10)

Theme 10: Communication, Promotion, Capacity Building, and Administration

D. Ouya, G. Kimani, S. Mugo, S. T. Gichuki, and D. Poland

10.1 Communication/Promotion

Events

On 21 July 2005 twelve (12) members of the National Biosafety Committee (NBC) visited the Bt maize confined field trials in Kiboko. The members were shown the successful second season crop, and the post-harvest monitoring from the first season crop.

On 23-24 November 2005 the Communications theme members participated in the Joint IRMA Scientists and Technical Advisory Board Meeting, which had a considerable focus on communication and issue management.

On 25 November 2005 the IRMA Stakeholders Meeting was held, with attendance of approximately 100 people, including a large contingent from the media. Press kits were prepared and distributed, including two press releases, one of which dealt exclusively with the "trial stoppage" issue. Coverage of the meeting was good with reports appearing in the local print media and on television.

In January 2006 S. Mugo presented IRMA research at the Science Forum at CIMMYT Mexico.

On 7April 2006 (traditionally the 'World Anti-GM day') the IRMA project, together with ABSF and others, co-organized the First National Symposium on Biotechnology at the Grand Regency Hotel in Nairobi. Journalists and editors from the local media attended the meeting and made presentations. IRMA was represented by S. Mugo, S. Gichuki and D. Ouya, who were also part of the organizing committee. Marianne Banziger and E. Mukisira attended and spoke at the workshop as invited guests.

On 11 April 2006, Simon Gichuki and Stephen Mugo attended the A-Harvest-organized Roundtable on trade implications of biotechnology regulation in Kenya, at the Grand Regency Hotel, Nairobi, Kenya. The objective was to provide inputs into the Kenya biosafety bill. International experts from Kenya, USA, South Africa, and the Philippines participated.

On 20 April 2006 the Ministry of Agriculture organized a workshop on biotechnology and biosafety for farmer organizations, at KARI Headquarters. Simon Gichuki and Stephen Mugo made presentations on KARI biotechnology and IRMA project activities. The workshop sought to link the private and public institutions and groups with an interest in biotechnology in Kenya, in order to "share information, and avoid duplication and misuse of available resources," according to its convener, Agriculture Secretary Dr. Wilson Songa. Thirteen NGOs under the umbrella of the Kenya GMO Concern (KEGCO) were represented, as were KARI and CIMMYT.

On 26 May 2006 Panos Eastern Africa in conjunction with Panos Institute London hosted a luncheon at the Grand Regency Hotel to discuss proposed recommendations for effective communication of academic research through the media. Themed 'Strategy for Communicating Research through the Media in Kenya,' the meeting sought to come up with an Action Plan for creating an effective reporting of research findings and development issues by the media. Daisy Ouya represented the IRMA project.

On 6 June 2006 Daisy Ouya and S. Mugo participated in a seminar on Empowering scientists on Media Communications on Science & technology Matters including Biotechnology" at the Jacaranda Hotel in Nairobi. It was co-organized by A-Harvest and USAID.

On 27 June 2006 Jost Frei, Grace Kimani, Geoffrey Murenga, and Obongo Nyachae visited the Bt Cotton CFTs at KARI-Mwea and maize research at KARI-Embu. Dr. Waturu (PI of the Bt cotton trials), Mr. Ngige (OIC, KARI–Mwea), Mr. Kambo (Deputy OIC KARI–Mwea), Dr. Gethi (Centre Director, KARI-Embu), Dr. Kihanda, Dr. Mutinda (Maize Breeders, KARI-Embu) and their teams made presentation and conducted the visits.

On 25 July 2006 Daisy Ouya attended the official opening of the final consultative meeting of the AU/NEPAD African High-Level Panel on Modern Biotechnology, held at the Hilton Hotel in Nairobi, Kenya. She also attended the consultation on the draft report of the Panel at the same venue on 26 July, 2006. Science and Technology Minister Noah Wekesa opened the forum.

On 21 July 2006 S. Gichuki and S. Mugo attended a UNEP-GEF end of "Implementation of the National Biosafety Framework for Kenya Project" workshop on national biosafety framework for modern biotechnology at the Grand Regency Hotel. The workshop was organized by the National Council for Science and Technology in collaboration with UNEP-GEF. The workshop was to inform the stakeholders of the infrastructure put in place to regulate the modern biotechnology activities in Kenya.

On 25-27 July a 3-day consultation of the AU/NEPAD African High-Level Panel on Modern Biotechnology took place in Nairobi. Kenya's Minister for Science and Technology Dr. Noah Wekesa officiated at the event's opening at the Hilton Hotel. IRMA was represented.

On August 12-18 James Okuro, Simon Kimenju, Esther Ruto, and Hugo DeGroote attended the Conference of the International Association of Agricultural Economics, in Gold Coast, Australia.

Parliamentarians from World Bank member countries spent the first two of a four-day mission to Kenya visiting and interacting with CGIAR scientists, partners, and stakeholders. Marianne Bänziger, Wilfred Mwangi and Stephen Mugo participated in the panel discussion of 11 September 2006, led by Dr. Ephraim Mukisira, John Lynam of the Kilimo Trust, and three other scientists. CIMMYT and the other CGIAR centers each mounted individual poster exhibitions on Day one. The CIMMYT stand featured several activities, including the Global Rust Initiative, our work on Conservation Agriculture, the Africa Maize Stress Project, IRMA, QPM and Striga research. We received a good level of traffic and interest, in particular from the Kenyan MPs who browsed the CIMMYT flyers displayed and took away copies.

On 12-14 September 2006 S. Gichuki and J. Songa attended the "Towards a common regional Policy, regulatory and biosafety framework on GMO in East Africa" organized by the East African Community, Entebbe, Uganda. EAC Ministers and MPs and MPs from member countries also attended.

On 14 September 2006 S. Mugo, S. Gichuki, D. Ouya, and others attended the Launch of the "Open Forum on Agricultural Biotechnology in Africa" at the Norfolk Hotel. The monthly forum, organized by AATF, is intended to be a place where issues of interest, ideas, progress are discussed. It will also serve as a focal point for the media, law makers and policy makers who have questions and need scientific answers on biotechnology.

Publications

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- Mulaa, M., S. Mugo, B. Muli, and D. Poland (Editors). 2005. Report of a Workshop on Integrating Pastures, Fodders and Cereal Crops as Refugia for Stem Borers in the Farming Systems of the Humid Coastal Kenya, 26-29 July 2004: IRMA Project Document No. 17. Nairobi, Kenya and Mexico D.F.: KARI and CIMMYT.

- KARI and CIMMYT. 2005. Insect Resistant Maize for Africa Annual Report 2003-2004. KARI/CIMMYT IRMA Project. Project Document No. 20. Mexico D.F.: KARI and CIMMYT.
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- S. Mugo, D. Poland, M. Mulaa, D. Ouya, and S. Gichuki (eds.) 2006. Sixth Stakeholders Meeting: Insect Resistant Maize for Africa (IRMA II) Project phase II, "Delivering Products to Farmers". IRMA Project Document No. 24. Nairobi, Kenya: KARI and CIMMYT.

Others

- A piece on GMO facts was contributed and appeared in the January-February edition of Farmer's Guide magazine, distributed to around 4000 farmers in Kenya.
- CIMMYT E-news story on IRMA, 'Bug Havens Keep Maize Pest-Proof' (http://www.cimmyt.org/english/wps/news/2005/dec/bugHavens.htm) was authored by D. Ouya and widely distributed via the Internet.
- CIMMYT E-news story on IRMA, 'Blind to Borers' (http://www.cimmyt.org/english/wps/news/2006/jul/blindborers.htm), was authored by D. Ouya and widely distributed via the Internet.
- Bett, C. and De Groote, H. (2006) Participatory Rural Appraisal for Pest Assessment in Semi-arid Eastern Kenya: The dry mid-altitude and the dry transitional maize zones. IRMA Socioeconomics Working Paper No. 02-03. Nairobi, Kenya. CIMMYT and KARI.
- IRMA Updates as follows
  - Vol. 6, Issue 3, September 2005
  - Vol. 6, Issue 4, December 2005
  - Vol. 7, Issue 1 & 2 September 2006
  - Vol. 7 Issue 3 November 2006

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Smale M., H. De Groote, and J. Falck-Zepeda. 2006. Biosafety and biodiversity risks. Genetic Resources Policies Research Brief 26. IFPRI: Washington D.C.

Book chapters

Mugo. S. 2006. Maize production and Improvement in Africa. Book Chapter under review for an ABSF project supported by the Rockefeller Foundation.

Internal documents and reports

Produced an issue management matrix and crisis communication plan and flow chart for implementation, as recommended by the IRMA-TAB. This involved soliciting input from all project participants and theme leaders. General responses in bullet point form have been formulated. Others were:

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10.2 Capacity Building

Facilities & capital items

Computers and printers were purchased for KARI Embu, Kitale, Kiboko, and the Biotechnology Center. A project motor vehicle was also purchased.

Training

The BGHC continued to be a focal point for informal training through group visits, recording more than 150 visitors from 62 institutions and nationalities during the reporting period. In addition, university students have been attached to the complex, for exposure to general principles of biotech applications and biosafety (Appendix 8).

Murenga Mwimali attended an FAO/KEPHIS-sponsored training workshop on Biosafety for Regulatory Officers, held at KEPHIS headquarters, Karen, 29 November to 1 December 2005. The objective of the training was to enhance the participant's understanding of the concepts and issues associated with modern agricultural biotechnology; to enhance the participant's understanding Kenya's policy and regulations on GMOs; evaluate Kenya's preparedness to monitor GMO-related activities; facilitate the acquisition and use of correct technical information for making informed decisions on matters of biotechnology & biosafety; establish institutional linkages for continued collaboration on issues relating to the application of modern biotechnology and the associated concerns on biosafety; and formulate dependable guidelines for use in decision making on matters of biotechnology and biosafety.

Murenga Mwimali, Regina Tende, Haron Karaya, and Dennis Obonyo participated in the CGIAR Student Research Induction, and took a writing course. Both activities were held at the World Agroforestry Centre (ICRAF) Nairobi campus. The 3–7 April induction had 35 participants, all students conducting their research in Kenya under the supervision of CGIAR scientists based at the ILRI or ICRAF Kenya offices. The training sought to equip the students with essential skills for their research: conceptualization, data collection, analysis, and presentation. Mwimali, Tende, and Obonyo also attended a three-day workshop, "Writing to Be Read," 11–13 April 2006. This highly popular workshop focuses on improving writing and presentation skills for a range of materials, from research articles, to project proposals, to journalistic fare for a lay readership. Both workshops were sponsored by the Netherlands Government (SII)

Murenga Mwimali conducted two IRMA-sponsored in-house biosafety training courses for the staff of Kenya Agricultural Research Institute-Biotechnology Centre, aimed at enhancing the participants' understanding of basic concepts in biotechnology and biosafety.

Likewise, the OQS at Kiboko continued to be a focal point for informal training through visits by various groups. More than 175 visitors from 30 institutions and various nationalities visited the OQS. These included the IRMA EC on 4 Feb 2006 and the NBC on 21 February 2006. During the second and third quarter, the OQS at Kiboko continued to be a focal point for informal group training. More than 56 visitors from 27 institutions and nationalities visited the research and facilities at the OQS at KARI Kiboko.

Dennis Ndolo Obonyo attended a 6-day course on Biosafety Risk Assessment in September 2006, funded by BioSafetrain Project. The objective was to equip participants with information and skills that would enable them effectively address issues of biosafety with regard to agricultural biotechnology and effectively conduct Biosafety Risk Assessment studies. Issues covered were 1) Ethical, social, environmental, legal and food safety issues of biosafety, 2) Societal, legal and regulatory aspects of agricultural biotechnology, 3) Ecological impact of transgenic crops, and 4) Principles and practices of biosafety.

Students

- Dennis Obonyo continued with his PhD Dissertation project – "Tri-trophic interactions between parasitoids, lepidopteran stem borers and Bt maize in Kenya" (See section 3). He is registered at the Entomology, Entomology Dept., Chiromo campus, University of Nairobi.

- Haron Githu Karaya graduated with a MSc. Degree, Plant breeding, Department of Crop Science, Kabete, University of Nairobi on 1 Sept 2006.

- Simon Kimenju successfully defended his thesis " Kimenju, S. C. 2006. Economic evaluation of consumer awareness, attitudes, and willingness to pay for GM food: the case of maize meal in Nairobi. MSc Thesis, Department of Agricultural Economics, University of Nairobi". He has joined Tegemeo Institute, a policy research institute of Egerton University as a research fellow working in close collaboration with international partners such as the Michigan State University, Department of Agricultural Economics. We congratulate and wish him well in his new assignment.

- Mr. Maurice Oyoo, the maize Breeder at KARI Mtwapa, proceeded for his PhD training at the Tsukuba University in Japan in early September 2006. He handed over maize research work at KARI Mtwapa to J. M. Shuma. We wish him well in his studies and welcome Mr. Shuma to the IRMA family.

- Regina Tende drafted her thesis on "resistance development to Bt maize toxins in two maize stem borers (*C. partellus* and *Busseola fusca*).

- Kengo Danda finished his MSc course work in Agricultural Economics and is now concentrating on his thesis research. He started the literature review and the preliminary analysis of the distribution of local OPVs at the coast. Collaboration with Oklahoma State University for the analysis is under way.

- James Biriah Ndiso continued with his thesis project on "characterization for morphological and drought tolerance traits in local coastal maize landraces (see section 4).

- The IRMA project hosted two fourth year BSc Agriculture students from the College of Agriculture and Veterinary Sciences, University of Nairobi, for two months between 10 July and 1 Sept 2006. William Ngare and Violet Mogaka were exposed to conventional and Bt maize breeding activities.

10.3 Administration

A planning and budgeting meeting was held on 15 March 2005. This brought together project theme team leaders to align the activities with the actual budget available. A total of 15 participants attended the one-day event at KARI Headquarters. The draft revised budget was submitted to CIMMYT and KARI management, before it was formally accepted and approved by the IRMA Executive committee meeting in June 2005.

On 11 Oct 2005, a planning meeting for theme leaders was held, at which major issues facing IRMA project were discussed and the joint Theme leaders and IRMA-TAB meeting was planned.

On 23-24 November 2005, the IRMA project Technical Advisory Board (IRMA-TAB) provided feedback on major issues facing the project via email and at a joint meeting with the project team.

The IRMA Annual Project Meetings were held in November 2005 at the Safari Park hotel as follows:
- 07 – 08 Nov 2005 - IRMA Annual Review and Planning meeting – Attended by IRMA theme leaders, KARI and CIMMYT scientists working within the IRMA project. Notes from that meeting will be prepared.
- 23-24 Nov 2005 - Joint IRMA theme leaders and IRMA-TAB meeting. A major product from that meeting was a mini-review report.
- 25 Nov 2005 (Morning) - Annual Stakeholders' meeting – Attended by about 100 stakeholders' representatives, including the media. The report of this meeting is being prepared.
- 26 Nov 2005 - Optional visits to the Biosafety Greenhouse complex at KARI-NARL and CFTs at the Kiboko OQS. A group of IRMA socio-economists visited Kiboko.

The IRMA Executive Committee (IRMA-EC) met on 3 Feb 2006 at the Ministry of Agriculture office, Nairobi, hosted and chaired by Permanent Secretary Dr. Romano Kiome. Major decisions reached during the meeting were:

- IRMA to request Monsanto for a royalty-free grant of Bt maize event Mon810. A negotiating team was formed and it started its work as reported in the regulatory section.
- Approval of an IRMA communication strategy supported by an issue management matrix (IMM) developed by CIMMYT communication staff in Mexico and Kenya.
- A new IRMA-TAB membership was formed: Prof. Norah Olembo, ABSF; Dr. Willy De Greef, IBRS; Dr. Rob Tripp, ODI, UK; Mr. Obongo Nyachae, STAK; and Dr. Carl Pray, Univ. of New Jersey. The IRMA team and the TAB itself will have the authority to appoint the TAB Chair, and co-opt additional members if necessary.

Timetable of major events and meetings in 2006:

- 26 June 2006 – mid-year IRMA Executive Committee meeting
- 5-11 November 2006 – IRMA Annual meetings (planning, Stakeholders' & Executive committee meetings)

Dr. Kiome stepped down from the IRMA Executive Committee chairmanship, and passed on the responsibility to Dr. E. Mukisira, Ag. Director KARI. Dr. Kiome said he would be willing to participate at future IRMA meetings, on invitation. The EC thanked Dr. Kiome for his able chairmanship since the project started in 1999, and wished him well in his new responsibility as Permanent Secretary, Ministry of Agriculture. The IRMA team hosted a dinner at Tamambo restaurant, Westlands, in honor of Dr. Kiome, to congratulate him on his appointment to PS, Ministry of Agriculture, and appreciate his contribution as IRMA ExCo chair from 1999 to 2005.

David Poland the CIMMYT Writer/Editor David Poland, who was involved in the IRMA project's communication work since its inception, moved to the US to take up a job with the Malaria Vaccine Initiative. All at IRMA will miss his contribution and we wish him all the best in his new assignments.

Josephine Songa was appointed to the position of Coordinator, KARI Crop Protection Program. In this new leadership position, chief among Songa's new responsibilities will be to prioritize the crop protection activities of the entire KARI multidisciplinary crop research network. She succeeds Gilbert Kibata and becomes the first woman to hold this senior position at KARI. Songa has led IRMA's Environmental Impact Assessment theme since the project's inception.

A planning and budgeting meeting was held on 2-3rd May 2006 at CIMMYT Offices, ICRAF Campus. This brought together various project theme team leaders to revise the Workplan and budget 2006 and revise the activities for each theme. The group also reviewed the outputs and planned for the year. 10 participants attended the one-day meeting. The draft revised budget was presented to the ExCo meeting later in June.

Socio-economists in IRMA Project held a planning meeting from 6th to 9th June, 2006 at ICRAF campus, Nairobi. The meeting reviewed IRMA baseline data, developed strategies for completion of baseline data analysis, sharpened the socio-economists' skills in data analysis, especially the analysis of data from participatory farmer variety evaluations in Katumani, Embu and Kakamega regions.

The IRMA Executive Committee (IRMA-EC) met on 26 June 2006 at the CIMMYT Offices, ICRAF Campus, Nairobi. Major decisions reached during the meeting were:

- IRMA to draft an agreement with Monsanto to share MON810 on humanitarian Use Exemption (HUE) on a royalty-free basis for the poor in Kenya.
- IRMA project to write to University of Ottawa to the effect that CIMMYT wishes to retain their events for research only.

The IRMA Annual Project Meetings were planned to be held on various dates in November 2006 as follows:

- Monday 6 November 2006 - Arrival at Blue Posts Hotel, Thika.
- Tuesday 7 November 2006- Annual review meeting by project teams.
- Wednesday 8 November 2006- Annual planning meeting by project teams
- Thursday 9 November 2006- Planning for ExCo & Stakeholders meeting
- Friday 10 November 2006- Departures

The list of invitees (Appendix 9) program (Appendix 10), list of participant (Appendix 11) are included in this report. Also included is a revised IRMAII time lines (Appendix 12).

The Executive committee requested that their meeting be held on 5 February 2007.

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VI. DISCUSSIONS DURING IRMA PROJECT ANNUAL REVIEW AND PLANNING MEEETINGS IN 2005

1. Major issues facing IRMA Project by 2005

S. Mugo and S. T. Gichuki.

Included are the major issues facing IRMA Project by end of 2005 and discussions on how to address them

1. Germplasm conversion to Bt – appropriateness of methods and types

Lack of control for *B. fusca* by the public events of cry1Ab and cry1Ba genes. The issue was whether Bt maize carrying the public events should be released in Kenya.

The main issues here were presented as follows:

1. *C. partellus* -resistant but *B. fusca*-susceptible maize if grown in B. fusca areas would enhance the dominance of B. fusca.
2. Exposure of *B. fusca* to sub-lethal Bt toxins would enhance their resistance even to any effective Bt toxin available later
3. Even if release was made in restricted *C. partellus* only areas, there will be unrestricted movement of seed of *C. partellus* resistant but *B. fusca* susceptible maize by farmer to farmer seed exchanges, and hence creation of the above scenarios.

While scenarios one and two could occur, some thought that movement of seed from the coast and mid-altitude dry areas to predominantly *B. fusca* areas is at insignificant level. However, a decision was made not to deploy these cry1Ab events if IPR issues are not sorted out.

2. The IPR issues surrounding cry1Ab, cry2Aa, and cry1Ba genes

A background was given indicating the position of IRMA on IPR concerning cry1Ab events. To ensure that the Bt technology developed will be accessible to farmers without being prohibitively expensive, the IRMA project commissioned a review of IPRs, including a Freedom to Operate (FTO) review. The study concluded that no patents had been filed in Kenya concerning the Bt technology, and, therefore, no patent restrictions are expected in Kenya. Moreover, when a company files for a patent in one country, it has a limited time (one year). Since all patented technologies under consideration by the IRMA project have been patented for more than one year, these patents can no longer be filed in Kenya.

Even though there are no patent restrictions, other agreements might apply. Most importantly, when CIMMYT obtained Bt genes and constructs from different collaborators, in particular the University of Ottawa, it signed a "research purposes only" material transfer agreement. Problems might arise if IRMA uses these constructs to develop varieties, and wants to license Bt lines or varieties to commercial companies for seed production. A request was made to the University of Ottawa to provide an agreement for commercial use of the genes and constructs that have been used by CIMMYT. However, given the complexity of different IPR components belonging to different companies, it remains unclear if the University of Ottawa can provide an agreement for commercial use. CIMMYT had since approached all the major seed companies (Monsanto, Syngenta, and DuPont) with a letter of intent to ensure that the act of CIMMYT releasing these constructs to Kenyan farmers through the different national seed businesses will not result in litigation against the University of Ottawa, CIMMYT or the national seed producer. Negotiations were continuing on these issues.
Legal expert input was lacking as both CIMMYT's Shawn Sullivan left and KARI's Betty Kiplagat was away on study leave. Dr. Gichuki was to look for way to have Mr. Oluoch a KARI lawyer to take up some of these responsibilities. CIMMYT management had given this priority and Dr. Banziger, the then

ALP Director, Dr. John Dodds, the then CIMMYT DDGR, and Dr. Iwanaga, DG CIMMYT had taken this personally with the help of the Rockefeller Foundation.

AATF was also to be approached and explore possibilities of leading negotiations. A possibility also existed to hire an independent consultant.

3. Should IRMA project consider testing and using commercial Bt Events?

The pros and cons of this were discussed. First, IRMA will have to backtrack on some of its guiding principles of using only publicly developed products. However, this could be the way to ensure farmers even in low potential areas access the technology in a timely manner.

The Bt maize being used in South Africa (MON 810) gives control for B. fusca. This is likely due to the promoter that is used (35S proprietary to Monsanto) as well as other factors such as the insertion point. IRMA could approach Monsanto for permission to use Event MON810 with one option to develop maize only for the low-potential areas of Kenya, leaving the high-potential areas for Monsanto's commercial maize (MON810). This issue was to be presented to and discussed at the meeting of Theme leaders and the IRMA-TAB as well as at the Executive Committee meeting in November 2005.

4. Publicity – Giving / receiving, how to deal with unfavorable publicity

ABSF will be informed that lawmakers would like to receive training on GM technology.

5. How can the IRMA intra-project collaboration be improved to enhance progress?

The theme leaders and their individual teams should meet more regularly, at least quarterly.

6. Environmental Impact Assessment

It was, decided that KARI could check on its need to conduct a NEMA environmental audit. J. Songa was to be requested to write a position paragraph on whether EAI for KARI is needed. J. Danson was to circulate ILRI-BECA EAI draft to theme leaders.

Issue 1: Appropriateness of Bt testing methods in the laboratory, biosafety greenhouse and open quarantine field site

C. Taracha, J. Danson, S. Mugo, S. Gichuki, D. Bergvinson, and G. Murenga

Background

The interest on this issue arose from the negative publicity that arose from termination of the evaluation trial of Bt maize in the confined field trial at the open quarantine site at Kiboko. It was meant to provide a forum to discuss ways in which such incidences can be avoided in future. A summary of the testing methodology in the biosafety laboratory, green house and open quarantines will be described briefly followed by the steps taken during the second season testing at the OQS.

Methodology

1. *Biosafety Laboratory*

A level 2 biosafety laboratory was developed prior to development of the biosafety greenhouse complex. This was mainly used for leaf bioassays and was specifically used for insect bioassays to evaluate the efficacy of the Bt genes against the Kenyan maize stem borers. One inch square leaf samples are cut out from the second fully expanded leaf from the whorl, and the leaf tissue is placed on moistened filter paper in small 5cm Petri dishes. The leaf samples are infested with first instar stem borer larvae sealed and kept in darkness at room temperature for five days. The mortality and number of live insects is recorded and the total leaf area consumed measured using a mm^2 square grid. .Resistant plants will show an average leaf damage rating of less than 4mm.

2. *Biosafety Greenhouse Testing*

Maize seedlings are infested at the 4^{th} leaf stage of plant development by placing 10-20 stem borer neonate larvae in the whorl. Leaf damage scores on the plants is assessed after five days by scoring visual damage rating system on a 1-9 scale (1= no damage, 9= extensive damage). The plants exhibiting few pin point lesions but no extensive damage are regarded as resistant. Where desirable, such plants are grown to maturity for seed production or for breeding with other genotypes. Where leaf bioassays are desired, e.g. when testing with more than one stem borer species, leaf samples are take at about the 8^{th} leaf stage of plant development. Leaf bioassays are as described above.

Although the first generation stem borer control is important, the second generation, if present, can cause damage to the ear, stem and loss of yield, and is likely to be present for B. fusca. Studies will be carried out to determine the effectiveness of Bt maize against the second generation of stem borers, both in the BSGH and in the confined field trials. At the mid-pollen shed stage, plants will be infested with 200 black head eggs by placing these at the ear leaf axil and the axils of the leaves immediately above, and below the ear. At the end of grain filling period, the stalks of the infested plants will be split longitudinally and the number of exit holes counted and the cumulative tunnel length measured.

3. *Testing Bt maize in the confined Field Trials in the OQS at Kiboko*

The Bt seeds are planted in the field and 2-3 weeks after germination, at the 4th leaf stage, each seedling is infested with 20 black head stem borer eggs, the stage just before the larva hatch from the eggs. Leaf feeding damage to the whorl is evaluated and scored two weeks after infestation. Where bioassays are desired, e.g. when testing with more than one stem borer species, leaf samples are take at about the 8^{th} leaf stage of plant development. Leaf bioassays are carried out in the laboratory as described above. If plants are grown to maturity, the stalks of the infested plants will be split longitudinally and the number of exit holes counted and the cumulative tunnel length measured.

The Details on the evaluation trial that was terminated were as follows. Briefly, the trial was planted 27 May 2005. The IRMA Executive Committee visited Kiboko on 14 June 2005, and observed low stand counts in the plots, which was due to attack by the white grub. Some of the visiting team may have discussed informally, the use of Furadan, a systemic insecticide to control the grubs. The technician in-charge Mr. Joel Mbithi acquired and applied Furadan on soil around each plant in the trial on 16 June 2005 before consulting S. Mugo or S. Gichuki. Leaf damage scores done in the field and in bioassays from plants sampled within 1-2 weeks from the plants were as expected since Furadan takes time to be dissolve in the soil and be absorbed by the plant. However, new leaves on the susceptible rows started appearing without damage and at this is when Furadan application became known.

The NBC visited Kiboko on 18 July 2005, were briefed on the treatments and recommended harvesting and re-planting of trial 1. A mid-term report to the NBC was prepared on 22 July including a request to authorize early harvesting and re-planting n. However, a delay in decision found the trial being harvested on 31 August 2005 as originally planned. An approval for replanting has now been granted pending conditions from KEPHIS.

An article citing Secretary of Agriculture Dr. W. Songa published in The Sunday Nation- 28 August gave the wrong impression that Bt maize research was stopped by the government. It was thought that the secretary would correct that impression but this did not happen and this impression has been carried by local and foreign media as the truth as evidenced in articles.

The testing methods using bioassays in the biosafety lab was said to be appropriate judging by the consistent results from independent experiments performed there. Likewise testing in the biosafety greenhouse was found to be adequate. Communication strategy should be in place early enough, if any similar events occurring. Protocols for use in the field will be more clearly spelt out, and no TA will take decisions without consulting the principal investigators, S. Gichuki and S. Mugo. More positive publicity is needed to clarify the situation. IRMA will invite the press to the stakeholders' meeting, and make statements without direct reference to articles in the press. The agronomic management protocols in the second planting currently growing at the OQS are more detailed and comprehensive to avoid errors like the one reported above.

Issue 2: Appropriateness of methods and germplasm types in conversion of maize germplasm to Bt

S. Mugo, J. Ininda, G, Gethi, M. Oyoo, C. Mutinda, G. Ombakho, O. Odongo, & G. Murenga

Background

Large scale transformability of tropical maize has not been achieved so far, and only a few maize inbred lines have this characteristic. Most products of genetic engineering will therefore be available in an inbred line background and must be bred into other desirable germplasm. For Bt maize at CIMMYT, the approach was to transform embryos of the hybrid CML216xCML72 and recover CML216 inbred line through several backcrosses. After identifying the desirable Bt maize events, we set out to convert a number of genotypes, which in total would constitute a wide enough choice for development of adequate germplasm to cover the various maize growing ecologies where the *C. partellus* and Chilo orichalcociliellus stem borer species are dominant.

Germplasm being converted

Tropical germplasm adapted in Kenya and East and Southern Africa, and to include germplasm to cover various maize zones, maturity groups, major stem borer species, resistance to various stresses, and cultivar types. The germplasm selected for conversion includes:

- CIMMYT Germplasm - CML202, CML204, CML312, CML144, CML159, CML395, CML390, CML442, CML444, & Pool 15 QPM-SR-OPT-1, MBR line
- KARI Germplasm - EM11-133, EM12-210, MUL-509, MUL-619, KML-1, KML-2, & Katumani Composite

Other farmer preferences like quality traits are considered by the choice of germplasm and through the breeding process. Preference in the choice of germplasm to be converted is given for KARI and CIMMYT maize germplasm, which have less complex IPR issues. We will need to consider how to work with popular varieties that belong to private seed companies. The germplasm being converted is selected to include those with desirable traits like quality protein maize (QPM) and Imidazolinone (IR) traits.

Methodology

The Backcross method was selected since it is the most effective and efficient method to transfer one or a few desirable traits from a donor parent to a desirable recurrent that is deficient of the desirable trait(s), while recovering the recurrent parent fully. The backcross methods also does not change the other desirable quality traits. Since we are working with mostly inbred lines, we planned to develop up to BC3 generation before selfing the germplasm to fix the genes and extract the converted inbred lines.

The following have been done or are planned steps for the first set of Backcrosses:

- 2004 SR BC0F1 formed in BGHC
- 2005 LR BC1F1 formed in Bt maize CFT at Kiboko
- 2005 SR BC2F1 formed in Bt maize CFT at Kiboko
- 2006 LR BC3F1 formed in Bt maize CFT at Kiboko
- 2006 SR BC2F1 formed in Bt maize CFT at Kiboko
- 2007 LR BC3S1s formed in Bt maize CFT at Kiboko
- 2007 SR Single Cross (SC) hybrids formed in Bt maize CFT at Kiboko
- 2008 LR Three-Way Cross (TWC) hybrids formed in CFTs
- 2008 SR Multi-location testing of TWCs
- 2009 LR NPT trials in Kenya

These activities are on course with BC_0F_1 that were made in the BGHC having been sown at Kiboko in may 2005 and BC_1F_1 were formed and harvested in October 2005. These BC_1F_1 were sown in November 2005 to form BC_2F_1.at the OQS. For biosafety reasons, the BC is used as the female to reduce Bt maize pollen production and movement in the environment.

The Backcross method is being used and planned to be up to BC3 generation. BC_0F_1 were made in the BGHC, while BC_1F_1 and BC2F1 were formed in the OQS using the Bt as the female due to biosafety requirements that aims at reducing Bt maize pollen in the environment. A large number of inbred lines and two OPVs are expected. The aim is to generate adequate germplasm to cover areas where *Chilo partellus* is found. The IRMA group thought that this method and plans are appropriate and adequate. However, the generations could be advanced to BC5 to ensure full conversion.

Maize Cultivar type – OPVS vs. hybrids

In Africa, the informal maize seed system is large. A large number of farmers produce both traditional and modern varieties, market their own production, and take care of their own research needs, and supply more than 90% of seed in Africa, with over 80% being farmer saved. The IRMA project was developed with a major focus on resource poor farmers benefiting from the technology. Resource poor farmers use a combination of hybrids and OPVs. Open pollinated varieties are often considered more suitable for small scale farmers because they can be recycled without loss of yield potential. Improved OPVs are easier to develop than hybrids, their seeds production is simpler and relatively less expensive, and subsistence farmers who grow them can save their own seed for planting the following season, reducing their dependence on external sources. However, farmers often grow more than one maize variety from farm saved seeds, with varying degrees of recycling seed of landraces, OPVs and hybrid varieties, as well as a high rate of farm to farm spread of seed. These factors point to the possibilities of out crossing and spread of GM maize varieties in the communities. If Bt maize OPVs are availed to the communities, there will be a need for increased education for the GM maize varieties more than for the improved conventional maize varieties. This package will include the management of OPVs to reduce out crossing to neighboring varieties and management of the refugia. It might be desirable for IRMA to consider hybrids only but at the risk of alienating small scale resource poor farmers.

The group thinks that the germplasm selected for conversion, the methods used and planned time lines are appropriate and adequate. The group is not unanimous in its support for the hybrids only and omission of OPVs from the menu of Bt maize cultivars to be offered to farmers and guidance of the IRMA-TAB is desirable.

Issue 5: Intellectual Property Rights

D. Bergvinson and S. Mugo

Introduction

Before engaging in a new technology, it is important to analyze the Intellectual Property Rights (IPRs) that are involved. IPRs are designed to protect one's investment into intellectual property and the products that are derived from these advances so as to provide economic returns to research to stimulate additional investment in research and product development. They usually increase the cost of using the technology, commonly referred to as 'technology fees' that not only cover development costs but also the costs associated with defending IP claims.

IPR in IRMA

Freedom to Operate (FTO) review

To ensure that the Bt technology developed will be accessible to farmers without being prohibitively expensive, the IRMA project commissioned a review of IPRs, including a Freedom to Operate (FTO) review. The study concluded that no patents had been filed in Kenya concerning the Bt technology, and therefore no patent restrictions were expected in Kenya (Swift Reviews 2001). Moreover, when a company files for a patent in one country, it has a limited time (one year from the time of filing in the US) to file the patent in another country that is a member of the "Paris Convention". Another treaty called the Patent Cooperation Treaty (PCT) is now used as a tool to reduce the complexity of foreign filing issues. Under this treaty, most members of the Paris Convention have agreed that the filing of a single English-language PCT application in the US Patent and Trademark Office, will be sufficient as a filing in other designated countries which must be filed within one year of the US filing date. Since all patented technologies under consideration by the IRMA project have been patented for more than one year, these patents can no longer be filed in Kenya.

Other agreements – University of Ottawa MTA

Even though there are apparently no patent restrictions within Kenya, other agreements apply. Most importantly, when CIMMYT obtained Bt genes and constructs from different collaborators, in particular the University of Ottawa, it signed a material transfer agreement (MTA) which stipulates for "research purposes only". As these constructs were derived from Monsanto's published sequence in Canada, patent infringement is a major concern if IRMA uses these same constructs in commercial varieties through sublicenses to commercial companies for seed production and sale. A request was made to the University of Ottawa to provide an agreement for commercial use of the genes and constructs that have been used by CIMMYT. This process was initiated in May 2004 and by May 2005 the university agreed (correspondence was between CIMMYT's legal council Shawn N. Sullivan [no longer with CIMMYT] and Sean Flannigan, Interim Director, Technology Transfer & Business Enterprise) to lift the research only clause only if a "statement of consent and no objection" was signed by the multi-national seed companies, namely Syngenta, Monsanto, Bayer, and DuPont. None of these documents have been signed to date. However, given the complexity of different IPR components belonging to different companies, it remains unclear if the University of Ottawa can even provide an agreement for commercial use.

Other agreements – Major seed companies

CIMMYT has since approached the major seed companies (Monsanto, Syngenta, and DuPont) with a letter of intent to ensure that the act of CIMMYT releasing these constructs to Kenyan farmers through the different national seed businesses will not result in litigation against the University of Ottawa, CIMMYT or the national seed producer. As Monsanto holds the original patent on cry1Ab/c in maize and since Illimar Altosaar used this published sequence, as cited in Plant Cell Reports (1996) 15:677-681, to generate the synthetic sequences for both cry1Ab and cry1Ac, CIMMYT really must obtain permission from Monsanto or else the University of Ottawa could face litigation as these sequences are patented in Canada where the synthetic constructs were generated. Senior management of CIMMYT is exploring other avenues, namely DuPont, where events that are effective against *Busseola fusca* could be obtained through a sublicensing agreement but these exchanges have only been verbal. A meeting is planned for February 2006 between Rockefeller Foundation (Garry Toennisson) and key stake holders in Bt maize for Africa to see the way forward in accessing patented technologies to improve the lives of African farmers.

Bt gene cry2Aa2 and ST-LS1, a potato promoter

CIMMYT has continued to transform maize with cry2Aa2 obtained from the University of Ottawa. However, this gene is driven by ST-LS1, a potato promoter that enables expression at high levels in green tissue, at least in tobacco. The concern here is that we have not yet encountered an event that contains the gene and can provide complete control of Spodoptera frugiperda belonging to the same family, Noctuidae, as *Busseola fusca* that we use as a prescreening surrogate prior to sending events to Kenya. This gene, to the best of our knowledge, has not been commercialized and is not patented in Kenya so obtaining Freedom to Operate will likely be easier but KARI and CIMMYT will require a release from the "research only" clause of the MTA from the University of Ottawa. We are waiting to see if an effective event is identified prior to approaching the companies with a statement of consent.

Stewardship and in-licensing issues

One of the major aims of this project was to deliver Bt-based technology into the hands of farmers (both commercial and resource poor) at little additional cost compared to conventional hybrids via local seed companies (De Groote et al. 2004a). As the gene is dominant, this trait can readily be incorporated into a range of varieties and can be recycled by farmers – this raises important issues regarding stewardship that are additional challenges for the project to address. However, the use of Bt genes in farmer-saved seed is not allowed in many countries. Therefore, this issue needs further attention to ensure that the issue of seed recycling is addressed within the licensing agreement and that farmers are provided with the appropriate information to promote product stewardship such as maintaining a refugia and managing their maize so as to maintain the efficacy of Bt maize for future generations.

Issue 6: Strategies for Release of Bt Maize across Kenya and for Post Release Resistance Monitoring and Management

M. Mulaa, M Gethi, D. Bergvinson, S. Mugo and R. Tende

Background

It is desirable that efficacy of the maize Bt technology be extended for as long as possible. This call for development of insect resistance management strategies and the employment of effective post large scale release monitoring approaches. Since Bt maize will co-exist with other maize cultivars and be adopted into the existing farming systems, it is important to look at a national strategy for Bt maize in Kenya.

Insect resistance management strategies

The most practical strategy for management of resistance will be use of 20% refugia next to 80% Bt maize. Suitable crop species have been identified as suitable refugia such as sorghum, maize and improved Napier varieties. Data from the refugia studies including field surveys and evaluation trials needs to be synthesized and availed to the scientific community through publications. The economics, as expressed in cost/benefit ratios, needs to be determined from the yield data already obtain from the refugia field trials conducted in Kitale, Kakamega, Embu and Mtwapa. Farmer preferences in different regions and farming systems have to be included in the evaluations.

Seed selection for effective control

If OPVs were to be considered or farmers practiced recycling of hybrid seeds, a key issue would be on methods to maintain the Bt gene in the seeds, as both could lead to loss of Bt gene in some plants in the OPV or in recycled seeds. The solution would be educating farmers on effects of seed recycling and on seed selection for Bt maize. Practical steps would be to detassel plants showing stem borer that may not contain effective Bt gene and frequent monitoring for the damage. To reduce effects of gene flow resulting to contamination of Bt maize by pollen from non Bt maize, farmers could harvest seed from plants not damaged from the middle rows of the Bt maize plot. Planting hybrid cultivars only would greatly reduce the need for this extensive education and planting refugia could go a long way to alleviate the problem.

Seed quality

The seed quality control system would assist in verifying seed quality using DUS to check for homozygosis of seed parents may be by use of commercial dip stick kits to verify the presence of Bt gene in the plants to be used as seed.

Post release monitoring

Using GIS maps on distribution of refugia to identify areas with less than 20% refugia will enable focusing future monitoring to areas with inadequate refugia. However monitoring for resistance will require determining a susceptibility baseline for borer species in different regions using a discriminatory dose (LD50). Farmers will need to scout for damaged plants in Bt maize fields and report to extension or KARI staff whenever damage is observed so that appropriate measures are taken.
Integrated pest management strategies

While the IRMA project is focused on the development of stem borer resistant maize varieties and hybrids it is recognized that this is just one of several control options that are potentially available to maize farmers in Eastern Africa. While the IRMA project is focused on developing host plant resistance (both conventional and Bt-based) there is need to look at how this HPR would compliment/antagonize other control strategies. A summary of the different control strategies has been prepared but needs to be completed. The four major components on an integrated pest management strategy are biological control, cultural control (including habitat management), host plant resistance (conventional and biotechnological approaches), and chemical control.

Views by the IRMA Project Scientist team

It was decided that the refugia studies including field surveys and evaluation trials are adequate, but this data needs to be synthesized and availed to the scientific community. The draft IPM for IRM strategy in Kenya needs to be completed before it is shared with other institutions to come up with a national IRM strategy for maize. There is need to consult scientists in other institutions to develop a suitable strategy. However, it is recognized that there is a need for an actual Bt maize product for experimentation to verify the hypothesis. The OQS can be used for some of this experimentation.

Issue 7: Environmental Impact Assessment

J. Songa, D. Bergvinson, and S. Mugo

An Environmental Impact Assessment means: A systematic examination conducted to determine whether or not a program, activity or project will have any adverse impacts on the environment. EIA is conducted on 'Individual projects' not Organizations. Therefore, an EIA will be required for the IRMA project, but not for KARI as an institution, nor for a research centre.

The Environmental (Impact Assessment and Audit) Regulations (2002), govern most of the requirements of EIA. An EIA is a requirement for all projects that deal with areas under the list of areas of concern with respect to the environment. Genetically Modified crops fall under the projects that would require and EIA. In such a case, one is required to approach NEMA. EMA then will appoint an external registered EIA expert to conduct the EIA of the project. An EIA expert is an individual expert or firm of experts registered under regulation 14 and includes a lead expert and an associate expert. The EIA registered expert will prepare a project report.

The Environmental Impact Assessment study

An environmental impact assessment study shall be conducted in accordance with Terms of Reference developed during the scoping exercise by the proponent and approved by the Authority. The Terms of Reference shall include matters required to be considered in the making of an environmental impact assessment as may be contained in the Second Schedule to these Regulations and such other matters as the Director General may in writing require. An environmental impact assessment study shall be conducted in accordance with the general environmental impact assessment Guidelines and sector environmental impact assessment guidelines set out in the Third Schedule to these Regulations. However, in a case of on-going projects, which commenced prior to the coming into force of the above mentioned regulations, then, an Initial Environmental Audit will need to be conducted on activities likely to have an adverse negative impact. The Initial environmental audit shall be conducted by a qualified and authorized environmental auditor – registered in accordance with regulation 14. The initial environmental audit is meant to provide baseline information upon which subsequent environmental control audit studies shall be based. The following annual EA is conducted based on a checklist prepared after the initial audit, and which have been recommended by the external auditor.

The proponent shall be required to conduct an annual environmental audit. Incase the proponents has capacity within the company to conduct the audit, then the annual audits will be self audits using internal capacity. By having competent capacity, it means having personnel that have experience in the areas of: safety, health and the environment. Incase there is no internal capacity on this, then the proponent shall have to be ready to pay for the services of an external registered auditor, during every annual environmental audit.

General points of information

These Regulations shall apply to all policies, plans, programs, projects and activities specified in Part IV, Part V and the Second Schedule of the Act. No proponent shall implement a project:- likely to have a negative environmental impact; or for which an environmental impact assessment is required under the Act or these regulations; unless an environmental impact assessment has been concluded and approved in accordance with these Regulations:

- No licensing authority under any law in force in Kenya shall issue a license for any project for which an environmental impact assessment is required under the Act unless the applicant produces to the licensing authority a license of environmental impact assessment issued by the Authority under these Regulations.

- No licensing authority under any law in force in Kenya shall issue a trading, commercial or development permit or license for any micro project activity likely to have cumulative significant negative environmental impact before it ensures that a strategic environmental plan encompassing mitigation measures and approved by the Authority is in place.

Issue 8: The status of biosafety legislation and how this affects IRMA project

S. Gichuki and S. Mugo

Background

The issue here relates to the extent to which Kenya legislation will facilitate availing Bt maize to farmers in Kenya and when the legislation will be passed. Currently, Kenya has regulations and guidelines for biosafety in biotechnology that is operational at the ministerial level. Through these regulations Kenya has managed to steer the research phase of products of genetic engineering. For IRMA project, these have led to achievement in 1) approvals for biosafety facilities (Lab, greenhouse and open quarantine site), 2) Introductions of Bt maize leaves and seeds, 3) approvals for Bt maize confined field trials – evaluations & Backcrossing, and 4) guidance through CFTs planting (x2), harvesting, disposal, & monitoring.

The national biotechnology and biosafety Policy and a Biosafety Bill for Kenya are being developed, being at with the National Council for Science and Technology (NCST) and has been going through reviews before being forwarded to the cabinet and subsequently to parliament.

Kenya and Cartagena Protocol

Kenya is a party to Convention to Biological Diversity (CBD) 1992. The Cartagena protocol on transboundary movement of GMOs was signed in 2000, ratified in 2002, and came into force in September 2003. Kenya is currently trying to domesticate this protocol by putting in place measures for implementation. The measures are:

- A policy on biotechnology and Biosafety, which is often part of a broader national policy on biotechnology.
- A regulatory regime for Biosafety, which usually consists of a Bill or act in combination with implementing regulations.
- A system to handle notifications or requests for authorizations for certain activities, such as field test releases of GMOs in the environment. The system typically provides for public participation and risk assessment and public participation.
- A system for monitoring and inspections.
- A system for public information, i.e. a system to inform stakeholders about the development and implementation of the national Biosafety framework.

Status of the Biotechnology Policy and Biosafety Bill

Bt then, the NCST was coordinating the development of Biotechnology policy and Biosafety bill through the National Biotechnology and Biosafety Coordination Committee and the National Biosafety Committee. Experts for drafting were drawn from civil societies, NGOs and relevant Government ministries, including the Ministry of Agriculture. The experts drafted a Biotechnology policy, a Biosafety bill with the guidance of the Attorney General Chambers. The scope of the policy has included traditional and modern biotechnology, GMOs in transit, the domestication of the function of the Cartagena Protocol on Biosafety, the creation of public awareness and the development of a legal framework. Awareness Workshops were held to discuss the policy and Biosafety bill, attended by professionals, members of Parliament, other stakeholders, three parliamentary technical committees. It was then revised by lawyers ABSF, and scientists. KARI hosted the drafting team and made presentations of concerns of the Biotechnology research and development stakeholders over the biosafety policy. The NCST revised the policy based on comments from various stakeholders. The final drafts of the policy and the bill were sent to the Minister for Science and Technology on 5th of April 2005. The policy has since been adapted by the cabinet, while the Bill will be tabled in parliament.

Regulatory Agencies
There are offices already in place to regulate Biotechnology. These include:
- Kenya Plant health inspectorate services (KEPHIS) which is supposed to regulated plant related issues
- National Environment management Authority (NEMA) to regulate issues related to environment
- Public Health department which is supposed to regulate food and feeds derived from Modern biotechnology techniques
- Kenyan Bureau of standards, which is supposed to regulates standards
- Department of veterinary Services (DVS), which is supposed to regulate animal related issues.

Regulatory process in Kenya
The regulatory Process for GMO field trials in Kenya is a long one covering:
- Preparation of research proposal by scientist
- Application for confined field trials made to KARI IBC
- Application deliberated on and approved by KARI IBC
- Experimental facility inspected by KEPHIS
- Application made to NBC by KARI IBC
- Application deliberated on and approved by NBC
- Advisory of approval received from NBC
- Application and approval by the KSTCIE
- Compliance document from KARI to KEPHIS
- Letter of authorization and permit issued by KEPHIS
- KARI signs letter of commitment to KEPHIS
- Commencement of experiments with KEPHIS supervision

Current Status of Applications for GMO trials
The regulations in Kenya have allowed the following activities on GMOs in Kenya:
1. The Bt. Cotton application for field testing was approved by NBC Pending approval by KSTCPIE and issuance of permit by KEPHIS.
2. The IRMA Bt. Maize has gone through the second planting CFT after approval by NBC
3. Transgenic cassava was asked to present data over two seasons data on insect species and mock trial requested by NBC
4. Rinderpest vaccine was approved by the KARI IBC
5. Transgenic sweet potatoes application is being considered by the KARI IBC.

IRMA contribution to Kenya GMO legislation
IRMA has had contribution through reviewing the drafts and providing a product that paves way through considerations. A possibility of IRMA lobbying for the bill through engaging a consultant to follow up the biosafety bill on behalf of IRMA has been discussed.

VII. PROGRESS REPORTS IN 2005

Theme 2: Development of insect resistant conventional and Bt maize, and compositional analysis

***S. Mugo, J. Ininda, G, Gethi, M. Oyoo, C. Mutinda, G. Ombakho, O. Odongo, & G. Muren*ga**

Objectives

To develop maize varieties that resist the major insect pests found in Kenyan maize production systems, using conventional breeding and biotechnology, specifically Bt maize technology.

Progress

A. Development of insect resistant maize germplasm using conventional methods

Conventional insect resistant maize development germplasm involved the search for sources of resistance from CIMMYT and KARI, mainly through screening for insect resistance among elite and non-elite sources. It also involved the search for elite germplasm to backcross to Bt maize source lines. This was done through evaluation of Kenyan germplasm for stem borer resistance and through characterization of germplasm in CIMMYT international maize trials. Finally, there was need to develop new source germplasm for insect resistance and finished products, insect resistant hybrids and OPVs.

Germplasm development and testing involves a central nursery at Kiboko where seeds are produced through crossing, selfing and germplasm advancement. This germplasm is then tested at selected sites where varying stresses are imposed. These include *C. partellus*, low-N, and drought at the Kiboko site, random drought at Katumani; *Busseola fusca*, *C. partellus* and MSV at Embu; Exerohilum turcicum, and Puccinia sorghi at Muguga; low-N at Kakamega, and grain yield evaluation at Kitale. Desirable germplasm should be superior in its resistance to stem borers. In addition, its grain yield evaluation as well as other special traits like quality protein maize (QPM) and disease resistance should remain high.

A large number of inbred lines and OPVs have been screened mainly from CIMMYT entomology activities in Mexico as well as from KARI. Inbred lines from the multiple borer resistant (MBR) populations have been found to contain good levels of resistance and have been used to develop other source populations and finished products. Some OPVs from this screening process were found to contain good levels of resistance and have completed two years testing in the Kenya maize national performance trials (NPTs) and may be released in early 2006.

Neither Kenyan commercial nor CIMMYT elite germplasm in international trials showed good resistance to stem borers, but germplasm that was good in other traits was identified and formed the set that is being converted to Bt in the biosafety greenhouse (BGH) and in the biosafety open quarantine field site (OQS).

Among the finished products available are the six OPVs that have been tested in the early, medium and mid–late maturity maize NPTs by KEPHIS, and double cross hybrids (DC) and double top cross (DTC) hybrids (TWC) that are being tested at various locations during 2006A season. From these good ones will be nominated to the NPTs in February 2006.

B. Development of insect resistant Bt maize germplasm

A breeding program to develop Bt maize cultivars using converted inbred lines was initiated to develop adapted Bt maize germplasm for Kenya. The process towards development of insect resistant germplasm using Bt technology is longer as it involves:

Identification of effective genes and constructs against main stem borer pests,
Identification of suitable maize inbred lines and OPVs for various ecologies,
development of facilities and biosafety protocol to develop and evaluate Bt transgenic germplasm,
Initiation of backcrossing to convert inbred and OPVs to Bt, and finally,
development of finished insect resistant hybrids and OPVs

The backcross method, the most effective and efficient method to convert germplasm with one or two traits, is being used to convert adequate germplasm to cover various maize zones, maturity groups, major stem borer species, resistance to various stresses, and cultivar types. The germplasm selected for conversion includes CIMMYT Germplasm (CML202, CML204, CML312, CML144, CML159, CML395, CML390, CML442, CML444, & Pool 15 QPM-SR-OPT-1, MBR line) and KARI Germplasm (EM11-133, EM12-210, MUL-509, MUL-619, KML-1, KML-2, & Katumani Composite). The BC2F1s generation is being developed in Bt maize confined field trials (CFT) at KARI Kiboko. We expect to go up to the BC3 generation before fixing the genes and extract the converted inbred lines.

Summary

Conventional insect resistant maize germplasm with leaf toughness as one mechanism of resistance have been developed. This germplasm combines the best in insect resistance from CIMMYT and the adapted maize in Kenya. Insect resistant OPVs are in the second year of testing in the Kenya maize national performance trials (NPT). However, conventional resistance faces challenges from its genetics and implementation and that is why Bt maize is desirable. Conversions of germplasm to cover most maize growing ecologies through backcrossing to Bt was initiated in the BGHC and continued to the BC_2F_1 stage the Bt maize CFT at Kiboko.

Theme 3: Environmental Impacts of Bt maize in Kenya

J. M. Songa, D. Bergvinson, and S. Mugo

Introduction

One of the concerns about the utilization of Bt maize for the management of stem borers is its potential impacts on non-target arthropods. A prerequisite to generating information on the non-target effects of Bt maize is the identification of key non-target arthropods in major maize growing regions in the country. It is also important to note that the arthropods found in a given maize habitat may be influenced by the prevailing environmental conditions, the maize cropping system, the varieties of maize and that of the association crops, and also by the crop husbandry practices used.

The objectives of this project were therefore to:

1. Conduct on-farm surveys in order to understand key aspects of the maize production systems – with respect to stem borer damage and management in each of the five major maize growing regions in Kenya;
2. Identify and determine the relative abundance of the target and non-target arthropods of Bt maize in each of the five regions;
3. Establish a reference collection of arthropods in the major maize cropping systems in Kenya;
4. Determine the key non-target arthropods on which to focus the impact studies; and
5. Determine the impacts of Bt –maize on major non-target arthropods in a bio-safety greenhouse and in a confined field.

Progress 1999-2005

1. On-farm surveys on maize production systems

On-farm surveys were conducted in each of five major maize growing regions in Kenya, including the lowland tropics (Kilifi), dry mid-altitudes (Machakos), moist mid-altitude (Embu), moist transitional (Kakamega) and the highland tropics (Kitale), and information collected on the major maize cropping systems, common varieties of maize and the association crops. Information was also collected on the key crop management practices, including, time of planting and soil fertility practices.

2. Characterization of arthropods in each of five maize growing regions

On-farm studies were also conducted in each of the five regions to identify the major target and non-target arthropods of Bt maize. This was done through weekly monitoring using pitfall, water and sticky traps, and by destructive sampling of maize plants, three times a season. The two major targets (stem borers) in each of the regions were: Kakamega: *Busseola fusca* and *C. partellus*; at Kilifi: *C. partellus* and *C. orichalcociliellus*; Kitale: B. fusca and *S. calamistis*; Machakos: *C. partellus* and *S. calamistis*; Embu B. fusca and *C. partellus*. This information on the key stem borers in each region was essential for better targeting of the Bt genes with respect to each specific region. Out of the wide range of arthropods recovered from farmers' maize fields in the different regions, five categories of non-target arthropods of interest were identified, including, non-target lepidopteran herbivores (e.g. Helicoverpa armigera), non-target non-lepidopteran herbivores (e.g. crickets, aphids and *Prostephanus truncatus*), parasitoids (*Cotesia flavipes*, *C. sesamiae*, *Goniozus indica* and *Dentichasmias busseolae*), predators (ladybirds, earwigs, and ants), and pollinators (the honey bee *Aphis melinifera*). The relative importance of the foregoing non-target arthropods varied among the different regions, with some of the arthropods being limited to certain regions. For example *G. indica* was limited to the Kenyan Coast, at Kilifi. For each distinct group of arthropods identified, voucher specimens were kept in the reference collection at KARI-Katumani.

3. Arthropod Reference Collection

An arthropod reference collection, comprising of voucher specimens of various specific identified arthropod groups, collected from farmers' maize fields in the five maize growing regions, has been established. This collection will serve as a technical reference during the monitoring phase in Bt maize fields. The foregoing information provides baseline information on the current status of arthropods in farmers maize fields before the Bt maize is deployed in the fields. Preliminary controlled studies on the non-target effects of Bt maize will focus on the key arthropods in the respective regions. This information also serves as a benchmark against which comparisons will be made in determination of impacts of Bt maize on specific arthropod groups.

4. Non-target effects of Bt-biopesticide and conventional insecticides on arthropods in a maize/bean cropping system

A study was conducted to determine the effect of Thuricide (a Bt-biopesticide) and the conventional insecticides (Dimethoate and Bulldock) for the control of stem borers in maize, and ii) to determine the impacts of Thuricide (a Bt-biopesticide) and the conventional insecticides on the abundance of different non-target arthropods in a maize bean cropping system. Results of this study showed that both the Bt-biopesticide and the conventional insecticides (Bulldock and Dimethoate), were effective in reducing stem borer damage in maize. However, the insecticides had more negative impacts on the non-target arthropod diversity (families) and abundance. The insecticides also had a greater negative impact on the stem borer parasitoid diversity and on some of the predator groups such as the ladybird beetles. Considering that the Bt-biopesticide and Bt maize have similar modes of action, it is conceivable that results of this study give an indication of the potential impact of Bt maize, compared to commonly used insecticides, on the target and non-target arthropods of Bt maize.

5. Monitoring of non-target arthropods at the Kiboko confined field site

Studies were conducted at the confined field site at Kiboko in the years 2003 and 2004, to determine the range of arthropods that are found at the site. The baseline information generated at this site was part of the information that was used for permission to commence Bt maize trials at the confined field trial (CFT) site at Kiboko. Once the Bt maize was planted at the CFT, monitoring of the arthropods including the natural enemies continued in Bt and non-Bt plots at the site. Results of the first season study showed that the hybrid Bt maize fields had a higher number of some common predators such as the ants, lady bird beetles and spiders than the non-Bt maize inbred lines. The same applied for other generalist arthropods such as the ones in the family Sarcophagidae

6. Greenhouse / laboratory studies on impacts of Bt maize on the bionomics of key parasitoids of maize stem borers

Mock trials using non-transgenic CML202 maize inbred line, were conducted at the biosafety laboratory. The objective of the mock trials was to optimize the protocols for the non-target studies and also to obtain basic information on the development time of the stem borers and the parasitoids in the laboratory.

Theme 4: Insect resistance Management and Contingency Plans

M. Mulaa, D. Bergvinson, R. Tende and S, Mugo

Introduction

One concern of utilizing Bt maize technology is the likelihood of development of resistance to the Bt toxins by the target stem borer species. However, the rate of evolution of this resistance can be slowed down or stopped through the use of appropriate resistance management strategies. Resistance management strategies are being developed, the primary strategy being providing the stem borer host plants that do not produce the toxin, and so can maintain populations of non resistant borers. These would breed with potentially resistant borers and ensure that any resistance buildup will mostly be in the heterozygous state thereby limiting the buildup of resistant insect populations. To be accepted by farmers, IRM strategies must conform to existing cropping systems, and the refugia crops must be economically viable and socially acceptable to those making the management decisions at the farm level.

Objectives

The objectives of the studies under IRM were to:

1. Identify suitable alternate hosts, which can serve as refugia for Bt maize in different agro-ecological zones within Kenya.
2. Estimate and document the area covered by already established potential 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 may be necessary.
3. Raise awareness on refugia and solicit ideas from farmers and extension on potential refugia and their management in various maize growing ecologies in Kenya
4. Studies on resistance development in *C. partellus* and *Busseola fusca*

Progress

1. Identification of suitable alternate hosts for refugia for Bt maize in various maize growing ecologies in Kenya

To select suitable crop species to be used as refugia, recommended forages, sorghum and maize varieties were evaluated for stem borer preference and survivorship in the field. The trials run over four years and seasons (2001 and 2004) at four KARI centers (Mtwapa, Embu, Kakamega, and Kitale) representing the four major agro-ecological zones in Kenya. Results from field trials indicate higher borer damage rating and exit holes in all sorghum and maize varieties, indicating that these are the preferred hosts. Grass species with many exit holes included some improved Napier varieties e.g. Kakamega 1, Napier 16837, Sudan grass, Columbus grass, giant setaria and panicums.

Laboratory bioassays for larval development rates and fecundity were conducted using four stem borer species: *C. partellus*, *Busseola fusca*, Sesamia calamistis and Eldana saccharina, and showed significant differences among stem borer species. *Busseola fusca*, the species for which resistance development is a major concern, had the highest survivorship on sorghums and maize, and the lowest in Napier grass. Egg production per female was highest in maize and lowest for Napier grass. The total borer life cycle was shortest on maize and longest on Napier grass.

2. *Estimation and mapping of proportion of land occupied by alternative hosts of major stem borer species, which may be recommended as natural refugia*

Vegetation surveys were conducted in major maize growing districts in Kenya to quantify the percent area covered by different natural refugia in order to estimate the availability of refugia in existing maize cropping systems. The survey covered 850 farmers all interviews were geo-referenced and GIS maps on existing refugia generated for both cropping seasons. Most parts of Kenya have natural refugia of more than 20%. Some districts had less than 20% refugia, largely due to an almost exclusive planting of maize and very little area planted to alternate hosts, including sorghum. Such regions will require structured or augmented refugia to attain 20% refugia, and frequent monitoring for resistance.

3. *Raising awareness on refugia and soliciting ideas from farmers and extension workers on* potential refugia and their management in various maize growing ecologies in Kenya

To complement the researchers' efforts and increase the chances of the Bt maize and refugia concept being accepted by the farmers, KARI and CIMMYT scientists in the IRMA project organized a workshop to get farmer and extension input into the project. The first workshop was conducted at KARI Mtwapa and attended by farmers, researchers and extension staff.

A group exercise was conducted to rank refugia species in the experimental plots by the three 3 categories of participant, based on their criteria. There were differences in the criteria and the ranking of the varieties for use as pastures and refugia. When all the criteria listed by the three groups were combined, the most common criteria used by all was resistance to stem borers, alternative uses (food, pasture, refugia, hay) and the ability to attract and support stem borers. The farmers also mentioned availability of seed as an important criterion.

4. *Studies on resistance development in C. partellus and Busseola fusca*

Laboratory studies conducted to investigate the possibility of *C. partellus* and *Busseola fusca* developing resistance to Cry1Ab and Cry1Ba delta-endotoxins indicated no resistance development to *C. partellus* after four generations. These toxins have low control levels for B. fusca.

Theme 7: Market assessment and analysis

M. Odendo, H. De Groote, J. Wanyama, and J. Ouma

Summary
The purpose of this theme is to assess potential demand for Bt maize by different consumers and identify marketing constraints and opportunities in the maize sub sector. Formal and informal studies, as well as literature reviews were conducted. The following are the major activities undertaken:

1. Consumer awareness and attitudes toward GM foods in Kenya
A survey was conducted in Nairobi to determine consumers' awareness, attitudes, and willingness to pay for GM crops. A sample of 604 Nairobi consumers was selected systematically at the outlets where they purchased maize meal: supermarkets, kiosks and posho mills.

The results show that 38% of the respondents had heard or read something about GM crops. Awareness was highest among supermarket clients (50%), but less in kiosks (34%) and posho mills (31%). Men were more aware than women (45% vs. 29%). Awareness increased with education and income levels. Newspapers were the most important source of information on GM crops (34% of respondents) followed by schools and colleges (21%), and television (11%). About 68% of the consumers were willing to buy GM maize meal at the same price as their favorite brand.

Most people interviewed believed in the technology's positive impacts, in particular that it can offer a solution to the world food problem (81%), and that it can reduce pesticides on food (79%). However, about half of the consumers expressed concerns about potential negative effects GM crops may cause--death of non-target insects and loss of local varieties. Public opinions should be monitored frequently to determine awareness levels, capture the impact of awareness campaigns and note changing perceptions. Consumer surveys should be extended to smaller towns and rural areas to include other consumer groups.

2. Commercialization of maize
The study was conducted to assess the degree of commercialization of maize in highlands (maize surplus) and Moist Mid-altitude (maize deficit zones). The proportions of maize harvest sold were used as a proxy to degree of commercialization. Overall of 44.7% of the harvested maize was sold. However, the proportion was higher, as expected, in the highlands (58.1%) relative to Moist Mid-altitude (23.1%). The proportion sold did not necessarily reflect self-sufficiency in maize supply, as farmers sold maize even if they did not have enough for the households in order to meet other domestic obligations

3. Analysis of grain marketing information systems
This study was carried out to evaluate farmers' perceptions of importance of marketing information; identify existing farmers' sources of grain marketing information; determine farmers' confidence in and use of marketing information; and assess farmers' willingness to pay (WTP) for marketing information. This study was carried out in traditionally grain surplus-and deficit zones. Results show that 68% and 55% of the households in grain surplus and deficit zones, respectively, recognized that marketing information is very important. Farmers received marketing information from multiple sources, mainly from traders (67%) and other farmers (66%). However, most of the farmers who received the information were not utilizing the information due unreliability of the information and poor access to complementary infrastructure. Education level of the household was the most significant factor that positively affected WTP for marketing information. To improve grain marketing, smallholder farmers should be catalyzed to form strong associations so as to enjoy economies of scale in accessing marketing information and markets. In view of farmers' perception that information provided by the private sources is unreliable, the public sector ought to provide marketing information as a public service.

4. Seed sector Analysis

The aim of seed sector analysis was to identify and characterize the players in the seed industry with advent of market liberalization. The study shows that the monopoly of Kenya Farmers' Association (KFA) in maize seed distribution was reduced and many new seed companies are participating in the seed market. In addition, many traders are involved in seed retailing. There were no new seed entrants in highlands where Kenya Seed Company dominated seed sales (96.7%) and H614 still accounted for 50% of the sales in the highlands. Involvement of many players in the seed market also came with new maize varieties being released to the market. However, the process is still not efficient as it is bedeviled by constraints such as quality control at retail, resulting in seed adulteration.

5. Bio-safety and Regulation in East Africa

In East Africa the governments are generally considering biosafety and regulatory issues related to GM crops. However, the countries are at different stages. In Kenya for instance, the process is improving in quality and speed, although the law is not yet passed and this is problematic for IRMA. In Tanzania, and Uganda, regulations are in place.

6. On-going activities:

A survey of millers and processors: awareness and attitudes towards GMOs
Seed system analysis and international collaboration

Theme 9: Impact assessment and Socio-economics workgroup

J.O. Ouma & Hugo De Groote

Introduction

This briefing report documents the activities undertaken under the impact assessment theme of the Insect Resistant Maize for Africa (IRMA) project for the period 1999 to 2005. These activities can be grouped into seven categories:

1. Participatory Rural Appraisals
2. Participatory Plant Breeding
3. Maize sector study
4. Impact assessment
5. Biotechnology, Regulatory Issues and GMO issues
6. Biodiversity in Maize
7. Other maize traits interesting to IRMA

In the next sections these activities are briefly discussed. The list of publications appears in a separate CD. Activities 3 and 5 are discussed in the Market Analysis theme, which was formulated in phase two of the project.

1. Participatory Rural Appraisal

PRAs were conducted in all major maize growing zones with the aim to guide the breeding effort. Stem borers and storage pests were perceived as the major pest problems in all zones, with Striga being major constraint in Lake Victoria area. A report for each AEZ was written, as well as a summary paper (De Groote et al. 2004b). PRAs further showed that recycling of hybrids was common and consequently a study on economics of hybrid recycling was initiated in Embu and Kitale regions.

2. Participatory Plant Breeding

Although IRMA does not have varieties in the farmers' fields yet, collaborators have fine-tuned methods of participatory variety evaluation through other projects. These methods include soliciting farmers' preferences through PRAs, an evaluation method of new varieties using scores (1-5), and the use of the appropriate statistical tools (ordinal regression) that also allow for analyzing the difference in preferences by gender or wealth category (De Groote and Siambi 2005).

3. Impact Assessment

A major objective of the social scientists in IRMA is to assess potential impact. For this purpose, crop losses caused by stem borers needed to be assessed accurately. Using farmers' estimates of losses to stem borers from a 1992 survey, a national average of 12.9% was obtained (De Groote 2002). These results were verified by conducting crop loss assessments in the six maize growing zones, resulting in a yield loss estimation of 13.5 % (400,000 tons). High-potential areas have relatively low crop loss levels (10–12 %), while the low-potential areas have higher losses (15–21 %). Taking into account the higher yield of the former areas (more than 2.5 t/ha), the loss per hectare is remarkably constant, between 315 and 374 kg/ha, except for the dry mid-altitude zones, where losses total approximately 175 kg/ha (De Groote et al. 2004c).

To estimate the economic impact of maize for different agroecological zones and resistance against different species, a model was developed, in collaboration with ICIPE, to combine crop loss estimates with production data, species distribution, and efficacy of particular genes (De Groote et al. 2003). The results show that *Busseola fusca* is the major cause of economic loss due to stem borers (82% of all losses), followed by *C. partellus* (16%), while the other species are negligible. More than half of the losses occur in the moist transitional zone, followed by the highlands, which are also the zones with the highest adoption rate. It follows that a Bt gene, effective against B. fusca, incorporated into varieties for these two zones, would be the most likely to bring high returns. Under the current situation, with genes only effective genes against *C. partellus*, the benefits will still be higher than the costs, but not by so much.

Finally, it is important to assess the impact of new technologies on poverty and the equitable distribution of its benefits. Pooling information from different sources, IRMA's scientists came to the conclusion that the poor are likely to benefit from the new varieties, as well as the local seed industries, and poor, urban consumers (De Groote and Mugo 2005).

4. Biodiversity

The perceived threat of new technologies, in particular GM crops, on biodiversity is very common in the debate and the literature, and showed up prominently in the consumer survey. Therefore, IRMA is also describing, and characterizing all local varieties encountered. The Kenya National Gene Bank is collaborating and has agreed to conserve a sample of all varieties. The International Plant Genetic Resources Institute (IPGRI) has agreed to collaborate on their morphological and molecular characterization. To develop proper strategies to conserve local varieties, a study on georeferencing and spatial analysis of the distribution of local OPVs at the Coast was completed in 2005 as a pilot exercise. The purpose of the activity was to quantify gene flow and develop control methods.

5. Study of other maize traits interesting to IRMA

The development of new insect resistant maize varieties is not a stand-alone exercise. Farmers demand a wide range of traits in their varieties, so CIMMYT and KARI breeders are developing a wide range of materials with new traits. These traits include drought tolerance, resistance to herbicides to combat Striga, improved nutritional qualities such as quality protein maize and vitamin A biofortified maize. IRMA social scientists are also active in these field to understand farmers' demand and consumers' acceptance of these new traits. These studies help to focus the research, assess potential impact and identify where it would be useful to incorporate these traits in the insect resistant varieties.

Theme 10: Communication / Promotion Progress Report – 1999-2005

D. Ouya, G. Kimani, S. Mugo, S.T. Gichuki

Introduction

It was recognized since the initiation of this project in Mombasa that communication would have a unique and higher profile role in this project than most because of the controversial nature of the technology and lack of awareness about it. Objectives from initiation in 1999:

1. Public awareness / public information (and input) about the technology and the project.
2. Extension activities as needed and anticipated
3. Internal communications
4. Document project and lessons learned

1. Public awareness / public information (and input) about the technology.

- Annual stakeholder meetings
- Strive for "balanced" media coverage
- Two IRMA workshops for journalists and support for similar workshops by others
- Direct interaction with journalists (at events, with interviews, and interpersonal channels)
- Respond to erroneous reporting
- Distribution of ready-made stories to media outlets
- Contracts with Nairobi media house (Picasso Productions)
- Monitoring of print media in Kenya
- Media events
- Simultaneous launch of IRMA with ABSF
- Stakeholder Meetings
- Opening of open quarantine site
- Opening of biosafety greenhouse (with the Hon. President of Kenya participating)
- Project highlighted at CGIAR Annual General Meeting in Nairobi
- First field planting of transgenic maize in Kiboko
- Regular coverage in the major newspapers and TV. International coverage includes the New York Times, BBC, and CNN International.
- Production of flyer/brochures, reports, IRMA newsletter, newspapers supplements, and CIMMYT and CGIAR Annual Report stories. Established web site for project.
- Information gathering through IRMA socioeconomics surveys and media monitoring

2. Extension activities as needed and anticipated

- Conducted intensive extension workshops in all five major maize growing zones.
- Familiarization with the technology from different perspectives
- Star Search exercise conducted among all groups (talent and creative messages identified)
- Exercise and presentations videotaped and distributed back to participants and through the extension service.
- Fact sheets (six) drafted and passed through three rounds of review by extension agents and scientists (not released in deference to timing issues)
- IRMA Updates distributed through the extension system.
- Poster and presence of IRMA at Kenya Agriculture Shows

3. Internal communications

- Support for annual project review, planning, and steering committee meetings (documents, on-site editorial support, etc.), and IRMA II plan and business plan
- IRMA Updates

4. Document project

- IRMA project document series established (about 20 documents at this time)
- Editorial support on journal articles, gray literature, posters, etc.
- Two stand-alone videos, and video library (raw footage) of events and TV news coverage.

VIII. DISCUSSIONS DURING IRMA REVIEW AND PLANNING MEETING – 2006

Presentations by Themes

1. *Bt maize event analysis and human health safety assessment*

Comment: *The indication on the graph on number of volunteers showing one plant all*

Question *Why were the numbers of seedling being counted during post harvest monitoring in the CFT?*
Response: *It was a requirement by KEPHIS to further enforce the genetic and material confinements by ensuring that no Bt maize volunteers are left to flower and effect pollination or be eaten by humans or other animals. Hence, the requirement to monitor these for one year. However, this requirement is too long since maize does not have dormancy and in 2 months no volunteers should be available. This data will be fed into the regulatory process.*

Question: *Do the results obtained in Kiboko reflect expected results from other locations in Kenya?*
Response: *We are using inbreds lines, which unlike hybrids will not go for multilocational testing. This was for proof of concept. We planned to set up OQS at other location once we have germplasm for those mid-altitude and highland areas. However, the Kiboko area has high survival rates of C. partellus unlike in Embu and other mid-altitude areas.*

2. *Product Development (Conventional and Bt) insect resistant maize and compositional analysi*s

No questions

3. *Environmental Impact assessmen*t

Question: *Have there been studies on the other non-lepidopteran pests?*
Response:

Questions: *Why are you using partial feeding, ad how does this relate to natural stem borer populations feeding in the field?*
Response: *Later stem borers move from Bt to non-Bt in the natural environment.*

Question: *The design and analytical technique be revisited*
Response: *RCBD was used in the lab followed by ANOVA*

Question: *Analysis of larval mortality will require specific statistical tools. Have you found those?. Does low mortality indicates evolution of resistance among stem borers?*
Response: *Use less effective event to reduce the susceptibility.*

Comment: *Count data has problem since we have no normal distribution between Bt and non Bt maize. Be careful with data transformation*

4. *Insect resistant Mgt and contingency pla*ns

Questions: *How do you reconcile the views of farmers (males & females) on refugia and its use?*
Answer: *Farmers views should be included in all the trials (2nd season), to be effective in IRM.*

Question: *Do you consider sorghum as the best in refugia?*

Question: *Where are the reports on the IRM workshops carried out for Mtwapa, Kitale, and Kakamega?*
Response: *It was considered better to publish paper(s) on IRM rather than publish books. A presentation on these in Italy met congratulations by participants.*

5. Biosafety and Regulatory

Questions: *When will harmonization of biosafety regulations in the ECA region be effected?*
Response: *Tanzania and Uganda are still behind in biotechnology /biosafety legislation and there is need for Kenya to continue being the model for this work.*

6. IPR / Licensing

No questions

7. Seed Production

No questions

8. Market Assessment and Analysis

Question: *How do you propose to deal with other variables during the long rains season?*
Response: *We develop agro-ecozone-specific questions together with fairness. Evaluate more than once - at flowering and at harvest.*

Comment: *It is unfair to use grain yield and cob size to compare OPVS and hybrids.*

Question: *Is it possible to partition the results of OPVS and hybrids?*
Response: *We could use a revised analysis for comparison of varieties (OPVS Vs. OPVS and Hybrids Vs Hybrids).*

Comment: *This information is important and we should organize seminars to present socio economic data to parliamentarians.*

Question: *The information generated by the socio economics group should be availed to the parliamentarians and consumes in other owns. This information should be put in a readable form very soon; since the biosafety bill will be debated soon.*
Response: *There are published papers. Consumer surveys have been done in Machakos, Kericho, and Kisii.*

9. Economic Impact Assessment

Comment: *During questionnaire pre-testing, there were concerns by millers that prefer organic farming. These should be invited to the stakeholders meetings to raise their concerns.*

10. Communication and Promotion

Comment: *Some equipment went to Kiboko. However, it should be to KARI Katumani.*

Comment: *We need a clearer or updated IRMA brochure for the BGH, and the general biotechnology.*
Comment: *We need to develop a video on BGH operations. Action: Gichuki, Kimani, Ouya, Murenga, and Mugo.*

2. Discussions during presentations of special topics

1. *Market Segmentation for humanitarian and Commercial uses*

Question: *How do we reconcile the question on the scientist trained using public funds while there is a requirement for or demand for royalties?*

2. *Towards IRMA- Private Technology provider partnerships*.

Comment: *MON810 is effective against B. fusca but B. fusca survival may increase in later stages of plant development.*

Question: *Seed producers will be competitors with Monsanto products.*
Response: *Monsanto sells to small segment and keep the price high*

Question: *How will the tiered pricing be effected?*
Response: *Malawi and Kenya (Sauri village) are already practicing segmentation using vouchers or personal identification to access seed.*

Question: *What happens to the germplasm converted by Monsanto?*
Response: *The agreement id to return all converted seeds. They will not use any of the seeds.*

Question: *Will OPVs be considered or only hybrids.*
Response: *Only hybrids will ensure workable stewardship for Bt technology in Kenya.*

Comment *Makes sure that for each farmer particular stockists to which they can obtain seed be identified.*

Question *What agreements will be signed?*
Response: *An overall contractual agreement, trait conversion agreement, testing agreement, and other sublicensing agreements.*

Comments about going public about the partnership:

- What does MONSANTO or IRMA project feel about this?
- Whom do we start with in disclosing the feelings
- At appropriate time as the public, need time
- We should not because it is easy to be distracted. It should be after the converted materials have been received.
- Once Mon 810 is tested and advantages seen then we can go public
- Need to make progress before going public
- Joint in partnership in going public
- New need to go public now, since it is better, and we never know how the public would react.
- Let us test and see and at appropriate time go public
- For partnerships for trust between institutions we need to consult and agree if Monsanto refuses then we find ways of passing message about negotiation.
- We need to go public at the agreement(s) stage and not the (+ves) and (-ves).
- We new need SWOT analysis on the item of going public about this
- If material is not going out as product soon, then we need to wait
- Consider cost/Benefit (+ves) or (-ves) and what MERITS are there?
- Why do we seem to fear going public while our strategy in IRMA is open consultations?

- Let us do it at the agreement signing as the institutional level
- The PS MoA suggested that we hold going public until after the Biosafety Bill is discussed.

3. *Developing suitable IRM strategies for Bt maize in Keny*a

Question: *Where farmers grow Napier, is it a cash crop? Yet it's a has less*
Response: *For commercial purpose*

Comment: *Why is it that in all the crop/refugia, there is little significant differences in dry matter yield?. Does this mean that any crop could be used as refugia?*
Question: *How do we reconcile the choices between female and male farmers?*
Response: *The neighboring farms are within less than 200m and refugia can be shared. of among farmers. The data can be disaggregated to separate the information*

Question: *Would you make Napier as refugia as opposed to maize and Sorghum?*
Response: *Farmers will have more options and will have to be sensitized on refugia use. (through communication) and information packaging. The cropping systems of farmers will not be changed and that given that Bt maize technology will not penetrate 100%, then still the remaining proportion of maize area will act as refugia too.*

Comment: *The advantage of involving farmers is that IRM should be promoted, so that farmers take it up as their own message.*

Question: *Do we have reason to believe that we can get different results?*
Response: *Yes, since there are differences in ecosystems of cropping*

4. *Global strategies to control maize pests*

Question: *How do you rate the diseases on the table? How did you generate the numbers?*
Response: *The numbers are used as a guide for the different trait that should be in the germplasm*

Question: *The CIMMYT BoT visitors were shown a plastic eaten by LGB. How come then those we should be developing kernel toughness as a trait?*
Response: *The varieties are not immune but need to be combined with biological control for LGB for it to be effective to the LGB. Resistance may be due to biochemical but we need to consider other related factors like peroxidases and hydroxyl rich compounds in maize maybe the sources of resistance.*

Comment: *Selected non-damaged materials by LGB have lower germination.*
Response: *More studies on this are required.*
Comment: *The data for IRM need to be partitioned: one for publication in refereed journal and another for report. These should be included in the 2007 work plan.*

5. *Trait integration*

Question: *What are the IPR implications for KARI? KARI & MONSANTO has to negotiate on the matter even if it means sub-licensing? Will there be any legal issues arising from the agreement in view of the gene/trait insertion or conversion of KARI / CIMMYT materials? What are Monsanto's interest? In addition, what binds IRMA to it must be clearly stated. We should not be in a hurry to implement anything without a consideration of the risk implications.*
Responses: *Points taken. The agreements to be signed will be clear to all parties, as they will pass through all-important stages in the institutions – technical and legal offices of KARI, CIMMYT, and Monsanto.*

3. Review of IRMA II Business Plan

Question: *How will the timeline on Bt approach change?*
Response: *The plant breeders group will refine the timeline on Bt approach?*

Question: *What are the implications of the misidentification of B. Fusca to the refugia strategy?*
Response: *A workshop on this will be include in 2007 Workplan.*

Question: *What were the outcomes of the seed systems and economics of IRM strategies?*
Response: *Seed systems work is incomplete and will continue to next year. The Economic analysis of IRM strategies has been done but will be reported after refining of the strategies.*

Question: *What of the survey on communication needs of stakeholders?*
Response: *There were no funds available to implement the questionnaire. This should come as a part of a larger survey, as the questions are too few to justify the cost as the scope of study was narrow.*

4. Criteria for Workplans for 2007

- Critical but unfinished 2006 business.
- Any new activities that are necessary and that are event neutral
- For conventional germplasm any activity that lead to release of improved insect resistant maize germplasm
- Any activity that supports the legislation of biosafety bills in Kenya and the region
- Any activity that is necessary for enhancing new partnership with the target company
- Reporting in quality publications of past work

5. Issue Management

Comment: *We need to clarify that the public events were effective against most of the Kenyan stem borer species.*

Question: *Are there any negotiations for the private Bt events to public good?*
Response: *No. We will only access the trait and convert KARI and CIMMYT germplasm. This is what will be offered royalty-free.*

A small group of Dr. Mukisira, Dr. Gichuki and Dr. Mugo were designated as spokesmen on the issues management.

Daisy Ouya will make the proposed changes and send it to S. Mugo, who will preset it to the IRMA Sxco in February 2007, and later distribute it to all in IRMA.

6. Workplan presentations

Comment: *The digital data base be updated and possibly availed in a CD form*
Comment: *Investigate feasibility of carrying out the determination of the areas of overlap in the presence or absence of the B. Fusca and C. partellus.*

Comment: *When do you plan to sensitization workshops. Plan in a way that captures the long rains for Machakos area Sowing should be done very soon to be in time for the workshop.*

Comment: *Combine or liaise with communications group on the work with ABSF and KARI towards awareness creation to parliamentarians.*

7. Closing Discussions

1. There will be no IRMA-TAB meeting in early 2007 there being no important /pertinent issues to be discussed. However, TAB members should be invited for updates (electronically or otherwise), while those located in Kenya will be invited to join the ExCo.

2. The ExCo will meeting will be held in Nairobi on 5th February, 2007. MoARD response to attend the meeting has not been received. Dr. M. Banziger will represent DG CIMMYT. J. Songa, J. Ndolo, and C. Taracha will organize for the visit of ExCo to the BGHC. Some theme leaders will be invited to explain pertinent issues to the ExCo.

3. A stakeholders meeting could be held once the agreement with the private sector is signed, and if possible with trials ongoing in the BGHC or the OQS.

4. Theme leaders meeting will be held at least twice in 2007 with February 19-20 Feb. 2007 and 20-21Aug. 2007 as the suggested dates.

5. IRMA Annual Meetings will be held 5- 9 November 2007 at a location outside Nairobi. The suggested locations were Narumoru, Naivasha, Machakos, South Coast Mombasa, and Embu. Simba Lodge Hotel in Naivasha was preferred. Participants need to communicate on transport and hotel rooms to avoid wastage.

6. The 2006 Annual reports from theme leaders should be sent to the coordinator by 20th Dec 2006 to improve quality of the Annual Reports, these should be reviewed by the respect theme team members prior to sending to the coordinator.

7. The meeting ended with acknowledgement of the inputs of all. J. Songa speaking on behalf of KARI thanked S. Mugo, the coordinator for steering IRMA project through the ups and downs and for all the achievements. D. Bergvinson on behalf of M. Banziger thanked all and hoped for success in passing of the biotechnology and biosafety Bill and for the negotiations going on private sector events. Jost Frei felt privileged to be on IRMA since 1999. He appreciated the progress being made on the conventional resistance. He was convinced that the IRMA project team is still being the “Team Spirit” courtesy of S. Mugo and wished a Merry Christmas all members. M. Mulaa thanked the support team (Dorothy Nanzala and Andrew Chavangi), the students (Ndolo, Murenga, Kengo, and Regina), all presenters, and work group members.

IX. APPENDICES

Appendix 1: Budget for 2004 FS 028 ($219,950) – A grant from Rockefeller Foundation to KARI/CIMMYT IRMA Project, 1 January 2005 – 31 December, 2007

	Activity			**2004**		**2005**		**2006**		**Total**	**Total**	**TOTAL**
		KARI	**CIMMYT**	**KARI**	**CIMMYT**	**KARI**	**CIMMYT**	**KARI**	**CIMMYT**	**KARI**	**CIMMYT**	
1	Take new insect resistant maize OPVs and hybrids through NPT	NPT Testing	Produce seeds	9000	5000	9000	4000	7000	10765	25000	19785	44765
2	Geneflow studies at 5 KARI centers	Field evaluation	Produce seeds and field plans	6000	4000	5000	3000	-	-	11000	7000	18000
3	Quantifying and characterizing non-target arthropods at 2 OQS sites	Insect supply, set traps, collect and quantify arthropods	Grow mock trials at Kiboko and Embu sites	8000	5500	7500	4000	4000	4000	19500	13500	33000
4	Train extension providers on IR maize; germplasm, IRM and seed issues	Organize logistics	Provide expertise	5000	10000	-	-	-	-	5000	10000	15000
5	Producing and distributing educational materials for agricultural shows and other fora	Distribute materials	Produce materials	8000	12000	8000	10000	4000	6000	20000	28000	48000
6	Producing and distributing IRMA document series	Distribute documents	Produce documents	10000	17000	10000	10000	10000	17000	30000	52000	82000
7	Organize annual stakeholders meetings	Invite stakeholders	Organize meetings	15000	7000	15000	5000	15000	10000	45000	22000	67000
8	Support studies on impacts in product stewardship: economic, surplus model, seed sector and maize market studies	Impact assessment studies	Plan for and organize the studies	15000	10000	15000	10000	15000	12000	45000	32000	77000
	Total			76000	70500	69500	54000	55000	59765	200500	184265	384765
	KARI Overhead (10%) CIMMYT Overhead (20%)			7600	14100	6950	10800	5500	10785	20050	35685	55735
	Total			83600	84600	75450	64800	60500	70550	220550	219950	440500
	Total by year				156200		141250		131050		440500	440500

Appendix 2: Letter Adjusting Grant Period to 1 January 2005 – 31 December 2007

THE ROCKEFELLER FOUNDATION

August 3, 2005

Dr. Stephen Ngure Mugo
Associate Scientist
Maize Program
Centro Internacional de Mejoramiento de Maíz y Trigo
P. O. Box 25171
Nairobi, Kenya

In reply please quote: 2004 FS 028

Dear Dr. Mugo:

I am pleased to inform you that, in response to Dr. Peter Ninnes' letter of June 28, 2005, to Dr. Joe DeVries, the officers of the Rockefeller Foundation have taken action to amend the Foundation's grant, 2004 FS 028, to the Centro Internacional de Mejoramiento de Maíz y Trigo in support of research to be conducted in collaboration with the Kenya Agricultural Research Institute on development of insect-resistant maize for Africa. Under the amended grant terms, the time period of the grant has been changed from May 1, 2004 - April 30, 2007, to January 1, 2005 - December 31, 2007. Any grant funds unexpended on December 31, 2007, will revert to the Foundation.

In accordance with our usual policy, we shall need to receive an interim accounting and progress report as of December 31, 2005, and December 31, 2006. Within two months of the grant's new termination date of December 31, 2007, we shall also need to receive a final accounting on the use of the grant funds and a report on the substantive outcome of the grant. Please send all reports to the attention of Mrs. Wanjiku Kiragu, Grants Administrator, The Rockefeller Foundation, P. O. Box 47543 00100 GPO, Nairobi, Kenya.

It is a pleasure to report this action to you.

Sincerely,

Gary Toenniessen
Director, Food Security

GHT: met

Copy to: Dr. Marianne Banziger
Mr. Peter J. Ninnes
Dr. Joe DeVries

420 Fifth Avenue
New York, New York
10018-2702
Tel 212.869.8500
Fax 212.764.3468
www.rockfound.org

Amendment.doc

Appendix 3: Reviewed IRMA Project Budget and Workplan 2006

Group code	Activity code	Products	Activities	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Status
											Total	RF	SFSA	Total	RF	SFSA	
1. Bt Event analysis, development of source lines, and human health assessment																	
1	1	Donor Organism	Maize biology description adapted to the regions	Literature study	0	SM, MM, JI	X				0	0	0	0	0	0	
1	2	Donor Organism	Bacillus thuringiensis	Literature study	0	JD,JM		X			0	0	0	0	0	0	
1	3	Vectors and transformation methods	Storage of reference samples of constructs	Plasmid isolation	0	JD/JM					0	0	0	0	0	0	
1	4	Vectors and transformation methods		Maintenance of the specimens	0	JD/JM					0	0	0	0	0	0	
1	5	Vectors and transformation methods	Genetic constructs description	Report	0	JD/JM					0	0	0	0	0	0	
1	6	Vectors and transformation methods	Description of the effect of the gene	Report	0	JD, CT, JM, MM					0	0	0	0	0	0	
1	7	Vectors and transformation methods	Transformation experiment	Report/transgenic plants development	0	JD,JM,					0	0	0	0	0	0	
1	8	Molecular Characterization of the events	No. of copies	Report	0	JD,JM,					0	0	0	0	0	0	
1	9	Molecular Characterization of the events	Other inserted DNA	Report	0	JD,JM,					0	0	0	0	0	0	
1	10	Molecular Characterization of the events	Structure of the insert	Report	0	JD,JM,					0	0	0	0	0	0	
1	11	Molecular Characterization of the events	Sequencing of the insert	Report	0	JD,JM,					0	0	0	0	0	0	
1	12	Molecular Characterization of the events	Insertion locus determination	Report	0	JD,JM,					0	0	0	0	0	0	
1	13	Molecular Characterization of the events	Verification of no insert in ORF	Report	0	JD,JM,					0	0	0	0	0	0	

Group code	Activity code	Products	Activities	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Status
											Total	RF	SFSA	Total	RF	SFSA	
1	14	Molecular Characterization of the events	Peer Review of the results	Report	0	JD,JM,					0	0	0	0	0	0	
1	15	Expression analysis of inserted genes	Experiment stability in environment	Protein in different environs	0	JD, CT, JM, MM, SM					0	0	0	0	0	0	
1	16	Expression analysis of inserted genes	Methods for integrity of new variety	N.A.	0	JD, CT, JM, MM, SM					0	0	0	0	0	0	
1	17	Detection toolkit	Dev. protocols for protein detection	Purchase	0	JD, JM, MM, SM			X	X	0	0	0	0	0	0	
1	18	Detection toolkit	Quantitative test for regulatory test	Test effectiveness of the kit	0	JD, CT, JM, MM, SM					0	0	0	0	0	0	
1	19	Detection toolkit	Cheap Qualitative test for field use	Test effectiveness of the kit	0	JD, CT, JM, MM					0	0	0	0	0	0	
1	20	Detection toolkit	Dev. Protocol for DNA based detection kit	Experiment	0	JD, CT, JM, MM					0	0	0	0	0	0	
1	21	Detection toolkit	Real-time PCR, event specific	Experiment	0	JD, CT, JM, MM					0	0	0	0	0	0	
1	22	Detection toolkit	Discuss GMO detection standards with Kenyan authorities	Workshops	0	JD, CT, JM, MM					0	0	0	0	0	0	
1	23	Detection toolkit	Organize production and availability of reference materials	Production commitment /publications	0	JD, CT, JM, MM					0	0	0	0	0	0	
1	24	Allergenicity	Stability in SGF		0	JD, MM					0	0	0	0	0	0	
1	25	Allergenicity	Confirm AA sequence identity		0	JD, MM					0	0	0	0	0	0	
1	26	Allergenicity	AA sequence analysis compared to database		0	JD, MM					0	0	0	0	0	0	
1	27	Allergenicity	Follow evolution of codex activities on allergenicity		0	JD, MM					0	0	0	0	0	0	
1	28	Sourcing of new Bt genes	Literature	Keep abreast with new developments	1,000	JD,JM,CT,MM	X	X	X	X	500	0	500	500	0	500	Partly done
1	29	Capacity Building	Develop & disseminate security plan for BGH & OQS	Develop & disseminate security plan for BGH & OQS	0	SM					0	0	0	0	0	0	

Group code	Activity code	Products	Activities	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Status
											Total	RF	SFSA	Total	RF	SFSA	
1	30	Capacity Building	BGH operations course@NARL	BGH operations course@NARL for scientists	0	CT, MM, SM					0	0	0	0	0	0	
1	31	Capacity Building	OQS operations course at Kiboko (Technicians)	OQS operations course at Kiboko (Technicians)	0	SM, MM, JI					0	0	0	0	0	0	
1	32	Capacity Building	OQS operations course @Embu OQS	OQS operations course @Embu OQS	0	SM, MM, JI					0	0	0	0	0	0	
1	33	Capacity Building	Genetic engineering course @NARL	Genetic engineering course @NARL	0	JD, CT, JM					0	0	0	0	0	0	
1	34	Capacity Building	Establish OQS at Embu	Identify site for OQS at Embu	0	SM, MG		X			0	0	0	0	0	0	
					1,000						500	0	500	500	0	500	
2. Development of conventional and Bt products, and compositional analysis																	
Conventional products																	
2	1	Inbred lines	Inbred lines	develop new insect resistant inbred lines	4,000	SM, JG	X	X	X	X	1,000	1,000		3,000	1,000	2,000	Done
2	2	Inbred lines	Inbred lines	Evaluate new inbred lines for insect resistance	4,200	GO, CM, WM, SM, JI,, JG	X	X	X	X	1,500	1,500		2,700	1,500	1,200	Done
2	3	Inbred lines	Inbred lines	Maintain inbreds	2,000	SM , JG	X	X	X	X	0	0	0	2,000	0	2,000	
2	4	Inbred lines	Inbred lines	Release as CML	500	SM	X	X	X	X	0	0	0	500	0	500	
2	5	Hybrids	Development of hybrids	Nominate for NPT	5,400	JI	X				5,400	5,400	0	0	0	0	Done
2	6	Hybrids	Development of hybrids	Evaluate NPT	2,000	GO, SM, JI	X	X	X	X	0	0	0	2,000	0	2,000	Done
2	7	Hybrids	Development of hybrids	Monitor & evaluate NPT	3,000	GO, CM, WM, SM, JI,, JG	X	X	X	X	1,000	1,000	0	2,000	0	2,000	Done
2	8	Hybrids	Development of hybrids	Conduct multi-location on-farm trials	0	CM, MO, WM, GO, JI, JG		X	X	X	0	0	0	0	0	0	
2	9	Hybrids	Develop new hybrids	develop new insect resistant hybrids	5,000	SM, JG	X	X	X	X	1,000	0	1,000	4,000	1,000	3,000	Done
2	10	Hybrids	Evaluate new hybrids	Evaluate new hybrids for insect resistance	6,000	CM, MO, WM, GO, JI, JG	X	X	X	X	2,000	1,000	1,000	4,000	2,000	2,000	Done
2	11	OPVs	Development of OPVs (2)	Pre-release /Release OPVs	0	SM/JI	X	X			0	0	0	0	0	0	

Group code	Activity code	Products	Activities	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Status
											Total	RF	SFSA	Total	RF	SFSA	
2	12	OPVs	Development new OPVs	Development new OPVs from insect resistant inbred lines	4,000				X	X	1,000	1,000		3,000	0	3,000	Not done
2	13	OPVs	Evaluate new OPVs	Evaluate new in multi-locations	7,000			X	X	X	2,000	1,000	1,000	5,000	1,000	4,000	Not done
2	14	Resistance to storage pests	Post harvest	Screening for storage pests	2,000	PL, DB	X	X	X	X	1,000	0	1,000	1,000	0	1,000	Done
2	15	Resistance to stem borers	Insect infestations & evaluations	Rear, infest & rate trials	5,000	JS, SM	X	X	X	X	5,000	5,000	0	0		0	Done
Bt products																	
2	16	Product Development-Bt - public	Evaluating public events	Evaluate in Kiboko OQS	4,000	SM, JG	X	X			0	0	0	4,000	0	4,000	
2	17	Product Development-Bt - public	Evaluating public events	Screen for resistance to B. fusca in public x public event crosses, and public events x conventional resistance	5,000	SM, MM, CT	X	X	X	X	2,000	0	2,000	3,000	0	3,000	Partly done
2	18	Product Development-Bt - public	Backcrossing of public events into adapted lines	BC2F1 made with adapted lines & OPVS to lead public events in Kiboko OQS	3,000	SM, JI, JG	X	X			0	0	0	3,000	0	3,000	Done
		Product Development-Bt - public	Backcrossing of public events into adapted lines	BC1F1 plant selected using mol markers	2,000	SM, JI, JG	X	X			0	0	0	2,000	0	2,000	Done
2	19	Product Development-Bt - Public	Development of public event hybrids	Expression analysis	4,500	GM	X	X	X	X	4,500	0	4,500	0	0		
2	20	Product Development-Bt - Private event	Evaluating private event	Exp to compare private to public events	0	SM, JG, JI			X	X	0	0	0	0	0	0	Done
2	21	Resistance to stem borer pests (Bt)	Insect infestations & evaluations	Rear, infest & rate trials	4,000	JS, SM	X	X	X	X	0	0	0	4,000	0	4,000	Done
2	22	Compositional analysis of Bt maize	Identify an analytical lab and make contract	Identify analytical lab	0	SM, BK, SG					0	0	0	0	0	0	

Group code	Activity code	Products	Activities	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Status
											Total	RF	SFSA	Total	RF	SFSA	
2	23	Compositional analysis of Bt maize	Identify an analytical lab and make contract	Contract negotiation	0	SM, BK, SG					0	0	0	0	0	0	
2	24	Compositional analysis of Bt maize	Identify 6 locs for rep. field trials	Search	0						0	0	0	0	0	0	
2	25	Compositional analysis of Bt maize	Train staff at 6 locations & mock trials	Search	0						0	0	0	0	0	0	
					72,600						27,400	16,900	10,500	45,200	6,500	38,700	
3. Environmental impact assessment																	
3	1	Resistance to stem borer pests	Insect infestations & evaluations	Rear, infest & rate trials	4,000	JS, SM	X	X	X	X	4,000	0	4,000	0	0	0	
3	2	Impact on non-targets	Impact on Lepidoptera herbivores: Helicoverpa armigera : (BSGH/ lab --> OQS ---> Open field)		0	JS, DB					0	0	0	0	0	0	
3	3	Environmental toxicity	Ecotox	Bird experiment	0	UON/ Chiromo					0	0	0	0	0	0	
3	4	Environmental toxicity	Ecotox	Fish experiment	0	UON/Chiromo					0	0	0	0	0	0	
3	5	Environmental toxicity	Ecotox	Mammal experiment	0	UON/ Chiromo					0	0	0	0	0	0	
3	6	Environmental toxicity	Ecotox	Invertebrate experiment	0	UON/Chiromo					0	0	0	0	0	0	
	7	Environmental Impact Assessment									0	0	0	0	0	0	
3	8	Environmental toxicity	Ecotox	Aquatic invertebrate experiment	0	UON/ Chiromo					0	0	0	0	0	0	
3	9	Impact on non-targets	Impact on Cotesia flavipes, C. sesamiae, D. Busseolae (BSGH/ lab --> OQS ---> Open field)	Experiment	4,000	JS, DB - Student	X	X	X	X	4,000	4,000	0	0	0	0	Done

Group code	Activity code	Products	Activities	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Status
											Total	RF	SFSA	Total	RF	SFSA	
3	10	Impact on non-targets	Impact on the development and survival of predators: lady bird beetles : (BSGH/ lab --> OQS ---> Open field)	Exper. & literature	0	JS, DB, JO					0	0	0	0	0	0	
3	11	Impact on non-targets	Impact on the development and survival of honey bee larvae (BSGH & Lab)	Exper. & literature	0	JS, DB					0	0	0	0	0	0	
3	12	Impact on non-targets	Impact on ants (predators) - OQS	Exper. & literature	0	JS, DB					0	0	0	0	0	0	
3	13	Impact on non-targets	Impact on soil micro-organisms: (BSGH/ lab --> OQS ---> Open field) (BSGH, OQS)	Exper. & literature	0	JS, DB & collab.					0	0	0	0	0	0	
3	14	Impact on non-targets	Monitor arthropods / Natural enemies in (OQS)	Experiment	4,000	JS, DB	X	X	X		4,000	4,000	0	0	0	0	Done
3	15	Impact on non-targets	Monitor arthropods / Natural enemies in the field: On-station --> on-farm)	Experiment	0	JS, DB					0	0	0	0	0	0	
3	16	Impact on non-targets	Impact on non-target non-Lepidoptera: LGB & Sitophilus zeamais	Experiment	0	PL, DB					0	0	0	0	0	0	
3	17	Impact on non-targets	Fate of pollen/impact on non-target insects	Experiment	0	JS, DB		X	X		0	0	0	0	0	0	
3	18	Gene flow information	1. Distance of pollen flow (Field / OQS, on-farm, Literature)	Out crossing rate to local maize var.	2,000	SM,DB	X	X	X	X	1,000	1,000	0	1,000	1,000	0	Partly done
3	19	Gene flow information	Competitiveness of the F1s (Literature)	Out crossing to other plant species (lit search)	0	SM,DB					0	0	0	0	0	0	
3	20	Gene flow information	Gene flow experiments	Horizontal gene transfer	0	SM,DB					0	0	0	0	0	0	
					14,000						13,000	9,000	4,000	1,000	1,000	0	

Group code	Activity code	Products	Activities	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Status
											Total	RF	SFSA	Total	RF	SFSA	
4. IRM and contingency plans																	
4	1	Insect resistance management plan	Design IRM plan to take account of OPV route	Literature Review	0	MM, DB					0	0	0	0	0	0	
4	2	Insect resistance management plan	Screening for Resistance Cp and Bf	5cycles for Bf and 8cycles for CP completed	0	JS, DB,RT					0	0	0	0	0	0	
		Insect resistance management plan	Screening for Resistance Cp and Bf	Experiment	0						0	0	0	0	0	0	
4	3	Insect resistance management plan	Design IRM plan to take account of OPV route	Gene flow Exp	0	DM, MM, MG					0	0	0	0	0	0	
4	4	Insect resistance management plan	Quantify sensitivity of Chilo and Busseola to Cry: including variations	Lab Experiments LD 50	3,000	JS, DB,RT,MM	X	X	X	X	3,000	3,000	0	0	0	0	Not done
4	5	Insect resistance management plan	Insect resistance management plan	Experiment	0	SM, DB, Embu, MM					0	0	0	0	0	0	
4	6	Insect resistance management plan	Design an introduction plan of OPVs	Workshop & extension materials	0	SM, DB, Embu, MM					0	0	0	0	0	0	
4	7	Insect resistance management plan	Design Refugia Patterns and Incorporate Pull Push	Experiment	0	MM, DB	X	X	X	X	0	0	0	0	0	0	
4	8	Insect resistance management plan	Bt Persistence in different Cycles of OPVs	Experiment	0	MM, RT, MG					0	0	0	0	0	0	
	9	Insect resistance management plan	Models from existing data	Statistical analysis	1,000	DB, MM, SM		X			0	0	0	1,000	1,000	0	Done
4	10	Testing Commercial Bt Genes	Experiment	Lab Bio assays and field trials in Kiboko	0	CT,MG, PL, RT, MM,					0	0	0	0	0	0	
4	11	GIS Mapping for Borer species Distribution	Identify distribution of various stem borer species	Experiment	3,000	MM, MG,RT, PL	X	X	X	X	0	0	0	3,000	3,000	0	Partly done
4	12	Confined Refugia Oviposition Preference	Determine host preference	Experiment	1,500	MM, GM	X	X	X	X	1,000	1,000	0	500	500	0	Not done

Group code	Activity code	Products	Activities	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Status
											Total	RF	SFSA	Total	RF	SFSA	
4	13	Capacity built	GIS Training	Training workshop	0						0	0	0	0	0	0	
					8,500						4,000	4,000	0	4,500	4,500	0	
5. Regulatory issues																	
5	1		Application	Take two applications through NBC on Mon810	0			X	X	X	0	0	0	0	0	0	
5	2	Regulatory developments	Interact intensively with Kenyan national regulations development	Attend regulators meetings	1,000	SM / SG	X	X	X	X	1,000	1,000	0	0	0	0	Done
5	3	Regulatory developments	Interact intensively with Kenyan national regulations development	Visit Field trial at Kiboko by regulators	1,500	SM / SG	X	X			0	0	0	1,500	0	1,500	Done
5	4	Regulatory developments	follow regulatory developments in the region	Visit other regulatory centers and organizations in the region, Familiarize with Regulatory developments in the region	4,000	SM / SG	X	X	X	X	2,000	0	2,000	2,000	0	2,000	Partly done
5	5	Regulatory developments	follow developments in Cartagena Protocol	Develop internet linkage, Participate in public sector consultations	0	SM / SG					0	0	0	0	0	0	
5	6	Regulatory developments	Follow the developments on liability and readdress plan of Car. Prot.	Attend regional meetings	0	SM / SG		X	X	X				0	0	0	
5	7	Regulatory skills development	Dev. functions of RA manager at KARI and CIMMYT	Attachment and training of project manager and regulator to a private company (e.g. SBI)	0	SM / SG			X	X	0	0	0	0	0	0	
5	8	Regulatory skills development	Training of staff at KARI centers in handling GM maize	Develop training materials	0	SM / SG					0	0	0	0	0	0	

Group code	Activity code	Products	Activities	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Status
											Total	RF	SFSA	Total	RF	SFSA	
5	9	Regulatory skills development	Training of staff at agricultural research stations in handling GM maize	Conduct training at six KARI centers for scientists and technicians	0	SM / SG					0	0	0	0	0	0	
5	10	Regulatory skills development	Develop SOPs for all activities in the project	Revise SOP document	0	SM / SG / DP					0	0	0	0	0	0	
5	11	Kenyan Legislation	Follow developments	Follow up developments	6,000	SM / SG	X	X	X	X	5,000	0	5,000	1,000	0	1,000	Done
5	12	Contingency plan	Regulatory	Characterization of local varieties	0	JG, SM, JI					0	0	0	0	0	0	
					12,500						8,000	1,000	7,000	4,500	0	4,500	
6. IPR/licensing																	
6	1	IPR/licensing	In licensing agreements - UoOttawa	Negotiation	0	AATF, MI, MB, JD		X			0	0	0	0	0	0	
6	2	IPR/licensing	Seek commercial events from companies - Monsanto, DuPont, Syngenta	Negotiation	13,000	MI, MB, JD, RK, SM, AATF	X	X	X		5,000	0	5,000	8,000	0	8,000	Done
6	3	IPR/licensing	Training on IP for project members	Negotiation	0	AATF					0	0	0	0	0	0	
6	4	IPR/licensing	Discuss the process out licensing the IRMA events	Negotiation	0	MI, MB, JD, RK, SM, AATF				X	0	0	0	0	0	0	
					13,000						5,000	0	5,000	8,000	0	8,000	
7. Seed production																	
7	1	Hybrids	Development of hybrids	Develop descriptors for hybrids nominated in NPT	1,000	SM, GO, JG	X	X	X	X	0	0	0	1,000	0	1,000	Done
7	2	Hybrids	Development of hybrids	DUS tests - by KEPHIS upon payment of $600 per entry	5,400	JG, SM, JI	X	X	X	X	5,400	0	5,400	0	0	0	Done
7	3	OPVs	Development of hybrids	Conduct DUS trials - if any is required	0	JG, SM, JI	X	X	X	X	0	0	0	0	0	0	
7	4	OPVs	Development of OPVs (2)	Conduct DUS trials	0	JG, SM, JI	X	X	X	X	0	0	0	0	0	0	

Group code	Activity code	Products	Activities	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Status
											Total	RF	SFSA	Total	RF	SFSA	
7	5	OPVs	Development of OPVs (2)	Increase seed	2,000	SM, WM	X	X	X	X	0	0	0	2,000	2,000	0	Done
7	6	OPVs	Development of OPVs (2)	Identify commercial seed production partners	0	JI			X		0	0	0	0	0	0	
7	7	Seed Production	Seed production	Experiment	0	OO			X		0	0	0	0	0	0	
7	8	Seed Production	Demonstration and on farm trails	Experiments in conjunction with seed producers	0	WM	X				0	0	0	0	0	0	
7	9	Seed Production	Seed production for trials	On-farm trials for loss assessment	5,000	WM		X	X		2,500	2,000	500	2,500	1,500	1,000	Not done
					13,400						7,900	2,000	5,900	5,500	3,500	2,000	
8. Market analysis																	
8	1	Cooperation and seed trade in the regions	Market analysis	Literature review, internet search, consultation resource people, and analysis	10,000	LM, JW	X	X	X		5,000	5,000	0	5,000	5,000	0	Partly done
8	2	Description of major processors, activities and opinion on GM	Communicate with food and feed processors, industrial millers and distributors as needed	Survey on these groups, distribute handouts, pass education on GM	4,000	MO, KD, JW	X	X	X		2,000	2,000	0	2,000	2,000	0	Partly done
8	3	IRMA collaboration with other countries	Seed sub sector analysis	Informal and formal discussions	0	HdG, SM, & LM					0	0	0	0	0	0	
8	4	Description of current patterns of maize grain trade	Commercial grain sub-sector analysis	Survey of grain traders and sources of grain	0	CB, MO , KD					0	0	0	0	0	0	
8	5	Description of the seed systems in East Africa (Kenya, Tanzania, Uganda and Ethiopia)	Seed sub sector analysis, and international collaboration	Revisit Tz, Visit Ug	0	HdG, LM & OO, CB	X	X	X	X	0	0	0	0	0	0	
8	6	Estimation of demand for Bt OPV at the coast	Analysis of BD, informal surveys	Desk top analysis	0	DK					0	0	0	0	0	0	
					14,000						7,000	7,000	0	7,000	7,000	0	

Group code	Activity code	Products	Activities	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Status
											Total	RF	SFSA	Total	RF	SFSA	
9. Socio-economic impact assessments																	
9	1	Crop loss/increase and economic analysis of new varieties	Economic impact assessment	Data collection, analysis and reporting	3,000	CB		X		X	2,000	2,000	0	1,000	1,000	0	Partly done
9	2	Georeferencing of OPVs	Economics of IRM technologies - (group and hh int), dry lands, L Victoria	Survey of growing patterns of OPVs	0	KD, CB, & SK	X		X		0	0	0	0	0	0	
9	3	Development of varieties acceptable to all stakeholders	PRAs and on-farm evaluations	Participatory farmer evaluation	0	CB					0	0	0	0	0	0	
9	4	Contingency plan	Regulatory	Data collection and analysis of local varieties	0	HdG					0	0	0	0	0	0	
9	5	Economic analysis of IRM strategies	Estimating costs of detasseling, refugia (sorghum, maize, …)	Experiments	7,000	JW, HdG	X	X	X		5,000	5,000	0	2,000	2,000	0	Partly done
					10,000						7,000	7,000	0	3,000	3,000	0	
10. Communication, promotion, training and administration																	
10	1	IRMA brochure	Communications	Writing, publishing, distribution	0	DP, DO, GK, SM	X				0	0	0	0	0	0	
10	2	IRMA folder	Communications	Writing, publishing	0	DP, DO	X				0	0	0	0	0	0	
10	3	IRMA Updates	Communications	Writing, publishing, distribution	3,000	All, DP, DO, GK	X	X	X	X	2,000	1,000	1,000	1,000	1,000	0	Done
10	4	IRMA Document compilation	Communications	Collecting, organizing, publishing (CD-ROM)	1,000	DO, DP, GK	X	X	X	X	500	500	0	500	500	0	Partly done
10	5	IRMA Fact Sheets	Communications	Editing, review, publishing, distribution	2,000	All, DP, DO, GK	X	X			500	500	0	1,500	0	1,500	Partly done
10	6	Flyer on GMOs	Communications	Writing, publishing	1,000	DO			X		500	0	500	500	0	500	Partly done
10	7	Kilimo News, ag papers	Communications	Writing, editing, publishing	0	DO, DP, GK	X	X	X	X	0	0	0	0	0	0	

Group code	Activity code	Products	Activities	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Status
											Total	RF	SFSA	Total	RF	SFSA	
10	8	Ag Shows 5	Communications	Develop materials for booth and handouts, video, familiarization of those manning booths, monitor (Surveys)	3,000	DO, DP, GK		X	X	X	1,500	1,500	0	1,500	1,500	0	Done
10	9	Video on IRMA/Biotech	Communications	Preparing materials, writing voice over, video recording, editing, writing, interviews, field trip, travel, produce on CD/VHS	5,000	GK, DO, DP, SM, contractor	X				1,000	0	1,000	4,000	0	4,000	Partly done
10	10	Press event for Bt maize at OQS	Communications	Organizing, press release	0	DP, DO, others			X		0	0	0	0	0	0	
10	11	Stakeholder needs	Communications	Survey	2,000	DP, DO, GK, collaborators	X	X	X	X	500	0	500	1,500	0	1,500	Partly done
10	12	Workshop	Communications	Presentations, organization (For junk science workshop for journalists	5,000	DO, MK, DP, GK, all	X	X	X	X	1,000	0	1,000	4,000	0	4,000	Partly done
10	13	Press monitoring	Communications	Clipping service, web browsing	3,600	GK, DP, DO, CIMMYT office				X	0	0	0	3,600	0	3,600	Done
10	14	Policy briefs	Communications	Writing, editing, review, distribution	0	DO, DP, GK	X	X	X	X	0	0	0	0	0	0	
10	15	Stakeholders Meeting	Communications	Organization, publications, media relations	0	JD		X			0	0	0	0	0	0	
10	16	IRMA documents	Communications	Writing, editing, publishing, distribution	10,000	JD					4,000	4,000	0	6,000	6,000	0	Done
10	17	IRMA Scientific journal articles	Communications	Editing, submission, page charges	4,000	SM				X	1,000	1,000	0	3,000	3,000	0	Done
10	18	Newspaper supplements (1/4 page)	Communications	Writing, editing, publishing	0	SG					0	0	0	0	0	0	

Group code	Activity code	Products	Activities	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Status
											Total	RF	SFSA	Total	RF	SFSA	
10	19	Media contacts	Communications	Engage key personalities in local and international media	3,000		X	X	X	X	1,000	0	1,000	2,000	0	2,000	Done
					42,600						13,500	8,500	5,000	29,100	12,000	17,100	
		Total			201,600						93,300	55,400	37,900	108,300	37,500	70,800	

SM=Stephen Mugo, MM = Murenga Mwimali, JI = Jane Ininda, JD = Jedidah Danson, JM = Joel Mutiso, CT = Catherine Taracha, MG = Macharia Gethi, GO = George Ombakho, CM = Charles Mutinda, WM = Wilson Muasya, JG = James Gethi, PL = Paddy Likhayo, DB = David Bergvinson, JS – Josephine Songa, BK = Betty Kiplagat, SG = Simon Gichuki, JO = James Ouma, RT = Regina Tende, DP = David Poland, MI – Masa Iwanaga, MB – Marianne Bänziger, RK = Romano Kiome, OO = Omari Odongo, LM = Lutta Mohammed, JW = Japhether Wanyama, MO = Martins Odendo, KD = Kengo Danda, HdG = Hugo de Groote, CB – Charles Bett, SK = Simon Kimenju, DO = Daisy Ouya, GK = Grace Kimani

Appendix 4: IRMA Project Budget and Workplan 2007

Group code	Activity code	Products	Activities	Type of work	Group	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Total RF	Total SFSA
													TOTA	RF	SFSA	TOTA	RF	SFSA		
Development of Bt maize event, Bt source line, and human health safety assessment																				
1	1	Donor Organism	Maize biology description adapted to the regions	Literature study	Breeders	Literature study	0	SM, MM, JI					**0**	0	0	**0**	0	0	**0**	**0**
1	2	Donor Organism	*Bacillus thuringiensis*	Literature study	Molecular Biology	Literature study	0	JD,JM					**0**	0	0	**0**	0	0	**0**	**0**
1	3	Vectors and transformation methods	Storage of reference samples of constructs	Long term storage	Molecular Biology	Plasmid isolation	0	JD					**0**	0	0	**0**	0	0	**0**	**0**
1	4	Vectors and transformation methods			Molecular Biology	Maintenance of the specimens	0	JD/JM					**0**	0	0	**0**	0	0	**0**	**0**
1	5	Vectors and transformation methods	Genetic constructs description	Experiment description	Molecular Biology	Report	0	JD/JM					**0**	0	0	**0**	0	0	**0**	**0**
1	6	Vectors and transformation methods	Description of the effect of the gene	Lit. study / lab. / BGH observation	Molecular Biology	Report	0	JD, CT, JM, MM					**0**	0	0	**0**	0	0	**0**	**0**
1	7	Vectors and transformation methods	Transformation experiment	Exp. cry 2A / Descrip.of the exp. protocol	Molecular Biology	Report/transgenic plants development	0	JD					**0**	0	0	**0**	0	0	**0**	**0**
1	8	Molecular Characterization of the events	No. of copies	Experiment	Molecular Biology	Report	0	JD					**0**	0	0	**0**	0	0	**0**	**0**
1	9	Molecular Characterization of the events	Other inserted DNA	Experiment	Molecular Biology	Report	0	JD					**0**	0	0	**0**	0	0	**0**	**0**
1	10	Molecular Characterization of the events	Structure of the insert	Experiment	Molecular Biology	Report	0	JD					**0**	0	0	**0**	0	0	**0**	**0**
1	11	Molecular Characterization of the events	Sequencing of the insert	Experiment	Molecular Biology	Report	0	JD					**0**	0	0	**0**	0	0	**0**	**0**
1	12	Molecular Characterization of the events	Insertion locus determination	Experiment	Molecular Biology	Report	0	JD					**0**	0	0	**0**	0	0	**0**	**0**
1	13	Molecular Characterization of the events	Verification of no insert in ORF	Experiment	Molecular Biology	Report	0	JD					**0**	0	0	**0**	0	0	**0**	**0**
1	14	Molecular Characterization of the events	Peer Review of the results	Report	Molecular Biology	Report	0	JD					**0**	0	0	**0**	0	0	**0**	**0**

Group code	Activity code	Products	Activities	Type of work	Group	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Total RF	Total SFSA
													TOTA	**RF**	**SFSA**	**TOTA**	**RF**	**SFSA**		
1	15	Expression analysis of inserted genes	Experiment stability in environment	experiment	Molecular Biology	Protein in different environs	0	JD, CT, MM, SM					**0**	0	0	**0**	0	0	**0**	**0**
1	16	Expression analysis of inserted genes	Methods for integrity of new variety	Experiment	Molecular Biology	N.A.	0	JD, CT, MM, SM					**0**	0	0	**0**	0	0	**0**	**0**
1	17	Detection toolkit	Dev. protocols for protein detection	*Cry1Ab* and *CryIBa*	Molecular Biology	purchase	0	JD, MM, SM					**0**	0	0	**0**	0	0	**0**	**0**
1	18	Detection toolkit	Quantitative test for regulatory test	Experiment	Molecular Biology	Test effectiveness of the kit	0	JD, CT, MM, SM					**0**	0	0	**0**	0	0	**0**	**0**
1	19	Detection toolkit	Cheap Qualitative test for field use	Experiment	Molecular Biology	Test effectiveness of the kit	0	JD, CT, MM, SM					**0**	0	0	**0**	0	0	**0**	**0**
1	20	Detection toolkit	Dev. Protocol for DNA based detection kit	Experiment/Outsource	Molecular Biology	Experiment	0	JD, CT, MM, SM					**0**	0	0	**0**	0	0	**0**	**0**
1	21	Detection toolkit	Real-time PCR, event specific	Experiment	Molecular Biology	Experiment	0	JD, CT, MM, SM					**0**	0	0	**0**	0	0	**0**	**0**
1	22	Detection toolkit	Discuss GMO detection standards with Kenyan authorities	Workshops	All	Workshops	0	JD, CT, MM, SM					**0**	0	0	**0**	0	0	**0**	**0**
1	23	Detection toolkit	Organize production and availability of reference materials	Production commitment / publications	All	Production commitment /publications	0	JD, CT, MM, SM					**0**	0	0	**0**	0	0	**0**	**0**
1	24	Allergenicity	Stability in SGF	Literature study	Molecular Biology		0	JD, MM					**0**	0	0	**0**	0	0	**0**	**0**
1	25	Allergenicity	Confirm AA sequence identity	Literature study	Molecular Biology		0	JD, MM					**0**	0	0	**0**	0	0	**0**	**0**
1	26	Allergenicity	AA sequence analysis compared to database	Literature study	Molecular Biology		0	JD, MM					**0**	0	0	**0**	0	0	**0**	**0**
1	27	Allergenicity	Follow evolution of codex activities on allergenicity	Literature study	Molecular Biology		0	JD, MM					**0**	0	0	**0**	0	0	**0**	**0**
1	28	Sourcing of new Bt genes	Literature	Literature search	Molecular Biology	Keep abreast with new developments	1,000	JD, CT,MM	**X**	**X**	**X**	**X**	**1,000**	0	1,000	**0**	0	0	**0**	**1,000**
1	29	Capacity Building	Develop & disseminate security plan for BGH & OQS	Preparing materials & participating	Regulatory	Develop & disseminate security plan for BGH & OQS	0	SM					**0**	0	0	**0**	0	0	**0**	**0**
1	30	Capacity Building	BGH operations course@NARL	Preparing materials & participating	Regulatory	BGH operations course@NARL for scientists	0	CT, MM, SM					**0**	0	0	**0**	0	0	**0**	**0**

Group code	Activity code	Products	Activities	Type of work	Group	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Total RF	Total SFSA
													TOTA	RF	SFSA	TOTA	RF	SFSA		
1	31	Capacity Building	OQS operations course at Kiboko (Technicians)	Preparing materials & participating	Regulatory	OQS operations course at Kiboko (Technicians)	0	SM, MM, JI					**0**	0	0	**0**	0	0	**0**	**0**
1	32	Capacity Building	OQS operations course @Embu OQS	Preparing materials & participating	Regulatory	OQS operations course @Embu OQS	0	SM, MM, JI					**0**	0	0	**0**	0	0	**0**	**0**
1	33	Capacity Building	Genetic engineering course @NARL	Preparing materials & participating	Regulatory	Genetic engineering course @NARL	0	JD, CT,MM					**0**	0	0	**0**	0	0	**0**	**0**
1	34	Capacity Building	Establish OQS at Embu	Administartive exercise	Breeding	Identify site for OQS at Embu	0	SM, ST, MG					**0**	0	0	**0**	0	0	**0**	**0**
							1,000						**1,000**	**0**	**1,000**	**0**	**0**	**0**	**0**	**1,000**
Products Development - Conventional																				
2	1	Hybrids	Development of hybrids	Breeding	Seed production / Breeding	Evaluate NPT	2,500	GO, SM, JI	X	X	X	X	**2,500**	2,500		**0**			**2,500**	**0**
2	2	Resistance to stem borers	Insect infestations & evaluations	Entomology	Breeding / entomology	Rear, infest & rate trials	5,000	JS, SM	X	X	X	X	**0**			**5,000**		5,000	**0**	**5,000**
2	3	Hybrids	Development of hybrids	Breeding	Breeding	Nominate for NPT	5,000	JI	X				**5,000**	5,000		**0**			**5,000**	**0**
2	4	Hybrids	Development of hybrids	Breeding	Breeding / Socio-econ	Conduct multi-location on-farm trials	6,000	CM, OM, JS, WM, GO, JI, JG		X	X	X	**0**			**6,000**	5,000	1,000	**5,000**	**1,000**
2	5	Hybrids	Evaluate new hybrids	Breeding	Breeding / entomology	Evaluate new hybrids for insect resistance	6,000	CM, OM, MO, WM, GO, JI, JG	X	X	X	X	**0**			**6,000**	5,369	631	**5,369**	**631**
2	6	Resistance to storage pests	Postharvest	Breeding	Breeding / entomology	Screening for storage pests	2,000	PL, DB	X	X	X	X	**0**			**2,000**		2,000	**0**	**2,000**
2	7	Inbred lines	Inbred lines	Breeding	Breeding / entomology	Evaluate new inbred lines for insect resistance	3,200	GO, CM, WM, SM, JI,, JG	X	X	X	X	**3,200**	3,200		**0**			**3,200**	**0**
2	8	Landraces	Characterization of landraces	Breeding	Breedinfg / entomology	Morphological characterization, drought and storage pests tolerance evaluation	1,400	JN, SM	X				**0**			**1,400**		1,400	**0**	**1,400**
2	9	Inbred lines	Inbred lines	Breeding	Breeding	Maintain inbreds	2,000	SM , JG	X	X	X	X	**0**			**2,000**		2,000	**0**	**2,000**
2	10	Inbred lines	Inbred lines	Breeding	Breeding	Develop nrew insect resistant inbred lines	3,000	SM, JG	X	X	X	X	**3,000**	0	3,000	**0**			**0**	**3,000**
2	11	Hybrids	Develop new hybrids	Breeding	Breedding	Develop new insect resistant hybrids	2,000	SM, JG	X	X	X	X	**2,000**	0	2,000	**0**			**0**	**2,000**

Group code	Activity code	Products	Activities	Type of work	Group	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Total RF	Total SFSA
													TOTA	**RF**	**SFSA**	**TOTA**	**RF**	**SFSA**		
2	12	Inbred lines	Inbred lines	Breeding	Breeding / entomology	Develop LGB lines	3,000	SM, PL, DB	**X**	**X**	**X**	**X**	**0**			**3,000**		3,000	**0**	**3,000**
2	13	OPVs	Development new OPVs	Breeding	Breeding	Development new OPVs from insect resistant inbred lines	4,000				**X**	**X**	**0**			**4,000**	4,000		**4,000**	**0**
2	14	Workshop	Scientific publications	Breeding	Breeding	Develop scientific publications	5,000	CM, OM, MO, WM, GO, JI, JG	**X**				**0**			**5,000**	5,000	0	**5,000**	**0**
2	15	Inbred lines	Combining ability studies	Breeding	Breeding	Conduct diallel crosses	2,000	SM, JG, WNM	**X**	**X**	**X**	**X**	**2,000**	2,000		**0**			**2,000**	**0**
2	16	Hybrids	Development of hybrids	Breeding	Breeding	Monitor & evaluate NPT, Field visits	3,000	GO, CM, WM, SM, JI,, JG	**X**	**X**	**X**	**X**	**0**			**3,000**	3,000		**3,000**	**0**
2	17	Inbred lines	Inbred lines	Breeding	Breeding	Release as CML	500	SM	**X**	**X**	**X**	**X**	**0**			**500**		500	**0**	**500**
2	18	OPVs	Development of OPVs (2)	Breeding	Breeding / Seed production	Pre-release /Release OPVs	4,000	SM/JI	**X**	**X**			**4,000**		4,000	**0**			**0**	**4,000**
2	19	OPVs	Evaluate new OPVs	Breeding	Breeding / Socio -econ	Evaluate new in multi-locations	0			**X**	**X**	**X**	**0**			**0**			**0**	**0**
							59,600						**21,700**	**12,700**	**9,000**	**37,900**	**22,369**	**15,531**	**35,069**	**24,531**
																			0	**0**
Products Development - Bt																				
2	16	Product Development-Bt - public events	Evaluating public events	Breeding	Breeding	Evaluate in Kiboko OQS	0	SM, JG					**0**			**0**			**0**	**0**
2	17	Product Development-Bt - public events	Evaluating public events	Breeding	Breeding	Screen for resistance to *B. fusca* in public x public event croses, and public events x conventional resistance	0	SM, GM, CT	**X**	**X**	**X**	**X**	**0**			**0**			**0**	**0**
2	18	Product Development-Bt - public events	Backcrossing of a private event into adapted KARI lines	Breeding	Breeding	BC0F1 and BC1F1 made at a location outside Kenya	0	SM, JI, and private sector	**X**	**X**	**X**	**X**	**0**			**0**			**0**	**0**
		Product Development-Bt - public events	Backcrossing of a private event into adapted CIMMYT lines	Breeding	Breeding	BC0F1 and BC1F1 made at a location outside Kenya	0	SM, JI, and private sector	**X**	**X**	**X**		**0**			**0**			**0**	**0**
2	19	Product Development-Bt - public events	Development of public event hybrids	Breeding	Breeding	Expression analysis	1,000	GM	**X**	**X**			**1,000**		1,000	**0**			**0**	**1,000**

Group code	Activity code	Products	Activities	Type of work	Group	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Total RF	Total SFSA
													TOTA	**RF**	**SFSA**	**TOTA**	**RF**	**SFSA**		
1	29	Efficacy testing of private sector event and public events against *B. fusca* and other species in the BGH	Insect bioassays	Insect bioassays in BGH	Molecular Biology	Insect bioassays in BGH	0	JI, SM, CT, MM,	**X**	**X**			**0**			**0**			**0**	**0**
	30	Efficacy testing of private sector event and public events against B. fusca and other species in the field	Insect bioassays	Confined field trial testing in the OQS	Breeding and Molecular Biology	Confined field trial testing (OQS)	0	SM, JI, CT, MM,		**X**	**X**		**0**			**0**			**0**	**0**
1	30	Molecular Characterization of private sector event	confirmation of inser	PCR , leaf samples fr	Breeding and Molecular Biology	PCR , leaf samples fr	0	CT, MM	**X**	**X**	**X**	**X**	**0**			**0**			**0**	**0**
2	21	Resistance to stem borer pests (Bt)	Insect infestations & evaluations	Entomololgy	Environ. Assesment	Rear, infest & rate trials	2,000	JS, SM	**X**	**X**	**X**	**X**	**0**			**2,000**		2,000	**0**	**2,000**
2	22	Compositional analysis of Bt maize	Identify an analytical lab and make contract	Negotiation & Contract	Regulatory	Identify analytical lab	0	SM, BK, SG					**0**			**0**			**0**	**0**
2	23	Compositional analysis of Bt maize	Identify an analytical lab and make contract	Negotiation & Contract	Regulatory	Contract negotiation	0	SM, BK, SG					**0**			**0**			**0**	**0**
2	24	Compositional analysis of Bt maize	Identify 6 locs for rep. field trials	Search	Breeding	Search	0						**0**			**0**			**0**	**0**
2	25	Compositional analysis of Bt maize	Train staff at 6 locations & mock trials	Search	regulatory	Search	0						**0**			**0**			**0**	**0**
							3,000						**1,000**	**0**	**1,000**	**2,000**	**0**	**2,000**	**0**	**3,000**
							62,600						**22,700**	**12,700**	**10,000**	**39,900**	**22,369**	**17,531**	**35,069**	**27,531**
Environmental Impact Assessment																				
3	1	Resistance to stem borer pests	Insect infestations & evaluations	Entomololgy	Environ. Asses	Rear, infest & rate trials	2,000	JS, SM	**X**	**X**	**X**	**X**	**3,000**	0	3,000	**0**	0	0	**0**	**3,000**
3	2	Impact on non-targets	.Impact on Lepidoptyera herbivores: Helicoverpa armigera : (BSGH/ lab --> OQS ---> Open field)	Bioassays	Environ. Asses		0	JMS, DB					**0**	0	0	**0**	0	0	**0**	**0**

Group code	Activity code	Products	Activities	Type of work	Group	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Total RF	Total SFSA
													TOTA	RF	SFSA	TOTA	RF	SFSA		
3	3	Envronmental toxicity	Ecotox	Experiment & Literature	Environ. Asses	Bird experiment	0	UON/ Chiromo					**0**	0	0	**0**	0	0	**0**	**0**
3	4	Envronmental toxicity	Ecotox	Experiment & Literature review	Environ. Asses	Fish experiment	0	UON/Chiromo					**0**	0	0	**0**	0	0	**0**	**0**
3	5	Envronmental toxicity	Ecotox	Experiment & Literature review	Environ. Asses	Mammal experiment	0	UON/ Chiromo					**0**	0	0	**0**	0	0	**0**	**0**
3	6	Envronmental toxicity	Ecotox	Experiment & Literature	Environ. Asses	Invertebrate experiment	0	UON/Chiromo					**0**	0	0	**0**	0	0	**0**	**0**
	7	Environmental Impact Assessment			Environ. Asses								**0**	0	0	**0**	0	0	**0**	**0**
3	8	Envronmental toxicity	Ecotox	Experiment & Literature review	Environ. Asses	Aquatic invertebrate experiment	0	UON/ Chiromo					**0**	0	0	**0**	0	0	**0**	**0**
3	9	Impact on non-targets	Impact on Cotesia flavipes, C. sesamiae, D. Busseolae (BSGH/ lab --> OQS ---> Open field)	Bioassays	Environ. Asses	Experiment	3,000	JMS, DB - Student	X	X	X	X	**3,000**	3,000	0	**0**	0	0	**3,000**	**0**
3	10	Impact on non-targets	Impact on the development and survival of predators: lady bird beetles : (BSGH/ lab --> OQS ---> Open field)	Bioassays	Environ. Asses	Exper. & literature	0	JMS, DB, JO					**0**	0	0	**0**	0	0	**0**	**0**
3	11	Impact on non-targets	Impact on the development and survival of honey bee larvae (BSGH & Lab)	Bioassays	Environ. Asses	Exper. & literature	0	JMS, DB					**0**	0	0	**0**	0	0	**0**	**0**
3	12	Impact on non-targets	Impact on ants (predators) - OQS	Bioassays	Environ. Asses	Exper. & literature	0	JMS, DB					**0**	0	0	**0**	0	0	**0**	**0**
3	13	Impact on non-targets	Impact on soil micro-organisms: (BSGH/ lab --> OQS ---> Open field) (BSGH, OQS)	Bioassays	Environ. Asses	Exper. & literature	0	JMS, DB & collab.					**0**	0	0	**0**	0	0	**0**	**0**

Group code	Activity code	Products	Activities	Type of work	Group	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Total RF	Total SFSA
													TOTA	RF	SFSA	TOTA	RF	SFSA		
3	14	Impact on non-targets	Monitor arthropods / Natural enemies in (OQS) - & Establish referece collection	Field study	Environ. Asses	Experiment	3,000	JMS, DB	X	X	X		**2,000**	2,000	0	**0**	0	0	**2,000**	**0**
3	15	Impact on non-targets	Monitor arthropods / Natural enemies in the field: On-station --> on-farm).	Bioassays	Environ. Asses	Experiment	0	JMS, DB					**0**	0	0	**0**	0	0	**0**	**0**
3	16	Impact on non-targets	Impact on non-target non-lepidoptera: LGB & *Sitophilus zeamais*	Bioassays	Environ. Asses	Experiment	0	PL, DB					**0**	0	0	**0**	0	0	**0**	**0**
3	17	Impact on non-targets	Fate of pollen/impact on non-target insects	Determine lepidoptera and weed species within 10 mt of maize fields	Environ. Asses	Experiment	3,000	JMS, DB		X	X		**3,000**	3,000	0	**0**	0	0	**3,000**	**0**
3	18	Gene flow information	1. Distance of pollen flow (Field / OQS, on-farm, Literature)	Gene flow exp	Breeding	Outcrossing rate to local maize var.	1,000	SM,DB	X	X	X	X	**0**		0	**1,000**	1,000	0	**1,000**	**0**
3	19	Gene flow information	Competitiveness of the F1s (Literature)	Gene flow exp	Breeding	Outcrossing to other plant species (lit search)	0	SM,DB					**0**	0	0	**0**	0	0	**0**	**0**
3	20	Gene flow information	Gene flow experiments	Literature study	Breeding	Horizontal gene transfer	0	SM,DB					**0**	0	0	**0**	0	0	**0**	**0**
							12,000						**11,000**	**8,000**	**3,000**	**1,000**	**1,000**	**0**	**9,000**	**3,000**
IRM and Contigency Plans																				
4	1	Insect resistance management plan	Design IRM plan to take account of OPV route	Literature Review	IRM	Literature Review	0	MM, DB	X				**0**	0	0	**0**	0	0	**0**	**0**
4	2	Insect resistance management plan	Screening for Resistance CP and BF	Lab Experiment	IRM	5cycles for Bf and 8cycles for CP completed	0	JS, DB,RT					**0**	0	0	**0**	0	0	**0**	**0**
		Insect resistance management plan	Screening for Resistance CP and BF	BSGS Experiments	IRM	Experiment	0						**0**	0	0	**0**	0	0	**0**	**0**

Group code	Activity code	Products	Activities	Type of work	Group	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Total RF	Total SFSA
													TOTA	**RF**	**SFSA**	**TOTA**	**RF**	**SFSA**		
4	3	Insect resistance management plan	Design IRM plan to take account of OPV route	Experiment	IRM	Gene flow Exp	0	DM, MM, MG					**0**	0	0	**0**	0	0	**0**	**0**
4	4	Insect resistance management plan	Quantify sensitivity of *Chilo* and Busseola to Cry: including variations	Experiment	IRM	Lab Experiments LD 50	3,000	RT, JS, DB,MM	**X**	**X**			**1,500**	0	1,500	**1,500**	0	1,500	**0**	**3,000**
4	5	Insect resistance management plan	Insect resistance management plan	Design an introduction plan for hybrids	IRM	Experiment	0	SM, DB, Embu, MM					**0**	0	0	**0**	0	0	**0**	**0**
4	6	Insect resistance management plan	Design an introduction plan of OPVs	Train farmers to select non-Bt seed for OPVs	IRM	Workshop & extension materials	0	SM, DB, Embu, MM					**0**	0	0	**0**	0	0	**0**	**0**
4	7	Insect resistance management plan	Design Refugia Patterns and Incorporate Pull Push	Evaluate refugia parterns	IRM	Experiment	0	MM, DB					**0**	0	0	**0**	0	0	**0**	**0**
4	8	Insect resistance management plan	Bt Persistance in different Cycles of OPVs	Bioassays & Bt detection Kits	IRM	Experiment	0	MM, RT, MG					**0**	0	0	**0**	0	0	**0**	**0**
4	9	Insect resistance management plar	Design of Models from existin data	Modeling	IRM	Statistical analysis	1,000	DB, MM, SM	**X**	**X**			**1,000**	1,000	0	**0**	0	0	**1,000**	**0**
4	10	Testing Commercial Bt Genes	Experiment	Lab Bio assays and field trials	IRM	Lab Bio assays and field trials in Kiboko	0	CT,MG, PL, RT, MM,					**0**	0	0	**0**	0	0	**0**	**0**
4	11	GIS Mapping for Borer species Distribution	Identify distribution of various stem borer species	Survey and Mapping	IRM	Experiment	3,000	MM, MG,RT, PL	**X**	**X**	**X**	**X**	**0**	0	0	**3,000**	0	3,000	**0**	**3,000**
4	12	Confined Refugia Oviposition Preference	Determine host preference	Lab Bio assays	IRM	Experiment	1,500	MM, GM	**X**	**X**	**X**	**X**	**500**	0	500	**1,000**	0	1,000	**0**	**1,500**
4	13	Capacity built	GIS Training	Capacity building	IRM/SocEC	Training workshop	0						**0**	0	0	**0**	0	0	**0**	**0**
4	14	Keys to identify Busseola fusca	Workshop to train Kenyan entomologists	Capacity building	IRM	Training workshop	2,000		**X**				**0**			**2,000**		2,000	**0**	**2,000**
4	15	Additional farmer feedback for the last two major agroecologies	Embu and Machacos during short rains	Sensitization Workshop	IRM	Embu and Machacos during short rains	3,000	MM, SM	**X**				**0**			**3,000**		3,000	**0**	**3,000**

Group code	Activity code	Products	Activities	Type of work	Group	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Total RF	Total SFSA
													TOTA	RF	SFSA	TOTA	RF	SFSA		
4	16	Confirmation data as well as gap filling data for the coastal area for wild hosts.	Data on maize, sorghum, millet and giant grasses at division level. Area coverage for Coastal Area for wild grasses.	Data collection	IRM	Data on maize, sorghum, millet and giant grasses at division level. Area coverage for Coastal Area for wild grasses.		MM	X				**0**			**0**			**0**	**0**
4	17	Peer reviewed publications to highlight the novel approach to IRM for Kenya	Field trials, farm surveys, IRM synthesis	Papers	IRM	Field trials, farm surveys, IRM synthesis	1,500	MM, DB,	X	X			**500**		500	**1,000**		1,000	**0**	**1,500**
							15,000						**3,500**	**1,000**	**2,500**	**11,500**	**0**	**11,500**	**1,000**	**14,000**
Regulatory																				
5	1	Regulatory developments	Application	Introduction of private sector event to Kenya	Regulatory	Take one application through NBC on private sector event for CFT evaluation	0				X		**0**			**0**			**0**	**0**
5	2	Regulatory developments	Interact intensively with Kenyan national regulations development	Develop intensive communication	Regulatory	Attend regulators meetings	1,000	SM / SG	X	X	X	X	**1,000**		1,000	**0**			**0**	**1,000**
5	3	Regulatory developments	Interact intensively with Kenyan national regulations development	Develop intensive communication	Regulatory	Visit Field trial at Kiboko by regulators	1,000	SM / SG, private sector	X	X			**1,000**		1,000	**0**			**0**	**1,000**
5	4	Regulatory developments	follow regulatory developments in the region	Participate in meetings, offer experts	Regulatory	Visit other regulatory centres and organizations in the region, Familirialise with Regulatory developments in the region	2,000	SM / SG	X	X	X	X	**2,000**		2,000	**0**			**0**	**2,000**
5	5	Regulatory developments	follow developments in Cartagena Protocol	Participate in public sector consortium	Regulatory	Develop internet linkage, Participate in public sector consultations	0	SM / SG					**0**			**0**			**0**	**0**

Group code	Activity code	Products	Activities	Type of work	Group	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Total RF	Total SFSA
													TOTA	RF	SFSA	TOTA	RF	SFSA		
5	6	Regulatory developments	Follow the developments on liability and readdress plan of Car. Prot.	Current literature	Regulatory	Attend regional meetings	0	SM / SG					**0**			**0**			**0**	**0**
5	7	Regulatory skills development	Dev. functions of Regulatory Affairs manager at KARI and CIMMYT	commitment of personnel	Regulatory	Attachment and training of project manager and regulator to a private company (e.g. SBI)	0	SM / SG			X	X	**0**			**0**			**0**	**0**
5	8	Regulatory skills development	Training of staff at KARI centers in handling GM maize	Development of training programme	Regulatory	Develop training materials	0	SM / SG					**0**			**0**			**0**	**0**
5	9	Regulatory skills development	Training of staff at agricultural research stations in handling GM maize	Development of training programme	Regulatory	Conduct training at six KARI centers for scientists and technicians	0	SM / SG					**0**			**0**			**0**	**0**
5	10	Regulatory skills development	Develop SOPs for all activities in the project	Administrative exercise	Regulatory	Revise SOP document	0	SM / SG / DP					**0**			**0**			**0**	**0**
5	11	Kenyan Legislation	Follow developments	Develop intensive communication	Regulatory	Organize at least one session for parliamentarians	6,000	SM / SG	X	X	X	X	**0**			**6,000**		6,000	**0**	**6,000**
5	12	Contingency plan	Regulatory	Planting out varieties	Breeding	Characterization of local varieties (see theme II	0	JG, SM, JI					**0**			**0**			**0**	**0**
							10,000						**4,000**	**0**	**4,000**	**6,000**	**0**	**6,000**	**0**	**10,000**
Intellectual Property Rights (IPR)/Licensing																				
6	1	IPR/licensing	Inlicensing agreements - UoOttawa	Negotiation	IPR/licencing	Negotiation	0	MI, MB, JD, EM, BK, SG, SM		X			**0**			**0**			**0**	**0**
6	2	IPR/licensing	Seek commercial events from companies - Monsanto	Negotiation	IPR/licencing	Seek event negotiatio	6,934	MI, MB, JD, EM, SM, SG, BK	X		X		**2,000**		2,000	**4,934**		4,934	**0**	**6,934**
6	4	IPR/licensing	Discuss the process outlicensing the IRMA events	Negotiation	IPR/licencing	Negotiation	5,000	MI, MB, JD, EM, SM, SG, BK				X	**0**			**5,000**		5,000	**0**	**5,000**

Group code	Activity code	Products	Activities	Type of work	Group	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Total RF	Total SFSA
													TOTA	RF	SFSA	TOTA	RF	SFSA		
6	4	IPR/licensing	Develop process of farmer identification for the tier-pricing	Negotiation	IPR/licencing	Negotiation	5,000	SM, HG,MO,SG, Private sector	X	X	X	X	**1,000**		1,000	**4,000**		4,000	**0**	**5,000**
							16,934						**3,000**	**0**	**3,000**	**13,934**	**0**	**13,934**	**0**	**16,934**
Seed Production																				
7	1	Hybrids	Development of hybrids	Breeding	Breeding	Develop descriptors for hybrids nominated in NPT	1,000	SM, GO, JG	X	X	X	X	**0**		0	**1,000**	1,000	0	**1,000**	**0**
7	2	Hybrids	Development of hybrids	Breeding	Breeding	DUS tests - by KEPHIS upon payment of $600 per entry	5,400	JG, SM, JI	X	X	X	X	**0**	0		**5,400**	5,400		**5,400**	**0**
7	3	OPVs	Development of hybrids	Breeding	Breeding	Conduct DUS trials - if any is required	0	JG, SM, JI	X	X	X	X	**0**			**0**			**0**	**0**
7	4	OPVs	Development of OPVs (2)	Breeding	Breeding	Conduct DUS trials	0	JG, SM, JI	X	X	X	X	**0**			**0**			**0**	**0**
7	5	OPVs	Development of OPVs (2)	Breeding	Breeding	Increase seed	2,000	SM, WM	X	X	X	X	**2,000**	2,000		**0**			**2,000**	**0**
7	6	Hybrids	Development of Hybrids	Breding	Breeding	Increase seed	2,000	SM, WM, JS	X	X	X	X	**2,000**	739	1,261	**0**			**739**	**1,261**
7	7	OPVs	Development of OPVs (2)	Breeding	Breeding	Identify commercial seed production partners	0	JI			X		**0**			**0**			**0**	**0**
7	8	Seed Production	Seed production	Ear to row planting	seed production	Experiment	0	OO			X		**0**			**0**			**0**	**0**
7	9	Seed Production	Demonstration and on farm trails	seed production	seed production	Experiments in cojuction with seed producers	0	WM	X				**0**			**0**			**0**	**0**
7	10	Seed Production	Seed production for trials	seed production	Hybrid seed prod	Seed production for On-farm trials	4,000	WM		X	X		**2,000**	0	2,000	**2,000**	2,000		**2,000**	**2,000**
							14,400						**6,000**	**2,739**	**3,261**	**8,400**	**8,400**	**0**	**11,139**	**3,261**
Market Analysis																				
8	1	Description of major processors, activities and opinion on GM	Survey of food and feed processors, industrial millers and distributors	market analysis	Market assessment	Survey on these groups, distribute handouts, pass education on GM	1,500	CB, JO, MO, HdG	X	X			**1,500**	1,500		**0**			**1,500**	**0**

Group code	Activity code	Products	Activities	Type of work	Group	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Total RF	Total SFSA
													TOTA	RF	SFSA	TOTA	RF	SFSA		
8	2	Data analysis and report writing	Analysis of baseline and consumer survey data	Data processing and reporting	Market assessment	Data analysis, literature review and report writing in CIMMYT-Nairobi and other appropriate sites	4,000	JO, MO, KD, JW, CB, HdG	X	X			**2,500**	2,500		**1,500**		1,500	**2,500**	**1,500**
8	3	Developing policy briefs using past consumer surveys	Synthesis of past reports into policy briefs	market analysis	Market assessment	development of policy briefs	2,000	JO, MO, KD, JW, CB, HdG	X	X			**1,000**		1,000	**1,000**		1,000	**0**	**2,000**
8	4	Description of the seed systems in East Africa (Kenya, Tanzania, Uganda and Ethiopia)	Seed subsector analysis, and international collaboration	market analysis	Market assessment	Revisit Tz, Visit Ug	3,500	HdG and CB	X	X	X	X	**0**	0		**3,500**	3,000	500	**3,000**	**500**
8	5	Coordination	Project coordination	Coordination	Market assessment	Coordination of project activities	500	MO	X	X	X	X	**0**	0		**500**		500	**0**	**500**
8	6	Conferences	Presentation of project papers	Dissemination of research findings	Market assessment	Presentation of project papers	3,000	JO, MO, KD, JW, CB, HdG	X	X			**2,000**		2,000	**1,000**		1,000	**0**	**3,000**
			Sub-total				**14,500**						**7,000**	**4,000**	**3,000**	**7,500**	**3,000**	**4,500**	**7,000**	**7,500**
Socio-economic Impact Assesments																				
9	1	Data analysis and report writing	Analysis of baseline, georeferencing, nd economics of IRM strategies data	Data processing and reporting	Econ impact asses.	Data analysis, literature review and report writing in CIMMYT-Nairobi and other appropriate sites	3,000	JO, MO, KD, JW, CB, HdG			X	X	**2,000**	2,000		**1,000**	1,000	0	**3,000**	**0**
9	2		Compilation of database	Data base managemen	Econ impact asses.	Data base development	2,000						**1,000**		1,000	**1,000**		1,000	**0**	**2,000**
9	3	Development of varieties acceptable to all stakeholders	On-fram and On-station evaluations	Participatory variety evaluation	Econ impact asses.	participatory farmer e	4,300	CB, MO and JO	X	X			**2,300**		2,300	**2,000**		2,000	**0**	**4,300**
9	4	Coordination	Project coordination	Coordination	Econ impact asses.	Coordination of project activities	500	JO	X	X	X	X	**0**	0	0	**500**		500	**0**	**500**
9	5	GIS Training	GIS Workshop	Participation in training	Econ impact asses.	Training	1,500	JO, MO, KD, JW, CB, HdG		X			**1,500**		1,500	**0**		0	**0**	**1,500**
9	6	Conferences	Presentation of project papers	Dissemination of research findings	Econ impact asses.	Presentation of project papers	3,000	JO, MO, KD, JW, CB, HdG			X	X	**1,000**	1,000		**2,000**		2,000	**1,000**	**2,000**
9	7	Report writing Training workshop	Report writing training workshop	Capacity building	Econ impact asses.	Training	0	JO, MO, KD, JW, CB	X				**0**	0		**0**	0	0	**0**	**0**
			Sub-total				**14,300**						**7,800**	**3,000**	**4,800**	**6,500**	**1,000**	**5,500**	**4,000**	**10,300**

Group code	Activity code	Products	Activities	Type of work	Group	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Total RF	Total SFSA
													TOTA	RF	SFSA	TOTA	RF	SFSA		
Communication, Documentation																				
																			0	**0**
10	1	BGHC leaflet- 1000 copies	Communications	Writing, editing publishing	Comm,all	Writing, publishing, distribution	1,500	DO, GK, SM, SG.MM	**X**				**0**	0		**1,500**	0	1,500	**0**	**1,500**
10	2	IRMA folder	Communications	Writing, editing publishing	Comm	writing, publishing	0	DP, DO	**X**				**0**			**0**			**0**	**0**
10	3	IRMA Updates	Communications	Writing, editing publishing	Comm, all	writing, publishing, distribution	3,000	All, DP, DO, GK	**X**	**X**	**X**	**X**	**0**			**3,000**	2,000	1,000	**2,000**	**1,000**
10	4	IRMA Document complilation	Communications	Writing, editing publishing		Collecting, organizing, publishing (CD-ROM)	500	DO, DP, GK	**X**	**X**	**X**	**X**	**0**			**500**		500	**0**	**500**
10	5	IRMA Fact Sheets	Communications	Writing, editing publishing	Comm	editing, review, publishing, distribution	2,000	All, DP, DO, GK	**X**	**X**			**0**			**2,000**		2,000	**0**	**2,000**
p	6	Flyer on GMOs	Communications	Writing, editing publishing	Comm	writing, publishing	0	DO			**X**		**0**			**0**			**0**	**0**
10	7	Kilimo News, ag papers	Communications	Writing, editing publishing	Comm, ISAA, ABSF	writing, editing, publishing	0	DO, DP, GK, RN, AO	**X**	**X**	**X**	**X**	**0**			**0**			**0**	**0**
10	8	Ag Shows 5	Communications	Preparing materials & participating	Comm, Ext/MOA/KARI	Develop materials for booth and handouts, video, familization of those manning booths, monitor (Surveys)	1,500	DO, DP, GK, RN		**X**	**X**	**X**	**0**			**1,500**		1,500	**0**	**1,500**
10	9	Video on IRMA/Biotech	Communications	Preparing materials, writing voice over, interviews, produce on CD/vhs	Comm/IRMA, ISAAA	Preparing materials, writing voice over, video recording, editing, writing, interviews, field trip, travel, produce on CD/vhs	5,000	GK, DO, DP, SM, contractor	**X**				**0**			**5,000**		5,000	**0**	**5,000**
10	10	Video for decision-makers to support biosafety bill- dev. and safety tests for Bt release- showing all the steps.	Communications	Use some existing footage, add new footage, and produce. Target Public and policy makers.		writing voice over, video recording, editing, writing, interviews, field trip, travel, produce on DVD/vhs	4,000						**2,000**		2,000	**2,000**		2,000	**0**	**4,000**
10	11	Press event for Bt maize at OQS	Communications	Preparing materials & participating	Comm, All	Organizing, press release	0	DO, MK, others			**X**		**0**			**0**			**0**	**0**

Group code	Activity code	Products	Activities	Type of work	Group	Activity	Total costs	Persons responsible	Q1	Q2	Q3	Q4	KARI			CIMMYT			Total RF	Total SFSA
													TOTA	**RF**	**SFSA**	**TOTA**	**RF**	**SFSA**		
10	12	Stakeholder needs	Communications	Preparing materials & participating	Comm, Prod. , Reg, Prod Deve	survey	0	DO, GK, collaborators	**X**	**X**	**X**	**X**	**0**			**0**			**0**	**0**
10	13	Workshop support	Communications	Preparing materials & participating	Comm, ISAAA, ABSF, universities.	Presentations, organization of biotech workshops	3,000	DO, GK, SG, all	**X**	**X**	**X**	**X**	**0**			**3,000**		3,000	**0**	**3,000**
10	14	Press monitoring	Communications	Follow up	Comm, contract	Clipping service, web browsing	0	GK, DO, Cimmyt office				**X**	**0**			**0**			**0**	**0**
10	15						0	DO, GK	**X**	**X**	**X**	**X**	**0**			**0**			**0**	**0**
10	16	Stakeholders Meeting	Communications	Preparing materials & participating	KARI, CIMMYT, Comm	Organization, publications, media relations	5,000	JD		**X**			**2,000**	2,000		**3,000**		3,000	**2,000**	**3,000**
10	17	IRMA documents	Communications	Writing, editing publishing	Comm	Writing, editing, publishing, distribution on CD-ROM	7,500	JD					**3,000**		3,000	**4,500**		4,500	**0**	**7,500**
10	18	IRMA Scientific journal articles	Communications	editing, submission, page charges	Comm, All	editing, submission, page charges	3,000	SM				**X**	**0**			**3,000**		3,000	**0**	**3,000**
10	19	Newspaper supplements (1/4 page)	Communications	Writing, editing, publishing	Comm. Regulatory, All	Writing, editing, publishing	0	SG					**0**			**0**			**0**	**0**
10	20	Media contacts	Communications	Follow up	Comm. Regulatory, All	Engage key personalities in local and international media	4,000	GK,DO	**X**	**X**	**X**	**X**	**1,000**		1,000	**3,000**		3,000	**0**	**4,000**
		Sub-total communication					**40,000**						**8,000**	**2,000**	**6,000**	**32,000**	**2,000**	**30,000**	**4,000**	**36,000**
						Grand total	**200,734**						**74,000**	**33,439**	**40,561**	**126,734**	**37,769**	**88,965**	**71,208**	**129,526**
																		200,734		

Appendix 5: IRMAII 2007 Budget (USD) and Budgetary Notes

	Donor Line Item	IRMAII Planned	Planned 2007	Total SFSA	RF-KARI	RF-CIMMYT	Total RF
1	Operating : Event analysis [1]	45,000	1,000	1,000	0	0	**0**
2	Operating : Product Development	125,450	62,600	27,531	12,700	22,369	**35,069**
3	Operating : Environmental Safety [3]	23,000	12,000	3,000	8,000	1,000	**9,000**
4	Operating : Insect Resistance Mgt [4]	55,000	15,000	14,000	1,000	0	**1,000**
5	Operating : Regulatory [5]	38,200	10,000	10,000	0	0	**0**
6	Operating : IPR / Licensing [6]	0	16,934	16,934	0	0	**0**
7	Operating : Seed Production [7]	0	14,400	3,261	2,739	8,400	**11,139**
8	Operating : Marketing [8]	0	14,500	7,500	4,000	3,000	**7,000**
9	Operating : Social econ impacts [9]	21,000	14,300	10,300	3,000	1,000	**4,000**
10	Operating : Comm. / Promotion [10]	45,000	40,000	36,000	2,000	2,000	**4,000**
	Total Operating	**352,650**	**200,734**	**129,526**	**33,439**	**37,769**	**71,208**
11	Capital : Computers[11]	0	0	**0**	0	0	**0**
12	Capital : Vehicles	50,000	0	**0**	0	0	**0**
13	Capital : Kitale bioassay room	0	0	**0**	0	0	**0**
14	Capital : LCD Projectors	0	0	**0**	0	0	**0**
15	Capital : Digital cameras	0	0	**0**	0	0	**0**
16	Capital : Scanner	0	0	**0**	0	0	**0**
17	Capital : Photocopier	0	0	**0**	0	0	**0**
	Total Capital	**50,000**	**0**	**0**	**0**	**0**	**0**
18	**Annual Meeting [12]**	**30,000**	**30,000**	**400**	**13,100**	**16,500**	**29,600**
				0			**0**
19	**Project Reviews (TAB)**	**15,000**	**15,000**	**15,000**	**0**	**0**	**0**
20	CIMMYT FTEs (1.5 pa) [13]	432,000	144,920	**144,920**	0	0	**0**
21	CIMMYT Travel (MX->KE) [14]	40,000	3,400	**3,400**	0	0	**0**
	Total	**472,000**	**148,320**	**148,320**	**0**	**0**	**0**
		919,650	**394,054**	**293,246**	**46,539**	**54,269**	**100,808**
22	CIMMYT OH (20%)	183,930	78,811	58,649	9,308	10,854	**10,800**
23	KARI OH (10%)	91,965	39,405	29,325	4,654	5,427	10,081
	Total overheads	**275,895**	**118,216**	**87,974**	**13,962**	**16,281**	**20,881**
24	Contingency	91,965	0	**0**	0	0	**0**
25	**Total**	**1,287,510**	**512,270**	**381,220**	**60,501**	**70,550**	**121,689**
						Syngenta	381,220
						RF	131,050
						Total	**512,270**
						RF KARI	60,500
						RF CIMMYT	70,550

Budgetary Notes: IRMA Workplan & Budgets 2007

1. Event analysis covers the lab and biosafety greenhouse as well as evaluation of Bt maize events in confined field trials. Given that we intend to move from public to private sector events, this activity will be pursued by the private sector. In 2007, we plan to test the efficacy of a private sector event in the BGH and the confined field trials. A literature study on the fate of Cry1Ab and Cry1Ba toxins and other parts of the gene construct after digestion in humans and livestock. A small amount of funds will be used to keep abreast with developments in the Bt technology.
2. The main activities for conventional breeding will be: 1) testing of newly developed insect resistant hybrids in the NPT evaluation, DUS tests and corresponding variety and line maintenance, 2) Conduct both on station and on farm testing of insect resistant germplasm, 4) Further improvement of the insect resistant germplasm for variety development for example development of insect resistant inbred lines, landraces, hybrids and OPVs, and 5) Monitoring and evaluation of both on station and on farm trials. For Bt-germplasm, a small proportion of the budget will be used for assessing *Busseola fusca* damage in advanced generation of breeding, public x public event crosses (effect of trait pyramiding), and public events x conventional resistance to assess a potentially more/less effective Busseola control in hybrids (versus inbred lines), when traits are pyramided or in homozygous versus heterozygous status. This is done in the greenhouse by evaluating the backcrosses generated over the past two seasons for B. fusca damage.
3. The activities for the year 2007 are will be 1) assessing the impacts of Bt maize (cry1Ab delta endotoxins) on parasitoids (in BGH), 2) Monitoring non-target arthropods / (and natural enemies) in Confined field site for four months, 3) Updating the reference collection and data bases, 4) Developing and publishing digital data base for wide spread access, and 5) studying the fate of pollen/impact on non-target arthropods in Bt maize fields. Information from these studies will be used for regulatory dossier, and as technical reference in future monitoring of non-target arthropods in Bt maize fields.
4. Major activities will be: 1) Follow up on concerns raised by ICIPE on distribution of different stem borer species by collecting borer species from the IRM experimental plots and from the wild hosts and organize a workshop on the proper identification and confirm the borer species in the natural refugia, 2) Establish the LD50 of the Kenyan stem borer to the Bt toxin itself to get baseline data for future reference when monitoring for resistance, 3) Determining host preference using lab bioassays to complete the data already collected, 4) Determining the overlap region of B. fusca and *C. partellus* in the maize growing region for future monitoring, 5) Use existing data to develop suitable IRM models, and sensitization workshops, farm surveys and lab bio-assays and present in journals sensitization Workshops in Machakos and Embu to cater for different Agro-ecological Zones and farming systems.
5. If IRMA gets access to private sector events, the substantial regulatory costs including direct costs of application, cost of research supervision by regulatory bodies, and specific training of KARI staff will be borne by the private sector provider. Project funds will be used to support ABSF and KARI for work with the parliamentary committees
6. These costs will be incurred while seeking out commercial events from private sector provider. Some resources will be used to develop a method for farmer identification that is necessary to implement the proposed tiered-pricing system of market segmentation.
7. Funds will be used to increase seed of the newly released insect resistant OPVs and for NPT, both on farm and on station trials and other related activities. Funds will also be used to breeder and basic seeds as well as licensing the OPVs to seed companies.
8. Market analysis will emphasize: 1) compilation of already collected data on seed cooperation, seed trade and seed systems in the region, 2) Description of major processors and their opinion on GM foods. Surveys are being conducted to collect information on GM foods in general and Bt maize in particular from stakeholders, and Focus will be directed at dissemination of research findings in workshops, conferences, and journals.

9. Socioeconomic impact will emphasize: 1) analysis of already collected data based on baseline survey, 2) participatory farmer evaluation of. insect resistant maize varieties developed through conventional breeding, 3) dissemination of research findings in workshops, conferences and journals, and determination of the economics of IRM
10. The revamped communication and education strategy will include: 1) publications on the progress of the project, 2) Develop and use an issues management matrix, asses communication needs of selected stakeholders, Develop a videos on experiences with Bt maize confined field trials and on experiences in the biosafety greenhouse complex.
11. Budgetary constraints will not allow purchase of any capital items
12. These are expenses for regular IRMA theme meetings, Executive Committee meetings and the annual review and planning meetings.
13. Includes time for the coordinator and breeder (12 months), consultant entomologist (1 month equivalent), consultant communication experts (1 month equivalent), and a socio-economist (1 month).
14. Includes travel for EC meetings and travel to attend scientific meetings between Kenya and Mexico.

Appendix 6: Table 1: List of BC_2F_1 Seeds Harvested from Bt Maize Confined Field Trial (CFT) Grown During 2006A Season at Kiboko, Kenya

Entry	Origin	Pedigree	No. of Seed
1	IR-KIB-06A-11-1-1	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-1	313
2	IR-KIB-06A-11-1-2	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-2	486
3	IR-KIB-06A-11-1-3	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-3	293
4	IR-KIB-06A-11-1-4	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-4	267
5	IR-KIB-06A-11-1-5	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-5	370
6	IR-KIB-06A-11-1-6	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-6	9
7	IR-KIB-06A-11-1-7	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-7	282
8	IR-KIB-06A-11-1-8	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-8	28
9	IR-KIB-06A-11-1-9	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-9	133
10	IR-KIB-06A-11-1-10	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-10	209
11	IR-KIB-06A-11-1-11	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-11	514
12	IR-KIB-06A-11-1-12	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-12	27
13	IR-KIB-06A-11-1-13	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-13	256
14	IR-KIB-06A-11-1-14	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-14	133
15	IR-KIB-06A-11-1-15	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-15	466
16	IR-KIB-06A-11-1-16	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-16	158
17	IR-KIB-06A-11-1-17	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-17	1
18	IR-KIB-06A-11-1-18	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-18	355
19	IR-KIB-06A-11-2-1	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-1	417
20	IR-KIB-06A-11-2-2	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-2	181
21	IR-KIB-06A-11-2-3	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-3	103
22	IR-KIB-06A-11-2-4	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-4	6
23	IR-KIB-06A-11-2-5	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-5	88
24	IR-KIB-06A-11-2-6	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-6	144
25	IR-KIB-06A-11-2-7	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-7	177
26	IR-KIB-06A-11-2-8	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-8	230
27	IR-KIB-06A-11-2-9	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-9	277
28	IR-KIB-06A-11-2-10	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-10	502
29	IR-KIB-06A-11-2-11	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-11	448
30	IR-KIB-06A-11-2-12	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-12	403
31	IR-KIB-06A-11-2-13	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-13	360
32	IR-KIB-06A-11-2-14	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-14	225
33	IR-KIB-06A-11-2-15	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-15	198
34	IR-KIB-06A-11-2-16	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-16	370
35	IR-KIB-06A-11-2-17	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-17	494
36	IR-KIB-06A-11-2-18	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-18	491
37	IR-KIB-06A-11-3-1	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-1	94
38	IR-KIB-06A-11-3-2	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-2	253
39	IR-KIB-06A-11-3-3	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-3	138
40	IR-KIB-06A-11-3-4	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-4	356
41	IR-KIB-06A-11-3-5	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-5	393
42	IR-KIB-06A-11-3-6	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-6	494
43	IR-KIB-06A-11-3-7	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-7	10
44	IR-KIB-06A-11-3-8	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-8	447
45	IR-KIB-06A-11-3-9	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-9	465
46	IR-KIB-06A-11-3-10	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-10	218
47	IR-KIB-06A-11-3-11	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-11	217
48	IR-KIB-06A-11-3-12	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-12	346
49	IR-KIB-06A-11-3-13	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-13	367
50	IR-KIB-06A-11-3-14	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-14	314
51	IR-KIB-06A-11-3-15	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-15	397
52	IR-KIB-06A-11-3-16	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-16	260
53	IR-KIB-06A-11-3-17	((Event 396 of CML216 BC_3S_1 (Cry1Ab actin) x CML202)/CML202)-B-BC_2F_1-17	375

Entry	Origin	Pedigree	No. of Seed
54	IR-KIB-06A-11-4-1	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-1	372
55	IR-KIB-06A-11-4-2	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-2	219
56	IR-KIB-06A-11-4-3	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-3	326
57	IR-KIB-06A-11-4-4	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-4	313
58	IR-KIB-06A-11-4-5	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-5	416
59	IR-KIB-06A-11-4-6	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-6	370
60	IR-KIB-06A-11-4-7	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-7	398
61	IR-KIB-06A-11-4-8	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-8	486
62	IR-KIB-06A-11-4-9	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-9	400
63	IR-KIB-06A-11-4-10	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-10	365
64	IR-KIB-06A-11-4-11	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-11	228
65	IR-KIB-06A-11-4-12	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-12	382
66	IR-KIB-06A-11-4-13	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-13	322
67	IR-KIB-06A-11-4-14	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-14	136
68	IR-KIB-06A-11-4-15	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-15	337
69	IR-KIB-06A-11-4-16	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-16	186
70	IR-KIB-06A-11-4-17	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-17	230
71	IR-KIB-06A-11-4-18	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML202)/CML202)-B-BC_2F_1-18	494
72	IR-KIB-06A-11-5-1	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-1	258
73	IR-KIB-06A-11-5-2	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-2	211
74	IR-KIB-06A-11-5-3	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-3	527
75	IR-KIB-06A-11-5-4	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-4	381
76	IR-KIB-06A-11-5-5	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-5	2
77	IR-KIB-06A-11-5-6	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-6	481
78	IR-KIB-06A-11-5-7	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-7	312
79	IR-KIB-06A-11-5-8	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-8	233
80	IR-KIB-06A-11-5-9	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-9	302
81	IR-KIB-06A-11-5-10	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-10	361
82	IR-KIB-06A-11-5-11	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-11	250
83	IR-KIB-06A-11-5-12	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-12	7
84	IR-KIB-06A-11-5-13	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-13	352
85	IR-KIB-06A-11-5-14	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-14	334
86	IR-KIB-06A-11-5-15	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-15	331
87	IR-KIB-06A-11-5-16	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-16	251
88	IR-KIB-06A-11-5-17	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-17	367
89	IR-KIB-06A-11-5-18	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-18	246
90	IR-KIB-06A-11-5-19	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-19	250
91	IR-KIB-06A-11-6-1	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-1	134
92	IR-KIB-06A-11-6-2	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-2	358
93	IR-KIB-06A-11-6-3	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-3	368
94	IR-KIB-06A-11-6-4	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-4	458
95	IR-KIB-06A-11-6-5	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-5	465
96	IR-KIB-06A-11-6-6	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-6	402
97	IR-KIB-06A-11-6-7	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-7	436
98	IR-KIB-06A-11-6-8	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-8	450
99	IR-KIB-06A-11-6-9	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-9	10
100	IR-KIB-06A-11-6-10	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-10	26
101	IR-KIB-06A-11-6-11	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-11	63
102	IR-KIB-06A-11-6-12	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-12	400
103	IR-KIB-06A-11-6-13	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-13	44
104	IR-KIB-06A-11-6-14	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-14	369
105	IR-KIB-06A-11-6-15	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-15	230
106	IR-KIB-06A-11-6-16	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-16	1
107	IR-KIB-06A-11-6-17	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-17	464
108	IR-KIB-06A-11-6-19	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-19	434
109	IR-KIB-06A-11-7-1	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-1	434
110	IR-KIB-06A-11-7-2	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-2	165

Entry	Origin	Pedigree	No. of Seed
111	IR-KIB-06A-11-7-3	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-3	212
112	IR-KIB-06A-11-7-4	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-4	618
113	IR-KIB-06A-11-7-5	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-5	350
114	IR-KIB-06A-11-7-6	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-6	462
115	IR-KIB-06A-11-7-7	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-7	370
116	IR-KIB-06A-11-7-8	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-8	200
117	IR-KIB-06A-11-7-9	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-9	374
118	IR-KIB-06A-11-7-10	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-10	198
119	IR-KIB-06A-11-7-11	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-11	299
120	IR-KIB-06A-11-7-12	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-12	465
121	IR-KIB-06A-11-7-13	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-13	312
122	IR-KIB-06A-11-7-14	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-14	464
123	IR-KIB-06A-11-7-15	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-15	351
124	IR-KIB-06A-11-7-16	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-16	208
125	IR-KIB-06A-11-7-17	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-17	120
126	IR-KIB-06A-11-7-18	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-18	488
127	IR-KIB-06A-11-7-20	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-20	614
128	IR-KIB-06A-11-8-1	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-1	361
129	IR-KIB-06A-11-8-2	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-2	166
130	IR-KIB-06A-11-8-3	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-3	329
131	IR-KIB-06A-11-8-4	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-4	396
132	IR-KIB-06A-11-8-5	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-5	235
133	IR-KIB-06A-11-8-6	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-6	143
134	IR-KIB-06A-11-8-7	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-7	332
135	IR-KIB-06A-11-8-8	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-8	538
136	IR-KIB-06A-11-8-9	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-9	398
137	IR-KIB-06A-11-8-10	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-10	256
138	IR-KIB-06A-11-8-11	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-11	402
139	IR-KIB-06A-11-8-12	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-12	290
140	IR-KIB-06A-11-8-13	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-13	346
141	IR-KIB-06A-11-8-14	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-14	265
142	IR-KIB-06A-11-8-15	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-15	151
143	IR-KIB-06A-11-8-16	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-16	436
144	IR-KIB-06A-11-8-17	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-17	324
145	IR-KIB-06A-11-8-18	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-18	497
146	IR-KIB-06A-11-8-19	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-19	54
147	IR-KIB-06A-11-8-20	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-20	398
148	IR-KIB-06A-11-8-21	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML204)/CML204)-B-BC_2F_1-21	120
149	IR-KIB-06A-11-9-1	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-1	396
150	IR-KIB-06A-11-9-2	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-2	217
151	IR-KIB-06A-11-9-3	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-3	242
152	IR-KIB-06A-11-9-4	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-4	155
153	IR-KIB-06A-11-9-5	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-5	79
154	IR-KIB-06A-11-9-6	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-6	73
155	IR-KIB-06A-11-9-7	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-7	296
156	IR-KIB-06A-11-9-8	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-8	323
157	IR-KIB-06A-11-9-9	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-9	476
158	IR-KIB-06A-11-9-10	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-10	484
159	IR-KIB-06A-11-9-11	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-11	140
160	IR-KIB-06A-11-9-12	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-12	291
161	IR-KIB-06A-11-9-13	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-13	190
162	IR-KIB-06A-11-9-14	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-14	314
163	IR-KIB-06A-11-9-15	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-15	378
164	IR-KIB-06A-11-9-16	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-16	460
165	IR-KIB-06A-11-9-17	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-17	446
166	IR-KIB-06A-11-9-18	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-18	395
167	IR-KIB-06A-11-9-19	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-19	357

Entry	Origin	Pedigree	No. of Seed
168	IR-KIB-06A-11-9-20	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-20	258
169	IR-KIB-06A-11-9-21	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-21	410
170	IR-KIB-06A-11-10-1	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-1	249
171	IR-KIB-06A-11-10-2	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-2	401
172	IR-KIB-06A-11-10-3	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-3	232
173	IR-KIB-06A-11-10-4	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-4	359
174	IR-KIB-06A-11-10-5	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-5	143
175	IR-KIB-06A-11-10-6	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-6	18
176	IR-KIB-06A-11-10-7	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-7	35
177	IR-KIB-06A-11-10-8	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-8	314
178	IR-KIB-06A-11-10-9	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-9	383
179	IR-KIB-06A-11-10-10	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-10	333
180	IR-KIB-06A-11-10-11	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-11	59
181	IR-KIB-06A-11-10-12	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-12	306
182	IR-KIB-06A-11-10-13	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-13	354
183	IR-KIB-06A-11-10-14	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-14	340
184	IR-KIB-06A-11-10-15	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-15	67
185	IR-KIB-06A-11-10-16	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-16	247
186	IR-KIB-06A-11-10-17	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-17	232
187	IR-KIB-06A-11-10-18	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-18	438
188	IR-KIB-06A-11-10-19	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML204)/CML204)-B-BC_2F_1-19	311
189	IR-KIB-06A-11-11-1	((Event 223 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-1	205
190	IR-KIB-06A-11-11-2	((Event 223 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-2	378
191	IR-KIB-06A-11-11-3	((Event 223 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-3	578
192	IR-KIB-06A-11-11-4	((Event 223 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-4	476
193	IR-KIB-06A-11-11-5	((Event 223 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-5	471
194	IR-KIB-06A-11-11-6	((Event 223 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-6	448
195	IR-KIB-06A-11-11-7	((Event 223 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-7	563
196	IR-KIB-06A-11-11-8	((Event 223 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-8	316
197	IR-KIB-06A-11-11-9	((Event 223 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-9	411
198	IR-KIB-06A-11-11-10	((Event 223 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-10	582
199	IR-KIB-06A-11-11-11	((Event 223 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-11	267
200	IR-KIB-06A-11-11-12	((Event 223 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-12	552
201	IR-KIB-06A-11-11-13	((Event 223 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-13	554
202	IR-KIB-06A-11-11-14	((Event 223 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-14	298
203	IR-KIB-06A-11-11-15	((Event 223 of CML216 BC_3S_1 (Cry1Ab ubi) x CML202)/CML202)-B-BC_2F_1-15	418
204	IR-KIB-06A-11-12-1	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML312)/CML312)-B-BC_2F_1-1	0
205	IR-KIB-06A-11-12-2	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML312)/CML312)-B-BC_2F_1-2	468
206	IR-KIB-06A-11-12-3	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML312)/CML312)-B-BC_2F_1-3	463
207	IR-KIB-06A-11-12-4	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML312)/CML312)-B-BC_2F_1-4	359
208	IR-KIB-06A-11-12-5	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML312)/CML312)-B-BC_2F_1-5	301
209	IR-KIB-06A-11-12-6	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML312)/CML312)-B-BC_2F_1-6	220
210	IR-KIB-06A-11-12-7	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML312)/CML312)-B-BC_2F_1-7	248
211	IR-KIB-06A-11-12-8	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML312)/CML312)-B-BC_2F_1-8	420
212	IR-KIB-06A-11-12-9	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML312)/CML312)-B-BC_2F_1-9	510
213	IR-KIB-06A-11-13-1	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML312)/CML312)-B-BC_2F_1-1	481
214	IR-KIB-06A-11-13-2	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML312)/CML312)-B-BC_2F_1-2	420
215	IR-KIB-06A-11-13-3	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML312)/CML312)-B-BC_2F_1-3	448
216	IR-KIB-06A-11-13-4	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML312)/CML312)-B-BC_2F_1-4	159
217	IR-KIB-06A-11-13-5	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML312)/CML312)-B-BC_2F_1-5	355
218	IR-KIB-06A-11-13-6	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML312)/CML312)-B-BC_2F_1-6	364
219	IR-KIB-06A-11-13-7	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML312)/CML312)-B-BC_2F_1-7	415
220	IR-KIB-06A-11-13-8	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML312)/CML312)-B-BC_2F_1-8	163
221	IR-KIB-06A-11-13-9	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML312)/CML312)-B-BC_2F_1-9	409
222	IR-KIB-06A-11-13-10	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML312)/CML312)-B-BC_2F_1-10	325
223	IR-KIB-06A-11-13-11	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML312)/CML312)-B-BC_2F_1-11	427
224	IR-KIB-06A-11-13-12	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML312)/CML312)-B-BC_2F_1-12	216

Entry	Origin	Pedigree	No. of Seed
225	IR-KIB-06A-11-13-13	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML312)/CML312)-B-BC_2F_1-13	280
226	IR-KIB-06A-11-13-14	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML312)/CML312)-B-BC_2F_1-14	356
227	IR-KIB-06A-11-13-15	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML312)/CML312)-B-BC_2F_1-15	188
228	IR-KIB-06A-11-14-1	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML144)/CML144)-B-BC_2F_1-1	217
229	IR-KIB-06A-11-14-2	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML144)/CML144)-B-BC_2F_1-2	147
230	IR-KIB-06A-11-14-3	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML144)/CML144)-B-BC_2F_1-3	430
231	IR-KIB-06A-11-14-4	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML144)/CML144)-B-BC_2F_1-4	284
232	IR-KIB-06A-11-14-5	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML144)/CML144)-B-BC_2F_1-5	113
233	IR-KIB-06A-11-14-6	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML144)/CML144)-B-BC_2F_1-6	191
234	IR-KIB-06A-11-14-7	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML144)/CML144)-B-BC_2F_1-7	145
235	IR-KIB-06A-11-14-8	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML144)/CML144)-B-BC_2F_1-8	250
236	IR-KIB-06A-11-14-9	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML144)/CML144)-B-BC_2F_1-9	58
237	IR-KIB-06A-11-14-10	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML144)/CML144)-B-BC_2F_1-10	6
238	IR-KIB-06A-11-14-11	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML144)/CML144)-B-BC_2F_1-11	157
239	IR-KIB-06A-11-14-12	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML144)/CML144)-B-BC_2F_1-12	442
240	IR-KIB-06A-11-14-13	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML144)/CML144)-B-BC_2F_1-13	476
241	IR-KIB-06A-11-14-14	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML144)/CML144)-B-BC_2F_1-14	234
242	IR-KIB-06A-11-15-1	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML144)/CML144)-B-BC_2F_1-1	163
243	IR-KIB-06A-11-15-2	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML144)/CML144)-B-BC_2F_1-2	266
244	IR-KIB-06A-11-15-3	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML144)/CML144)-B-BC_2F_1-3	101
245	IR-KIB-06A-11-15-4	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML144)/CML144)-B-BC_2F_1-4	349
246	IR-KIB-06A-11-15-5	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML144)/CML144)-B-BC_2F_1-5	16
247	IR-KIB-06A-11-15-6	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML144)/CML144)-B-BC_2F_1-6	78
248	IR-KIB-06A-11-15-7	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML144)/CML144)-B-BC_2F_1-7	82
249	IR-KIB-06A-11-15-8	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML144)/CML144)-B-BC_2F_1-8	260
250	IR-KIB-06A-11-15-9	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML144)/CML144)-B-BC_2F_1-9	272
251	IR-KIB-06A-11-15-10	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML144)/CML144)-B-BC_2F_1-10	131
252	IR-KIB-06A-11-15-11	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML144)/CML144)-B-BC_2F_1-11	44
253	IR-KIB-06A-11-15-12	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML144)/CML144)-B-BC_2F_1-12	140
254	IR-KIB-06A-11-15-13	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML144)/CML144)-B-BC_2F_1-13	251
255	IR-KIB-06A-11-15-14	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML144)/CML144)-B-BC_2F_1-14	191
256	IR-KIB-06A-11-16-1	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-1	234
257	IR-KIB-06A-11-16-2	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-2	201
258	IR-KIB-06A-11-16-3	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-3	278
259	IR-KIB-06A-11-16-4	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-4	164
260	IR-KIB-06A-11-16-5	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-5	46
261	IR-KIB-06A-11-16-6	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-6	87
262	IR-KIB-06A-11-16-7	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-7	0
263	IR-KIB-06A-11-16-8	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-8	300
264	IR-KIB-06A-11-16-9	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-9	0
265	IR-KIB-06A-11-16-10	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-10	12
266	IR-KIB-06A-11-16-11	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-11	305
267	IR-KIB-06A-11-16-12	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-12	464
268	IR-KIB-06A-11-16-13	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-13	260
269	IR-KIB-06A-11-16-14	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-14	5
270	IR-KIB-06A-11-16-15	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-15	443
271	IR-KIB-06A-11-16-16	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-16	212
272	IR-KIB-06A-11-16-17	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-17	39
273	IR-KIB-06A-11-16-18	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-18	200
274	IR-KIB-06A-11-16-19	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-19	18
275	IR-KIB-06A-11-16-20	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-20	0
276	IR-KIB-06A-11-16-21	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML159)/CML159)-B-BC_2F_1-21	28
277	IR-KIB-06A-11-17-1	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-1	187
278	IR-KIB-06A-11-17-2	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-2	258
279	IR-KIB-06A-11-17-3	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-3	294
280	IR-KIB-06A-11-17-4	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-4	96
281	IR-KIB-06A-11-17-5	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-5	151

Entry	Origin	Pedigree	No. of Seed
282	IR-KIB-06A-11-17-6	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-6	118
283	IR-KIB-06A-11-17-7	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-7	344
284	IR-KIB-06A-11-17-8	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-8	49
285	IR-KIB-06A-11-17-9	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-9	395
286	IR-KIB-06A-11-17-10	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-10	233
287	IR-KIB-06A-11-17-11	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-11	238
288	IR-KIB-06A-11-17-12	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-12	384
289	IR-KIB-06A-11-17-13	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-13	273
290	IR-KIB-06A-11-17-14	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-14	208
291	IR-KIB-06A-11-17-15	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-15	261
292	IR-KIB-06A-11-17-16	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-16	108
293	IR-KIB-06A-11-17-17	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-17	206
294	IR-KIB-06A-11-17-18	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-18	33
295	IR-KIB-06A-11-17-19	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x CML159)/CML159)-B-BC_2F_1-19	276
296	IR-KIB-06A-11-18-1	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-1	299
297	IR-KIB-06A-11-18-2	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-2	296
298	IR-KIB-06A-11-18-3	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-3	298
299	IR-KIB-06A-11-18-4	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-4	490
300	IR-KIB-06A-11-18-5	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-5	313
301	IR-KIB-06A-11-18-6	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-6	416
302	IR-KIB-06A-11-18-7	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-7	345
303	IR-KIB-06A-11-18-8	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-8	294
304	IR-KIB-06A-11-18-9	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-9	235
305	IR-KIB-06A-11-18-10	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-10	224
306	IR-KIB-06A-11-18-11	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-11	248
307	IR-KIB-06A-11-18-12	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-12	305
308	IR-KIB-06A-11-18-13	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-13	223
309	IR-KIB-06A-11-18-14	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-14	221
310	IR-KIB-06A-11-18-15	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-15	286
311	IR-KIB-06A-11-18-16	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-16	241
312	IR-KIB-06A-11-18-17	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-17	303
313	IR-KIB-06A-11-18-18	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-18	163
314	IR-KIB-06A-11-19-1	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-1	224
315	IR-KIB-06A-11-19-2	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-2	413
316	IR-KIB-06A-11-19-3	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-3	230
317	IR-KIB-06A-11-19-4	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-4	314
318	IR-KIB-06A-11-19-5	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-5	265
319	IR-KIB-06A-11-19-6	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-6	304
320	IR-KIB-06A-11-19-7	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-7	161
321	IR-KIB-06A-11-19-8	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-8	381
322	IR-KIB-06A-11-19-9	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-9	268
323	IR-KIB-06A-11-19-10	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-10	361
324	IR-KIB-06A-11-19-11	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-11	520
325	IR-KIB-06A-11-19-12	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-12	202
326	IR-KIB-06A-11-19-13	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-13	84
327	IR-KIB-06A-11-19-14	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-14	312
328	IR-KIB-06A-11-19-15	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-15	283
329	IR-KIB-06A-11-19-16	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-16	273
330	IR-KIB-06A-11-19-17	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-17	150
331	IR-KIB-06A-11-19-18	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-18	277
332	IR-KIB-06A-11-19-19	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-19	223
333	IR-KIB-06A-11-19-20	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-20	330
334	IR-KIB-06A-11-19-21	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x CML395)/CML395)-B-BC_2F_1-21	505
335	IR-KIB-06A-11-20-1	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-1	293
336	IR-KIB-06A-11-20-2	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-2	70
337	IR-KIB-06A-11-20-3	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-3	464
338	IR-KIB-06A-11-20-4	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-4	168

Entry	Origin	Pedigree	No. of Seed
339	IR-KIB-06A-11-20-5	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-5	284
340	IR-KIB-06A-11-20-6	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-6	448
341	IR-KIB-06A-11-20-7	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-7	270
342	IR-KIB-06A-11-20-8	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-8	96
343	IR-KIB-06A-11-20-9	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-9	194
344	IR-KIB-06A-11-20-10	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-10	238
345	IR-KIB-06A-11-20-11	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-11	180
346	IR-KIB-06A-11-20-12	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-12	153
347	IR-KIB-06A-11-20-13	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-13	292
348	IR-KIB-06A-11-20-14	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-14	283
349	IR-KIB-06A-11-20-15	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-15	231
350	IR-KIB-06A-11-20-16	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-16	64
351	IR-KIB-06A-11-20-17	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-17	275
352	IR-KIB-06A-11-20-18	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-18	111
353	IR-KIB-06A-11-20-19	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-19	326
354	IR-KIB-06A-11-20-20	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-20	80
355	IR-KIB-06A-11-20-21	((Event 10 of CML216 BC_3S_1 (Cry1Ba ubi) x Katumani)/Katumani)-B-BC_2F_1-21	143
356	IR-KIB-06A-11-21-1	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-1	38
357	IR-KIB-06A-11-21-2	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-2	277
358	IR-KIB-06A-11-21-3	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-3	110
359	IR-KIB-06A-11-21-4	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-4	124
360	IR-KIB-06A-11-21-5	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-5	5
361	IR-KIB-06A-11-21-6	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-6	258
362	IR-KIB-06A-11-21-7	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-7	240
363	IR-KIB-06A-11-21-8	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-8	78
364	IR-KIB-06A-11-21-9	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-9	468
365	IR-KIB-06A-11-21-10	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-10	281
366	IR-KIB-06A-11-21-11	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-11	78
367	IR-KIB-06A-11-21-12	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-12	146
368	IR-KIB-06A-11-21-13	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-13	281
369	IR-KIB-06A-11-21-14	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-14	125
370	IR-KIB-06A-11-21-15	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-15	146
371	IR-KIB-06A-11-21-16	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-16	301
372	IR-KIB-06A-11-21-17	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-17	125
373	IR-KIB-06A-11-21-18	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-18	118
374	IR-KIB-06A-11-21-19	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-19	252
375	IR-KIB-06A-11-21-20	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-20	243
376	IR-KIB-06A-11-21-21	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-21	210
377	IR-KIB-06A-11-21-22	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Katumani)/Katumani)-B-BC_2F_1-22	305
378	IR-KIB-06A-11-22-1	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-1	348
379	IR-KIB-06A-11-22-2	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-2	202
380	IR-KIB-06A-11-22-3	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-3	279
381	IR-KIB-06A-11-22-4	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-4	294
382	IR-KIB-06A-11-22-5	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-5	277
383	IR-KIB-06A-11-22-6	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-6	282
384	IR-KIB-06A-11-22-7	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-7	194
385	IR-KIB-06A-11-22-8	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-8	365
386	IR-KIB-06A-11-22-9	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-9	465
387	IR-KIB-06A-11-22-10	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-10	432
388	IR-KIB-06A-11-22-11	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-11	379
389	IR-KIB-06A-11-22-12	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-12	245
390	IR-KIB-06A-11-22-13	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-13	312
391	IR-KIB-06A-11-22-14	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-14	300
392	IR-KIB-06A-11-22-15	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-15	204
393	IR-KIB-06A-11-22-16	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-16	305
394	IR-KIB-06A-11-22-17	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-17	273
395	IR-KIB-06A-11-22-18	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-18	141

Entry	Origin	Pedigree	No. of Seed
396	IR-KIB-06A-11-22-19	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-19	403
397	IR-KIB-06A-11-22-20	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-20	242
398	IR-KIB-06A-11-22-21	((Event 127 of CML216 BC_3S_1 (Cry1Ba ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-21	288
399	IR-KIB-06A-11-23-1	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-1	184
400	IR-KIB-06A-11-23-2	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-2	361
401	IR-KIB-06A-11-23-3	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-3	367
402	IR-KIB-06A-11-23-4	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-4	143
403	IR-KIB-06A-11-23-5	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-5	308
404	IR-KIB-06A-11-23-6	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-6	442
405	IR-KIB-06A-11-23-7	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-7	202
406	IR-KIB-06A-11-23-8	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-8	406
407	IR-KIB-06A-11-23-9	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-9	196
408	IR-KIB-06A-11-23-10	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-10	467
409	IR-KIB-06A-11-23-11	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-11	353
410	IR-KIB-06A-11-23-12	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-12	257
411	IR-KIB-06A-11-23-13	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-13	431
412	IR-KIB-06A-11-23-14	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-14	232
413	IR-KIB-06A-11-23-15	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-15	516
414	IR-KIB-06A-11-23-16	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-16	375
415	IR-KIB-06A-11-23-17	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-17	395
416	IR-KIB-06A-11-23-18	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-18	555
417	IR-KIB-06A-11-23-19	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-19	302
418	IR-KIB-06A-11-23-20	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-20	224
419	IR-KIB-06A-11-23-21	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-21	469
420	IR-KIB-06A-11-24-1	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-1	393
421	IR-KIB-06A-11-24-2	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-2	491
422	IR-KIB-06A-11-24-3	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-3	260
423	IR-KIB-06A-11-24-4	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-4	448
424	IR-KIB-06A-11-24-5	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-5	363
425	IR-KIB-06A-11-24-6	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-6	290
426	IR-KIB-06A-11-24-7	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-7	338
427	IR-KIB-06A-11-24-8	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-8	532
428	IR-KIB-06A-11-24-9	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-9	294
429	IR-KIB-06A-11-24-10	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-10	430
430	IR-KIB-06A-11-24-11	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-11	451
431	IR-KIB-06A-11-24-12	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-12	296
432	IR-KIB-06A-11-24-13	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-13	401
433	IR-KIB-06A-11-24-14	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-14	414
434	IR-KIB-06A-11-24-15	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-15	375
435	IR-KIB-06A-11-24-16	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-16	378
436	IR-KIB-06A-11-24-17	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-17	278
437	IR-KIB-06A-11-24-18	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-18	292
438	IR-KIB-06A-11-24-19	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-19	442
439	IR-KIB-06A-11-24-20	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-20	386
440	IR-KIB-06A-11-24-21	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-21	389
441	IR-KIB-06A-11-24-23	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-23	412
442	IR-KIB-06A-11-24-24	((Event 216 of CML216 BC_3S_1 (Cry1Ab ubi) x Pool 15 QPM-SR-OPT-1)/Pool 15 QPM-SR-OPT-1)-B-BC_2F_1-24	475
		Total Seed	125,257

Appendix 7: List of BC_1F_1 Seeds Harvested from Bt Maize CFT Trial IR-KIB-05B-2 at Kiboko

Entry	Origin	Pedigree	No of seeds
1	IR-KIB-05B-2-1-1	(CML202 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML202 BC_1F_1-1	381
2	IR-KIB-05B-2-1-2	(CML202 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML202 BC_1F_1-2	291
3	IR-KIB-05B-2-1-3	(CML202 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML202 BC_1F_1-3	72
4	IR-KIB-05B-2-1-4	(CML202 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML202 BC_1F_1-4	359
5	IR-KIB-05B-2-1-5	(CML202 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML202 BC_1F_1-5	454
6	IR-KIB-05B-2-1-6	(CML202 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML202 BC_1F_1-6	292
7	IR-KIB-05B-2-1-7	(CML202 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML202 BC_1F_1-7	440
8	IR-KIB-05B-2-1-8	(CML202 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML202 BC_1F_1-8	528
9	IR-KIB-05B-2-1-9	(CML202 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML202 BC_1F_1-9	400
10	IR-KIB-05B-2-1-10	(CML202 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML202 BC_1F_1-10	467
11	IR-KIB-05B-2-2-1	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-1	384
12	IR-KIB-05B-2-2-2	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-2	361
13	IR-KIB-05B-2-2-3	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-3	43
14	IR-KIB-05B-2-2-4	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-4	465
15	IR-KIB-05B-2-2-5	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-5	380
16	IR-KIB-05B-2-2-6	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-6	546
17	IR-KIB-05B-2-2-7	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-7	265
18	IR-KIB-05B-2-2-8	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-8	497
19	IR-KIB-05B-2-2-9	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-9	444
20	IR-KIB-05B-2-2-10	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-10	426
21	IR-KIB-05B-2-2-11	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-11	456
22	IR-KIB-05B-2-2-12	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-12	431
23	IR-KIB-05B-2-2-13	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-13	323
24	IR-KIB-05B-2-2-14	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-14	419
25	IR-KIB-05B-2-2-15	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-15	386
26	IR-KIB-05B-2-3-1	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-1	486
27	IR-KIB-05B-2-3-2	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-2	223
28	IR-KIB-05B-2-3-3	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-3	509
29	IR-KIB-05B-2-3-4	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-4	278
30	IR-KIB-05B-2-3-5	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-5	476
31	IR-KIB-05B-2-3-6	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-6	380
32	IR-KIB-05B-2-3-7	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-7	578
33	IR-KIB-05B-2-3-8	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-8	549
34	IR-KIB-05B-2-3-9	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-9	510
35	IR-KIB-05B-2-3-10	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-10	569
36	IR-KIB-05B-2-3-11	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-11	521
37	IR-KIB-05B-2-3-12	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-12	99
38	IR-KIB-05B-2-3-13	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-13	519
39	IR-KIB-05B-2-3-14	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-14	348
40	IR-KIB-05B-2-3-15	(CML202 x Event 396 of CML216 BC_3S_1 (Cry1Ab actin))/CML202 BC_1F_1-15	202
41	IR-KIB-05B-2-4-1	(CML202 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML202 BC_1F_1-1	310
42	IR-KIB-05B-2-4-2	(CML202 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML202 BC_1F_1-2	561
43	IR-KIB-05B-2-4-3	(CML202 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML202 BC_1F_1-3	413
44	IR-KIB-05B-2-4-4	(CML202 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML202 BC_1F_1-4	444
45	IR-KIB-05B-2-5-1	(CML202 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-1	456
46	IR-KIB-05B-2-5-2	(CML202 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-2	276
47	IR-KIB-05B-2-5-3	(CML202 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-3	135
48	IR-KIB-05B-2-5-4	(CML202 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-4	527
49	IR-KIB-05B-2-6-1	(CML202 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-1	294
50	IR-KIB-05B-2-6-2	(CML202 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-2	450
51	IR-KIB-05B-2-6-3	(CML202 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-3	197
52	IR-KIB-05B-2-6-4	(CML202 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-4	165
53	IR-KIB-05B-2-6-5	(CML202 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-5	584
54	IR-KIB-05B-2-6-6	(CML202 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-6	412

Entry	Origin	Pedigree	No of seeds
55	IR-KIB-05B-2-6-7	(CML202 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-7	584
56	IR-KIB-05B-2-6-8	(CML202 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-8	174
57	IR-KIB-05B-2-6-9	(CML202 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-9	385
58	IR-KIB-05B-2-6-10	(CML202 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-10	458
59	IR-KIB-05B-2-7-1	(CML204 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML204 BC_1F_1-1	563
60	IR-KIB-05B-2-7-2	(CML204 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML204 BC_1F_1-2	504
61	IR-KIB-05B-2-7-3	(CML204 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML204 BC_1F_1-3	542
62	IR-KIB-05B-2-7-4	(CML204 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML204 BC_1F_1-4	342
63	IR-KIB-05B-2-8-1	(CML204 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML204 BC_1F_1-1	382
64	IR-KIB-05B-2-8-2	(CML204 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML204 BC_1F_1-2	449
65	IR-KIB-05B-2-8-3	(CML204 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML204 BC_1F_1-3	288
66	IR-KIB-05B-2-8-4	(CML204 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML204 BC_1F_1-4	247
67	IR-KIB-05B-2-8-5	(CML204 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML204 BC_1F_1-5	439
68	IR-KIB-05B-2-8-6	(CML204 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML204 BC_1F_1-6	353
69	IR-KIB-05B-2-8-7	(CML204 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML204 BC_1F_1-7	427
70	IR-KIB-05B-2-9-1	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-1	236
71	IR-KIB-05B-2-9-2	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-2	361
72	IR-KIB-05B-2-9-3	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-3	278
73	IR-KIB-05B-2-9-4	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-4	460
74	IR-KIB-05B-2-9-5	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-5	393
75	IR-KIB-05B-2-9-6	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-6	395
76	IR-KIB-05B-2-9-7	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-7	452
77	IR-KIB-05B-2-10-1	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-1	354
78	IR-KIB-05B-2-10-2	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-2	340
79	IR-KIB-05B-2-10-3	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-3	436
80	IR-KIB-05B-2-10-4	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-4	349
81	IR-KIB-05B-2-10-5	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-5	399
82	IR-KIB-05B-2-10-6	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-6	423
83	IR-KIB-05B-2-10-7	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-7	237
84	IR-KIB-05B-2-10-8	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-8	224
85	IR-KIB-05B-2-10-9	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-9	200
86	IR-KIB-05B-2-10-10	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-10	381
87	IR-KIB-05B-2-10-11	(CML204 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML204 BC_1F_1-11	330
88	IR-KIB-05B-2-11-1	(CML202 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-1	272
89	IR-KIB-05B-2-11-2	(CML202 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-2	360
90	IR-KIB-05B-2-11-3	(CML202 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-3	381
91	IR-KIB-05B-2-11-4	(CML202 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-4	401
92	IR-KIB-05B-2-11-5	(CML202 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-5	585
93	IR-KIB-05B-2-11-6	(CML202 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/CML202 BC_1F_1-6	116
94	IR-KIB-05B-2-12-1	(CML312 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML312 BC_1F_1-1	292
95	IR-KIB-05B-2-12-2	(CML312 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML312 BC_1F_1-2	501
96	IR-KIB-05B-2-13-1	(CML312 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML312 BC_1F_1-1	421
97	IR-KIB-05B-2-13-2	(CML312 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML312 BC_1F_1-2	449
98	IR-KIB-05B-2-13-3	(CML312 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML312 BC_1F_1-3	294
99	IR-KIB-05B-2-13-4	(CML312 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML312 BC_1F_1-4	254
100	IR-KIB-05B-2-13-5	(CML312 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML312 BC_1F_1-5	550
101	IR-KIB-05B-2-13-6	(CML312 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML312 BC_1F_1-6	413
102	IR-KIB-05B-2-13-7	(CML312 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML312 BC_1F_1-7	169
103	IR-KIB-05B-2-14-1	(CML144 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML144 BC_1F_1-1	444
104	IR-KIB-05B-2-14-2	(CML144 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML144 BC_1F_1-2	230
105	IR-KIB-05B-2-14-3	(CML144 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML144 BC_1F_1-3	428
106	IR-KIB-05B-2-14-4	(CML144 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML144 BC_1F_1-4	336
107	IR-KIB-05B-2-14-5	(CML144 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML144 BC_1F_1-5	408
108	IR-KIB-05B-2-15-1	(CML144 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML144 BC_1F_1-1	478
109	IR-KIB-05B-2-15-2	(CML144 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML144 BC_1F_1-2	498
110	IR-KIB-05B-2-15-3	(CML144 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML144 BC_1F_1-3	318
111	IR-KIB-05B-2-15-4	(CML144 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML144 BC_1F_1-4	456
112	IR-KIB-05B-2-16-1	(CML159 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML159 BC_1F_1-1	422

Entry	Origin	Pedigree	No of seeds
113	IR-KIB-05B-2-16-2	(CML159 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML159 BC_1F_1-2	268
114	IR-KIB-05B-2-17-1	(CML159 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML159 BC_1F_1-1	460
115	IR-KIB-05B-2-17-2	(CML159 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML159 BC_1F_1-2	422
116	IR-KIB-05B-2-17-3	(CML159 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML159 BC_1F_1-3	438
117	IR-KIB-05B-2-17-4	(CML159 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML159 BC_1F_1-4	532
118	IR-KIB-05B-2-17-5	(CML159 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML159 BC_1F_1-5	462
119	IR-KIB-05B-2-17-6	(CML159 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML159 BC_1F_1-6	232
120	IR-KIB-05B-2-17-7	(CML159 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML159 BC_1F_1-7	484
121	IR-KIB-05B-2-17-8	(CML159 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML159 BC_1F_1-8	510
122	IR-KIB-05B-2-17-9	(CML159 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML159 BC_1F_1-9	204
123	IR-KIB-05B-2-17-10	(CML159 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML159 BC_1F_1-10	281
124	IR-KIB-05B-2-17-11	(CML159 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML159 BC_1F_1-11	539
125	IR-KIB-05B-2-17-12	(CML159 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/CML159 BC_1F_1-12	524
126	IR-KIB-05B-2-18-1	(CML395 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML395 BC_1F_1-1	308
127	IR-KIB-05B-2-18-2	(CML395 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML395 BC_1F_1-2	303
128	IR-KIB-05B-2-18-3	(CML395 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML395 BC_1F_1-3	147
129	IR-KIB-05B-2-18-4	(CML395 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML395 BC_1F_1-4	185
130	IR-KIB-05B-2-19-1	(CML395 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML395 BC_1F1.1	399
131	IR-KIB-05B-2-19-2	(CML395 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML395 BC_1F1.2	284
132	IR-KIB-05B-2-19-3	(CML395 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML395 BC_1F1.3	369
133	IR-KIB-05B-2-19-4	(CML395 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML395 BC_1F1.4	402
134	IR-KIB-05B-2-19-5	(CML395 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML395 BC_1F1.5	477
135	IR-KIB-05B-2-19-6	(CML395 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML395 BC_1F1.6	148
136	IR-KIB-05B-2-19-7	(CML395 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML395 BC_1F1.7	102
137	IR-KIB-05B-2-19-8	(CML395 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/CML395 BC_1F1.8	49
138	IR-KIB-05B-2-20-1	(Katumani x Event 10 of CML216 BC_3S_1 (Cry1Ba ubi))/Katumani BC_1F_1-1	189
139	IR-KIB-05B-2-20-2	(Katumani x Event 10 of CML216 BC_3S_1 (Cry1Ba ubi))/Katumani BC_1F_1-2	333
140	IR-KIB-05B-2-20-3	(Katumani x Event 10 of CML216 BC_3S_1 (Cry1Ba ubi))/Katumani BC_1F_1-3	338
141	IR-KIB-05B-2-20-4	(Katumani x Event 10 of CML216 BC_3S_1 (Cry1Ba ubi))/Katumani BC_1F_1-4	200
142	IR-KIB-05B-2-20-5	(Katumani x Event 10 of CML216 BC_3S_1 (Cry1Ba ubi))/Katumani BC_1F_1-5	188
143	IR-KIB-05B-2-20-6	(Katumani x Event 10 of CML216 BC_3S_1 (Cry1Ba ubi))/Katumani BC_1F_1-6	135
144	IR-KIB-05B-2-20-7	(Katumani x Event 10 of CML216 BC_3S_1 (Cry1Ba ubi))/Katumani BC_1F_1-7	315
145	IR-KIB-05B-2-20-8	(Katumani x Event 10 of CML216 BC_3S_1 (Cry1Ba ubi))/Katumani BC_1F_1-8	368
146	IR-KIB-05B-2-20-9	(Katumani x Event 10 of CML216 BC_3S_1 (Cry1Ba ubi))/Katumani BC_1F_1-9	289
147	IR-KIB-05B-2-20-10	(Katumani x Event 10 of CML216 BC_3S_1 (Cry1Ba ubi))/Katumani BC_1F_1-10	187
148	IR-KIB-05B-2-20-11	(Katumani x Event 10 of CML216 BC_3S_1 (Cry1Ba ubi))/Katumani BC_1F_1-11	136
149	IR-KIB-05B-2-20-12	(Katumani x Event 10 of CML216 BC_3S_1 (Cry1Ba ubi))/Katumani BC_1F_1-12	283
150	IR-KIB-05B-2-21-1	(Katumani x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Katumani BC_1F_1-1	152
151	IR-KIB-05B-2-21-2	(Katumani x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Katumani BC_1F_1-2	386
152	IR-KIB-05B-2-21-3	(Katumani x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Katumani BC_1F_1-3	194
153	IR-KIB-05B-2-21-4	(Katumani x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Katumani BC_1F_1-4	229
154	IR-KIB-05B-2-21-5	(Katumani x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Katumani BC_1F_1-5	245
155	IR-KIB-05B-2-21-6	(Katumani x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Katumani BC_1F_1-6	166
156	IR-KIB-05B-2-21-7	(Katumani x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Katumani BC_1F_1-7	238
157	IR-KIB-05B-2-21-8	(Katumani x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Katumani BC_1F_1-8	274
158	IR-KIB-05B-2-21-9	(Katumani x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Katumani BC_1F_1-9	228
159	IR-KIB-05B-2-21-10	(Katumani x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Katumani BC_1F_1-10	217
160	IR-KIB-05B-2-21-11	(Katumani x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Katumani BC_1F_1-11	227
161	IR-KIB-05B-2-21-12	(Katumani x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Katumani BC_1F_1-12	383
162	IR-KIB-05B-2-22-1	(Pool 15 QPM-SR-OPT-1 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-1	251
163	IR-KIB-05B-2-22-2	(Pool 15 QPM-SR-OPT-1 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-2	229
164	IR-KIB-05B-2-22-3	(Pool 15 QPM-SR-OPT-1 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-3	240
165	IR-KIB-05B-2-22-4	(Pool 15 QPM-SR-OPT-1 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-4	144
166	IR-KIB-05B-2-22-5	(Pool 15 QPM-SR-OPT-1 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-5	108
167	IR-KIB-05B-2-22-6	(Pool 15 QPM-SR-OPT-1 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-6	343
168	IR-KIB-05B-2-22-7	(Pool 15 QPM-SR-OPT-1 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-7	171
169	IR-KIB-05B-2-22-8	(Pool 15 QPM-SR-OPT-1 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-8	133
170	IR-KIB-05B-2-22-9	(Pool 15 QPM-SR-OPT-1 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-9	264

Entry	Origin	Pedigree	No of seeds
171	IR-KIB-05B-2-22-10	(Pool 15 QPM-SR-OPT-1 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-10	158
172	IR-KIB-05B-2-22-11	(Pool 15 QPM-SR-OPT-1 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-11	258
173	IR-KIB-05B-2-22-12	(Pool 15 QPM-SR-OPT-1 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-12	187
174	IR-KIB-05B-2-22-13	(Pool 15 QPM-SR-OPT-1 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-13	183
175	IR-KIB-05B-2-22-14	(Pool 15 QPM-SR-OPT-1 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-14	110
176	IR-KIB-05B-2-22-15	(Pool 15 QPM-SR-OPT-1 x Event 127 of CML216 BC_3S_1 (Cry1Ba ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-15	161
177	IR-KIB-05B-2-23-1	(Pool 15 QPM-SR-OPT-1 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-1	178
178	IR-KIB-05B-2-23-2	(Pool 15 QPM-SR-OPT-1 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-2	171
179	IR-KIB-05B-2-23-3	(Pool 15 QPM-SR-OPT-1 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-3	323
180	IR-KIB-05B-2-23-4	(Pool 15 QPM-SR-OPT-1 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-4	120
181	IR-KIB-05B-2-23-5	(Pool 15 QPM-SR-OPT-1 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-5	181
182	IR-KIB-05B-2-23-6	(Pool 15 QPM-SR-OPT-1 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-6	167
183	IR-KIB-05B-2-23-7	(Pool 15 QPM-SR-OPT-1 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-7	138
184	IR-KIB-05B-2-23-8	(Pool 15 QPM-SR-OPT-1 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-8	213
185	IR-KIB-05B-2-23-9	(Pool 15 QPM-SR-OPT-1 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-9	202
186	IR-KIB-05B-2-23-10	(Pool 15 QPM-SR-OPT-1 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-10	225
187	IR-KIB-05B-2-23-11	(Pool 15 QPM-SR-OPT-1 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-11	157
188	IR-KIB-05B-2-23-12	(Pool 15 QPM-SR-OPT-1 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-12	98
189	IR-KIB-05B-2-23-13	(Pool 15 QPM-SR-OPT-1 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-13	123
190	IR-KIB-05B-2-23-14	(Pool 15 QPM-SR-OPT-1 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-14	272
191	IR-KIB-05B-2-23-15	(Pool 15 QPM-SR-OPT-1 x Event 223 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-15	195
192	IR-KIB-05B-2-24-1	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-1	226
193	IR-KIB-05B-2-24-2	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-2	399
194	IR-KIB-05B-2-24-3	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-3	318
195	IR-KIB-05B-2-24-4	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-4	309
196	IR-KIB-05B-2-24-5	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-5	300
197	IR-KIB-05B-2-24-6	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-6	212
198	IR-KIB-05B-2-24-7	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-7	271
199	IR-KIB-05B-2-24-8	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-8	425
200	IR-KIB-05B-2-24-9	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-9	318
201	IR-KIB-05B-2-24-10	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-10	287
202	IR-KIB-05B-2-24-11	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-11	105
203	IR-KIB-05B-2-24-12	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-12	258
204	IR-KIB-05B-2-24-13	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-13	327
205	IR-KIB-05B-2-24-14	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-14	179
206	IR-KIB-05B-2-24-15	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-15	374
207	IR-KIB-05B-2-24-16	(Pool 15 QPM-SR-OPT-1 x Event 216 of CML216 BC_3S_1 (Cry1Ab ubi))/Pool 15 QPM-SR-OPT-1 BC_1F_1-16	289
		Total Number of Seeds	67,606

Appendix 8: List of Institutions from where Visitors and Students were Hosted at the BGHC for Periods Between 1 Day and 4 Months

	Institution	Number of visits
1	University of Nairobi (UON)	22
2	General Service Unit (Kenya)	1
3	CIMMYT	26
4	Kenya Methodist University	9
5	Kenyatta University	99
6	Egerton University	1
7	KARI - NARL	8
8	KARI - Thika	1
9	KARI – Kakamega	1
10	KARI – Katumani	1
11	KARI – Muguga	1
12	KARI – TRC	1
13	KARI – Headquarters	2
14	Life Ministry	1
15	Kenya Plant Health Inspectorate Services (KEPHIS)	7
16	Ministry of Agriculture	34
17	Moi University	3
18	National Council for Science and Technology	1
19	UNWFP, South Africa	1
20	IFPRI	1
21	Ethiopian Ambassador to Kenya	1
22	Global Media	1
23	Kenya Polytechnic	11
24	Biosciences East and Central Africa (BECA)	1
25	BIGIN VIOODI, Zambia	1
26	ICRAF, PAMILL Cleaning Services	1
27	Makerere University	1
28	DANIDA	4
29	Ghana Foreign Minister	1
30	Cuban Foreign Minister	1
31	Sudan Embassy to Kenya	1
32	Zambia University	1
33	Ministry of Sciences, Zambia	1
34	Jubilee Insurance, Kenya	1
35	Egypt Foreign Minister	1
36	USDA representative	1
37	JKUAT	5
38	Tanzanian Delegation	1
39	South African Broadcasting Corporation (SABC)	1
40	IBC, South Africa	1
41	CSLZ, Zimbabwe	1
42	Dean of Biotechnology, Cairo University, Egypt	1
43	EMBRAPA/Brazil	1
45	Contractors	6
46	ICRISAT	1
47	BGGUN-WADS	1

	Institution	Number of visits
48	ILRI	1
49	IPGRI	1
50	PICASSO Productions	1
51	ICIPE	1
52	Royal Agricultural University	1
53	Progressive Media	1
54	LITLAB Suppliers	2
55	University of Dar es Salaam	1
56	COMESA, representatives	1
57	ACTS, Kenya	1
58	PCPB, Kenya	1
59	ARC, South Africa	1
60	TCC/DIAS	1
61	Monsanto	1
	Total	284

Appendix 9: List of Invitees to the IRMA Project Annual Review and Planning Meeting held at Blue Post Hotel, Thika, Kenya, 6-10 Nov 2006

	Name	Institution	Title/Discipline
1	Dr. Mugo Stephen	CIMMYT – Kenya	IRMA Coordinator
2	Dr. De Groote Hugo	CIMMYT – Kenya	Agricultural Economist
3	Mrs. Daisy Ouya	CIMMYT – Kenya	Science Writer/Editor
4	Dr. David Bergvinson	CIMMYT – Mexico	Entomologist
5	Dr. Banziger Marianne	CIMMYT – Zimbabwe	Director ALP
7	Dr. Simon Gichuki	KARI	Molecular Breeder
8	Mr. Charles Bett	KARI	Agricultural-Economist
9	Dr. Josephine Songa	KARI	Maize Component Manager
10	Mrs. Catherine Taracha	KARI	Senior Research Officer
11	Mr. Paddy W. Likhayo	KARI	Research Officer (Entomologist)
12	Dr. Omari Odongo	KARI	Center Director
13	Dr. Jane Ininda	KARI	National Maize Research Coordinator
14	Dr. James Gethi	KARI	Maize Breeder
15	Mr. Wilson Muasya	KARI	Maize Breeder
16	Dr. Macharia Gethi	KARI	Center Director
17	Dr. Charles Mutinda	KARI	Principal Maize Breeder
18	Mr. James Ouma	KARI	Socio-Economist
19	Dr. George Ombakho	KARI	CRO/Breeder
20	Mr. Danda Kengo	KARI	Research Officer
21	Mr. Japhether Wanyama	KARI	Socio Economist
22	Dr. Margaret Mulaa	KARI	SPRO Entomology
23	Mrs. Grace Kimani	KARI	Information Officer
24	Mrs. Regina Tende	Univ. of Nairobi	Student
25	Mr. Geoffrey Murenga	KARI	Student
26	Mr. James Ndiso	Ministry of Agriculture	Student
27	Mr. Were	KARI Kakamega	
28	Mr. Mwandoe Shuma	KARI Mtwapa	Research Officer
29	Mr. Dennis Obonyo Ndolo	KARI Biotechnology	Student

Appendix 10: Tentative Program for Annual Review Meeting, 6-10 November 2006

MONDAY, 6 NOVEMBER 2006		
05.00 pm	Arrivals	D. Nanzala
TUESDAY 7 NOVEMBER 2006		
Session 1: Opening		
Chair: S. Gichuki		
08:30 am	Registration	D. Nanzala
09:00	Welcome and Introductions	S. Mugo
09.15	Session I - Brief Reports - highlights	
09.15	Bt maize Event analysis, & human health safety assessment	C. Taracha
09.30	Product Development (convent. Bt) and comp. Analysis	S. Mugo/J. Ininda
09.45	Environmental Impact Assessment	J. Songa/D. Bergvinson
10.00	Insect resistance management and contingency plans	M. Mulaa/D. Bergvinson
10.15	Regulatory	S. Gichuki/S. Mugo
10:30	**Tea Break**	
11.00	1IPR/Licensing	Oluoch/H. De Groote
11.15	Seed production	O. Odongo/S. Mugo
11.30	Market assessment and analysis	M. Odendo/H. De Groote
11.45	Economic impact assessment	H. De Groote/O. Okuro
12.00	Communication/Promotion	D. Ouya/G. Kimani
12.30	**Lunch Break**	
01.30 pm	Session II – Special Presentations and reviews	
01.30	Towards IRMA-Private tech provider partnerships	S. Mugo/S. Gichuki
01.50	Market segmentation for humanitarian and commercial uses	H. De Groote/M. Odendo
02.10	Progress on development of conventional insect maize	S. Mugo/J. Ininda
02.30	IRMA Physical and digital reference collections of arthropods	J. Songa/D. Bergvinson
02.50	**Tea/Coffee break**	
03.20	Developing suitable IRM strategies for Bt maize in Kenya	M. Mulaa/D. Bergvinson
03.40	Global strategies to control maize pests	D. Bergvinson
04.15	Discussions	Chair
04.40	Planning for day 2	S. Mugo
05.00	**End of day 1**	
WEDNESDAY, 8 NOVEMBER 2006		
08.30	**Session III – Developing Work Plans for 2007**	
Chair: M. Mulaa		
08.30 am	Review of IRMA II Business plan	S. Mugo
09.30	Break out into Theme groups	
	Bt maize Event analysis, & human health safety assessment	C. Taracha/G. Murenga
	Product Development (convent. Bt) and comp. Analysis	S. Mugo/J. Ininda

	Environmental Impact Assessment	J. Songa/D. Bergvinson
	Insect resistance management and contingency plans	M. Mulaa/D. Bergvinson
	Regulatory	S. Gichuki/S. Mugo
	IPR/Licensing	S. Mugo/H. De Groote
	Seed production	W. Muasya/S. Mugo
	Market assessment and analysis	M. Odendo/H. De Groote
	Economic impact assessment	H. De Groote/O. Okuro
	Communication/Promotion	D. Ouya/G. Kimani
04.30 pm	Review of status of work plans 2006	M. Mulaa
05.00	**End of day 2**	
THURSDAY 9 NOVEMBER 2006		
Chair: Mr. Shuma		
08.30 am	**Session IV – Presentations of Work Plans & Budgets for 2007**	
08.45	Bt maize Event analysis, & human health safety assessment	J. Danson/C. Taracha
09.15	Product Development (convent. Bt) and comp. Analysis	S. Mugo/J. Ininda
09.45	Environmental Impact Assessment	J. Songa/D. Bergvinson
10:15	**Tea Break**	
10.45	Insect resistance management and contingency plans	M. Mulaa/D. Bergvinson
11.45	Regulatory	S. Gichuki/S. Mugo
12.15	1IPR/Licensing	Oluoch/H. De Groote
12.30	**Lunch Break**	
01.30 pm	Seed production	O. Odongo/S. Mugo
02.00	Market assessment and analysis	M. Odendo/H. De Groote
02.30	Economic impact assessment	H. De Groote/O. Okuro
03.00	Communication/Promotion	D. Ouya/G. Kimani
03.00	**Tea/Coffee break**	
03.30	**Session V – Planning for ExCo and Stakeholders Meetings (Feb 2007)**	
04.30	General discussions	Chair
05.00	**End of day 3 - Closing remarks and adjourn**	**S. Mugo**
FRIDAY, 10 NOVEMBER 2006		
08.00 am	Departures	

Appendix 11 List of Participants IRMA Meeting of 6-10 November, 2006

	Name	Title/Discipline	Organization	Address	Email	Telephone	Telephone (2)
1	George Ombakho	Breeder	KARI Kitale	P. O. Box 450, Kitale	irmaktl@africaonline.co.ke	054-30891	0722-779307
2	Grace Kimani	Public Relations Officer	KARI HQ	P. O. Box 57811, Nairobi	gkimani@kari.org		
3	Simon Gichuki	Head, Biotech.Centre	KARI NARL	P. O. Box 57811, Nairobi	stgichuki@swiftkenya.com	4444137	4444144
4	Josephine Songa	Entomologist	KARI NARL	P. O. Box 14733, Nairobi 00800	jmsonga@africaonline.co.ke	0722989520	
5	Daisy Ouya	Science Writer	CIMMYT - Kenya	P. O. Box 1041 Nairobi 00621	douya@cgiar.org	7224600	7224601
6	Macharia Gethi	Center Director, Entomologist	KARI Embu	P. O. Box 27, Embu	kariembu@winnet.co.ke	068-30286	0722328963
7	James Ouma Okuro	Agricultural Economist	KARI Embu	P. O. Box 27, Embu	j_okuro@yahoo.co.uk	068-30286	
8	Charles Bett	Agricultural Economist	KARI Katumani	P. O. Box 340, Machakos	charles_bett@hotmail.com	044-21122	0720-693805
9	Wanyama Masinde	Senior Research Officer, Socio-Economist	KARI Kitale	P. O. Box 450, Kitale	jmasindektl@yahoo.com	0721-551338	
10	Paddy Likhayo	Research Officer, Entomologist	KARI Biotech.	P. O. Box 14733, Nairobi 00800	plikhayo@yahoo.com	4444137/0722-228311	4444144/3
11	Wilson Muasya	Plant Breeder, Maize Breeder	KARI Kiboko	P. O. Box 340 Machakos	muasyawilson@yahoo.co.uk	0722-296918	
12	Catherine Taracha	Entomologist	KARI Biotech.	P. O. Box 14733, Nairobi 00800	ctaracha@yahoo.com	4444137	
13	Martins Odendo	Agricultural Economist	KARI Kakamega	P. O. Box 169, Kakamega	odendos@yahoo.com	0733-883394	
14	Murenga Mwimali	Masters Student, UoN	KARI Biotech.	P. O. Box 57811, Nairobi 00200	mwimali@yahoo.co.uk	0722-915500	4444137
15	Regina Tende	Masters Student, UoN	KARI Biotech.	P. O. Box 14733, Nairobi 00800	reginatende@yahoo.com	0720-361975	
16	Charles Mutinda	Maize Breeder	KARI Embu	P. O. Box 27, Embu	mutindacharles@yahoo.com	0723-533193	
17	Margaret Mulaa	Senior Research Officer	KARI Kitale	P. O. Box 450, Kitale	margaretmulaa@yahoo.com	0722-382769	
18	Jost Frei	Consultant	SFSA	.	jost.frei@syngenta.com	0041613237114	
19	James Gethi	Maize Breeder	KARI Katumani	P. O. Box 340, Machakos	jgethi@wananchi.com	044-20330/21122	
20	David Bergvinson	Entomologist	CIMMYT – Mexico	CIMMYT Mexico	dbergvinson@cgiar.org	52-5-5804-2004	
21	Stephen Mugo	IRMA Coordinator	CIMMYT - Kenya	P. O. Box 1041 Nairobi 00621	smugo@cgiar.org	7224600	7224610
22	James Ndiso	Senior Lecturer, Agronomy	Kilifi Institue of Agriculture	P. O. Box 195 Kilifi	james_ndisio@yahoo.com	0720785791	
23	Jackson Shuma	Senior Research Officer	KARI Mtwapa	P. O. Box 16, Mtwapa	jackshuma@yahoo.com	0722-347670	
24	Danda Kengo	Senior Economist/Socio-Economist	KARI Mtwapa	P. O. Box 16, Mtwapa	dkengo@yahoo.com	0733867537	
25	Dennis Ndolo Obonyo	Entomologist	KARI NARL	P. O. Box 14733, Nairobi 00800	ndolodennis@yahoo.com	0722654925	

Appendix 12: Revised IRMA II Timeline 2004-2008