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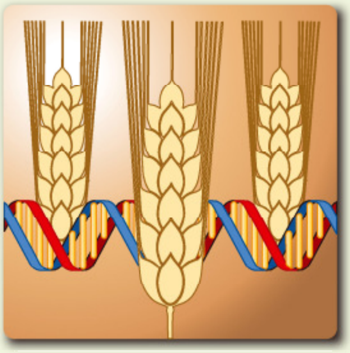

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IAEA
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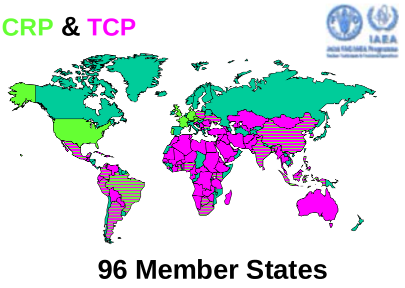
Consultants Meeting on 'Development of mutant germplasm for enhancing crop productivity with better adaptation to climate change' - Photos courtesy of Dr. Thelma Padolina – PhilRice, The Philippines

To Our Readers

This new biennium 2010–2011 will be characterized by a strengthened attention focusing on climate variability and change. In the next 50 years, global population and economic trends will exert increasing pressure on crop production and vital natural resources such as land and water through expanding demands for food, feed, fibre and energy. These trends will be compounded by the intensifying effects of climate change, which is negatively impacting crop productivity and land and water resources through increasingly variable and extreme conditions. These include elevated temperatures, irregular precipitation patterns and outbreaks of global pest epidemics. Thus, a major challenge to agriculture is to weather-proof the existing crop production systems. In order to make better use of both productive and marginal lands, it is paramount to select, evaluate and develop crop genotypes that can produce under conditions of high temperatures and low rainfall, or where soils suffer from salinity or acidity or have been 'mined' of nutrients. Producing not only more but better quality food with enhanced nutritive value is an important pathway towards reducing hunger and malnutrition thus enhancing human health and disease-resistance and ultimately contributing to the achievement of goal one of the UN Millennium Development Goals. Significant opportunities exist for meeting this challenge by harnessing nuclear techniques in conjunction with newly emerging techniques in cellular and molecular biology.

Innovative soil and water technologies will be integrated with newly developed mutant crop varieties with enhanced adaptability to climate change and variability. This integrated approach is important in the adoption of mutant varieties to field conditions to meet the increasing global demand on the quantity and quality of food within the next 50 years as well as to ensure the conservation of natural (e.g. soil and water) and agricultural (e.g. fertilizers) resources in highly dynamic agro-ecosystems.



As rising global energy needs increase the demand for biofuels, competition between agricultural production and energy production for land and water, as well as for financial and human resources, is further impacting crop production. In order, therefore, to support the sustainable intensification of agricultural production and socioeconomic development in Member States, we will do our best to serve 96 Member States through 57 national (27 Africa, 18 Asia and the Pacific, seven Latin America and the Caribbean, five Europe), five regional (28 Africa, 20 Asia and the Pacific, 13 Latin America and the Caribbean, 15 Europe) and one interregional Technical Cooperation Projects (TCPs), and four Coordinated Research Projects (CRPs). Highlights of these you will find inside this newsletter in the usual places.

There will be two new features:: the first will be a regular new space for you to voice your experience with the IAEA, called the **Alumni Corner**. As we care about you, we invite you former fellows, Chief Scientific Investigators (CSIs) and counterparts to share with us how your experience with the IAEA has impacted your career and life (Please send your contributions to k.allaf@iaea.org). Please find in this issue the inaugural contribution from Prof. Associado Dr. Augusto Tulmann Neto.

The second new regular feature will be found in the TC Highlights section, named 'News from Ug99' (relating to the TC project INT/5/150). During the second Steering and Coordination Meeting in Nairobi, Kenya, the plenum of participants came to the conclusion that further implementation of INT/5/150 should be conducted in the following three phases: (i) adoption and training in the use of uniform protocols, in order to assure homogeneity of handling (capacity building), (ii) yearly coordination and steering meetings (the third Steering and Coordination Meeting is planned in Turkey for the end of this year) and regional training (for detailed information on the Interregional Training Course on Mutation Induction and Breeding for Cereal — Wheat and Barley — Rust Resistance and Climate Hardening/Harsh Environment Adaptation Parts I & II see 'Forthcoming Events' in this issue). Regular yearly meetings are essential for harmonizing cooperation between participating Member States, the IAEA, FAO and its partners, CYMMYT (Kenya), ARS, BGRI, CAAS, BARC, ICARDA, DAFWA and the Secretariat of International Treaty on Plant Genetic Resources for Food and Agriculture (FAO, Italy), (iii) multilocation trials of mutant germplasm in endemic hot spots/screen houses. These phases are not necessarily consecutive, but overlapping.

If you navigate to our Homepage (http://www-naweb.iaea.org/nafa/pbg/index.html) you will find under 'Information Sources' our upgraded and updated Mutant Varieties and Genetic Stock Webpage (http://mvgs.iaea.org/). Have a look at the new features and do not forget to submit any new mutant variety (registration may be on-line). One of the new features, although still under construction, may be useful to you: our in-house protocols. Just click on the 'Lab Protocol' tab and you will be directed to our Protocols and Guidelines Webpage (http://mvgs.iaea.org/LaboratoryProtocals.aspx). Here you will find detailed protocols developed/adapted and tested at the IAEA's Laboratories. You will also find information, forms and protocols for genotyping and mutagenesis services and positive control kits for mutation discovery. Protocols were optimized for our laboratory. Further optimizations at your own facility may be necessary. If you have questions about one of these protocols, please contact us and one of our trained staff can assist you (contact addresses inside this issue).

It is hard to say goodbye. Regularly you will see me, as you already saw me, complain about this routine. Every seven years, colleagues have to leave the IAEA. This is called the 'rotation policy' of the IAEA.

So it is goodbye to Dr. Chikelu Mba, who served as Plant Breeding & Genetics Laboratory Head for his seven years of tenure at the FAO/IAEA Agriculture & Biotechnology Laboratories. Chikelu served as Course Director of six Interregional Training Courses, fondly remembered by 120 trainees from more than 50 different countries, and numerous fellows, interns and scientific visitors, trained by his staff at Seibersdorf. Chikelu enriched us all through his experience working on food security crops, especially cassava. His main tasks at the Joint FAO/IAEA Programme involved the application of crop mutation induction and efficiency enhancing molecular and bio-technologies, including reverse genetics strategies, and cell and tissue biology techniques to develop integrated technology packages facilitating breeding superior crop varieties. As Scientific Secretary, he was instrumental in developing and successfully steering two coordinated research projects: 'Molecular Tools for Quality Improvement in Vegetatively Propagated Crops Including Banana and Cassava (D2.30.27) (2005-2010)' and 'Development of Integrated Technology Packages for Enhancing the Efficiency of Induced Mutagenesis in

Crop Plants (D2.40.12) (2008-2013)'. Chikelu has recently joined the Plant Production and Protection Division of the Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. A loss for us, a gain for our sister division in Rome, we stay in close collaboration with Chikelu in his new function. We will miss his no nonsense approach, rock solid dedication to the sub-programme needs, and his willingness to go the extra mile.

It is also time to say farewell to Prof. Qingyao Shu, who served as Technical Officer for the Plant Breeding and Genetics Section. His work ethic and dedication are an inspiration to us all. In 2008, he organized the successful International Symposium on Induced Mutations in Plants (more than 500 participants, 252 posters and 122 oral presentations). A special recognition is due to Qingyao for effectively driving the Plant Mutation Reports journal through promotion, management and scientific editing of the Mutation Breeding Newsletter and Mutation Breeding Review and the upgrade of the Mutant Varieties and Genetic Stock (MVGS) database. During his seven year stay, Qingyao scientifically and technically backstopped 33 national and four regional Technical Co-operation Projects. During these duties he was in contact with 101 fellows, which he guided through their training curricula, spanning not less than 315 months (or 26.25 years) of capacity building. He was also responsible, as Scientific Secretary, for two coordinated research projects (CRP). Just before leaving, he began the CRP on 'Isolation and Characterization of Genes Involved in Mutagenesis of Crop Plants' (D2.40.13). We will miss Qingyao and know that he will be an invaluable gain to the Institute of Nuclear Agricultural Sciences, Zhejiang University (Hangzhou, China) in his new function as Deputy Director.

Pierre J.L. Lagoda
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Forthcoming Events

Interregional Training Course on Mutation Induction and Breeding for Cereal (Wheat and Barley) Rust Resistance and Climate Hardening/Harsh Environment Adaptation Part I — Responding to the Transboundary Threat to Wheat Black Stem Rust (Ug99) and Mutation Induction and Supportive Breeding and Biotechnologies for Improving Crop Productivity (ARASIA), INT/5/150 & RAS/5/048, Seibersdorf, Austria, 7–11 June 2010

Technical Officer: P.J.L. Lagoda

Course Director: B. Till

This training course had not yet occurred by the time this newsletter went to press. The training course has 24 participants registered from 18 countries and five external lecturers alongside Joint Programme staff to teach the course. The purpose of this course is to provide a theoretical as well as a practical introduction to breeding cereals (especially wheat) for rust resistance and climate hardening/harsh environment adaptation using mutation induction and efficiency enhancing molecular and biotechnologies. Changing climate patterns enhance the impact of transboundary pests and crop diseases by weakening naturally protected regions and bloating harsh environment areas. The Food and Agriculture Organization (FAO) is monitoring and charting the spread of the wheat black stem rust disease in the framework of the Global Rust Initiative. The IAEA Interregional Project INT/5/150 is designed to complement the ongoing international activities and provide a platform for the coordination of a network of laboratories (based on the previously established laboratory infrastructure through the Agency's technical cooperation projects) as a defence line against the Wheat Black Stem Rust (Ug99) disease. The IAEA Regional Project RAS/5/048 is designed to enhance desired traits of high yield, short duration, shatter-resistance, and climatic stress tolerance through the generation, characterization and dissemination of wheat and barley mutant varieties. In order to develop workable protocols and guidelines for efficiently breeding cereals (especially wheat) resistance to rust and tolerance to climate variability and change in the different agro-ecologies of the INT/5/150 and RAS5048 participating countries, this training course is bound to propose theoretical and practical modules on advanced mutation induction and Double Haploid (DH) technology. Specifically, the topics to be covered include: induced mutations, managing large scale mutant populations, screening for abiotic tolerance, plant disease resistance in general, rust disease resistance of wheat and barley, wheat black stem rust Ug99 resistance, advanced phenotyping methods, reverse-genetics and DH technology. The aim is to put every participant at the same level on technology packages integration mutation induction, DH and tolerance/resistance screening, in order to prepare the participants to assimilate the more advanced training, Part II at the Chinese Academy of Agricultural Sciences, Beijing, China, in August. The ultimate aim of this training the trainers exercise is to have enabled the participants of INT/5/150 and RAS/5/048 to train local staff in the implementation of these technology packages in their respective countries.

Interregional Training Course on Mutation Induction and Breeding for Cereal (Wheat and Barley) Rust Resistance and Climate Hardening/Harsh Environment Adaptation Part II - Responding to the Transboundary Threat to Wheat Black Stem Rust (Ug99), INT/5/150, Institute of Crop Sciences, Chinese Academy of Agricultural Sciences (CAAS), Beijing, China, 9–13 August 2010

Technical Officer: P.J.L. Lagoda

Group Training on mutant germplasm for G × E testing, multilocation trials in endemic hotspots/screen houses, seed storage and farmer participation. The course is open to about 20 participants from INT/5/150 who participated in Part I of the training course in Vienna. The purpose of this course is to provide a theoretical as well as a practical introduction to the management of project related activities in order to raise levels of collaboration on training, exchange of germplasm and harmonization of screening methods, especially for rust resistance. The participants are INT/5/150 counterparts and research group/breeding program leaders. The pandemic of wheat stem rust spread by Ug99 is considered the most serious threat to wheat and barley in 50 years. The threat has already caused an increase in wheat prices, as all commercial varieties are sensitive to the disease - but it also threatens barley. In order to maximize the usefulness of mutant germplasm and to achieve synergy amongst the participants of this Interregional Project, promising advanced mutant lines must be tested on multiple locations. This training course is bound to propose guidelines to the project counterparts on:

(i) How to test environmental effects on the crops (G × E), by choosing test sites, carrying out multilocation trials and performing statistical analyses;

(ii) How to optimize seed storage at the short and medium term (germination assays, seed multiplication, phytosanitarian aspects);

(iii) How to implement farmer participation (participatory planning and monitoring, participatory rural appraisal techniques, on-farm participatory trials, community-based action and development activities for supporting the livelihoods, biostatistics in participatory approaches). Under the guidance of the experts, the participants will draw a tentative roadmap for national G × E trials with farmer's participation and transnational multilocation trials.

IAEA/AFRA Regional Training Course on the Establishment of Guidelines on Socio-Economic Assessment Study on Newly Developed Mutant Lines Market Value and Impact in Populations' Livelihood, RAF/5/056, Pretoria, South Africa, 9–13 August 2010

Technical Officer: M. Spencer

The purpose of the training course is to provide theoretical and practical skills to staff members working with the breeders and/or the scientists involved in the development of new and improved crop varieties using mutation induction to assess the commercial value and the impact of these lines in the socio-economic situation in the Member States based on valid national data. The course is meant for scientists and crop breeders involved in the planning and evaluation of mutation induction in breeding programmes. The lectures will be designed to establish standard methods for evaluating the distribution and the market value of these new lines and also provide information on legal issues involving germplasm exchanges and breeders' right protection.

IAEA/AFRA Regional Training Course on Basic Molecular Markers and Data Analysis for Enhancing the Efficiency of Mutation Induction in Crop Improvement, RAF/5/056, Eldoret, Kenya, tentatively planned for 6–9 September 2010

Technical Officer: M. Spencer

In past years, the IAEA through its TC projects, RAF-AFRA, has participated in valuable capacity building in the regional Member States. So far, some of the participating national research institutes have well-established plant biotechnology laboratories, including plant tissue culture and molecular biology, particularly in the fields of crop improvement using mutation induction, *in vitro* culture and molecular markers.

The application of the laboratory and field experimental results requires a good mastering of statistical data analysis in order to attain international trade harmonization to assure mutual recognition and to prevent large financial losses through erroneous results.

The purpose of the training course is to familiarize the participants with two important aspects of crop breeding:

- Molecular techniques to be applied within a crop mutation induction programme; and
- Data collection, data handling and analysis of field data as well as laboratory data generated by molecular marker technologies.

An introduction to the most performing and more sophisticated molecular marker techniques will also be performed in order to prepare participants for the extension of their programme.

Third Coordination Meeting on Responding to the Transboundary Threat to Wheat Black Stem Rust (Ug99), INT/5/150, tentatively planned in Turkey, November 2010

Technical Officer: P.J.L. Lagoda

The meeting is open to the designated counterparts of all IAEA Member States (where wheat is an important crop and which are facing the threat of the Wheat Black Stem Rush threat) who participated at the Vienna first and second coordination meetings, and those Member States who showed interest but could not be present at the first and/or second coordination meeting. Additional stakeholders with a vested interest on Ug99 will also attend: FAO, International Center for Agricultural Research in the Dry Areas (ICARDA), the International Maize and Wheat Improvement Center (CIMMYT), the United States Department of Agriculture — Agricultural Research Service (USDA-ARS), BGRI (USA), Chinese Academy of Agricultural Sciences (CAAS), Bhabha Atomic Research Centre (BARC, India) and Western Australian Department of Agriculture and Food of the Government of Western Australia. The objectives of the meeting are:

(i) To conduct a progress evaluation from the second coordination meeting to present (activities planned in Kenya, activities accomplished, identify bottlenecks and plan the way forward to 2011 activities which will be reviewed by the Member States and adjusted accordingly);

(ii) To evaluate efficiency of mutant germplasm exchange pipeline projected at second coordination meeting through the first mutants and tested during the second coordination meeting;

(iii) To implement lessons learnt from the mutant test-run for the planned future interactions;

(iv) To harmonize cooperation between the IAEA and its partners, Member States, CIMMYT, ARS (Agricultural Research Services of the USDA), BGRI (USA), CAAS (Chinese Academy of Agricultural Sciences, BARC (Bhabha Atomic Research Centre, India) ICARDA (Syria), the International Treaty on Plant Genetic Resources for Food and Agriculture (FAO, Italy) and Western Australian Department of Agriculture and Food of the Government of Western Australia.

Fourth and Final Research Coordination Meeting on Molecular Tools for Quality Improvement in Vegetatively Propagated Crops including Banana and Cassava, D2.30.27, Brasília, Brazil, 8–12 November 2010

Technical Officer: B. Till

For detailed information, see Coordinated Research Projects (CRPs) and Research Coordination Meetings (RCMs).

Second Research Coordination Meeting on Enhancing the Efficiency of Induced Mutagenesis through an Integrated Biotechnology Pipeline, D2.40.12, tentatively planned in Gatersleben, Germany, 25–29 October 2010

Technical Officer: B. Till

For detailed information, see Coordinated Research Projects (CRPs) and Research Coordination Meetings (RCMs).

Past Events

IAEA/ARCAL Regional Training Course on the Establishment of Standard Screening Protocols for *In Vitro* and *In Vivo* Selection of Crop Mutant Lines Tolerant to Drought, RLA/5/056, Cali, Colombia, 1–5 February 2010

Technical Officer: M. Spencer

Thirty-five scientists and breeders from 13 countries including Argentina, Bolivia, Brazil, Cuba, Dominican Republic, El Salvador, Guatemala, Haiti, Mexico, Paraguay, Peru and Colombia attended the training course. The course was held at CIAT's Headquarters located in Cali, Colombia under the coordination of Drs. César P. Martinez, Jagadish Rane and Eleonora Izquierdo, who provided technical support throughout the training course.

The main objective of the course was to introduce evaluation and screening techniques for tolerance to abiotic stresses under greenhouse and field conditions, which could be utilized by participants for evaluation of induced mutants in their countries. The second objective was to follow up progress made by participants in their own mutation projects and allow them interaction and feedback. This was complemented by the distribution of hardcopies of relevant papers and book chapters. There were two invited key experts, who presented several lectures dealing with their field of expertise and several CIAT's staff presented papers on specific crops they are working with. About 70% of the time was devoted to theoretical aspects whilst 30% was used to run practical exercises under greenhouse or field conditions.

Experiences on breeding for drought stress or on screening techniques for drought in several crops, including beans, rice, cassava, sugarcane, wheat, forages and sorghum were presented by invited speakers and CIAT scientists. This was essential since the participants are working on different crops, even if most of the relevant data and information came from cereal crops. This course was well-timed since some of the participants had just started to generate mutants for field or greenhouse evaluations and benefited a lot from the interactions with speakers. On the other hand, they were also able to become acquainted with some useful equipment and/or software to meet their needs. Invited speakers, Drs. Rachid Serraj and Gustavo Slafer gave especial emphasis on the significance of crop phenology in the context of phenotyping for yield under water stress, drought avoidance and water use efficiency, physiological and molecular mechanisms of drought tolerance, and trade off. Emphasis was also given to the need of very well characterizing the different environments, where a given crop is planted to be able to select the most appropriate one for our needs and objectives. Data collection and analysis were also thoroughly covered and appreciated by all participants.

An evaluation of the training course was conducted, indicating that 96% of the participants assessed the course as very relevant to their needs. Most of the participants agreed that the course met their expectations and suggested that visits to participating countries will allow them to observe progress made in different crops.

Regional Training Course on Wheat and Barley Plant Breeding - Mutation Induction and Supportive Biotechnologies for Improving Crop Productivity (ARASIA), RAS/5/048, ACSAD, Damascus, Syrian Arab Republic, 25–29 April 2010

Technical Officer: P.J.L. Lagoda

Twenty participants from Iraq, Jordan, Lebanon, Syrian Arab Republic and Yemen were trained on basic principles of cereal breeding, especially wheat and barley. This course, in Arabic, included lectures, and laboratory as well as field practical exercises (Izraa Research Station) on good agricultural practices, nomenclature, plot design, practical principles of analyses of agricultural data by using statistical analysis programs, selection procedures, collecting and interpreting data and a synopsis of different breeding strategies (including inbreeding/selfing, backcrossing, NILs, intra-, interspecific and –generic hybridization, mutation breeding, transgenics and selection procedures). An introduction to ACSAD and to the Cereal Programme opened the regional training course, before principles of genetics and plant breeding were addressed. Modules on polyploidy and mutations, marker assisted breeding (marker assisted selection, marker assisted backcross), mutation breeding, cytoplasmic male sterility (CMS, including hybrid breeding), plant tissue culture (including embryo rescue, protoplast fusion, DH) and methods of cereal breeding (including breeding for high yields) were the main support of the regional training course. These modules were structured lectures and exercises containing a historical introduction, a description of the basic principles, a synopsis of the actual status and development (including at least one representative example of application) and a short discussion of the comparative advantages/disadvantages. Lectures on the physiological basis for improving tolerance of small grain cereals to draught stress, domestication, and the usefulness of landraces for breeding rounded up this regional training course.

Regional Training Workshop on Training on DNA Sequencing and TILLING, TUR/5/025, Ankara, Turkey, 26–30 April 2010

Technical Officer: B. Till

The objective of the course was to provide theoretical background and hands-on training in reverse-genetics using induced mutations and high-throughput mutation discovery methods. All steps of the TILLING procedure were covered. Topics included methods of mutation induction, population structure, DNA extraction, DNA quantification, nomenclature, sample storage, computational methods for gene identification and primer design, mutation discovery, sequencing of mutations and data analysis. A set of positive control samples developed in Seibersdorf were used for the course and students worked in teams to identify known mutations. Both low-cost agarose gel and high-throughput fluorescent readout platforms were used. The course was a success and induced mutations were recovered. This indicates that TILLING can be successfully performed at the Turkish Atomic Energy Authority (TAEK). From this preliminary data, a research plan was developed for further assay optimizations, and continued close ties between TAEK and the Plant Breeding and Genetics Laboratory in Seibersdorf are expected.

IAEA/ARASIA Regional Training Workshop on Farmer Participation and Seed Multiplication, RAS/5/048, Aleppo, Syrian Arab Republic, 9–13 May 2010

Technical Officer: P.J.L. Lagoda

Wheat and barley are among the most important food crops contributing to food security and sufficiency in the ARASIA region. However, despite the advances in increasing their yields, several biotic (disease and pest) and abiotic (drought) factors continue to limit their productivity. It is now a matter of urgency that new varieties should be bred with higher and more stable yield potentials, superior quality, and multiple resistances to disease and insects. The use of induced mutation for creating useful new germplasm and developing new cultivars is a profitable approach to improvement. If desired traits are to be enhanced and mutant varieties with high yield, short duration, shatter-resistance, and stress tolerance are to be developed, it is important that various valuable mutant germplasms should be generated, identified, and made best use of. The ARASIA countries have recognized the prime importance of developing improved varieties of food crops through the application of mutation techniques. The training workshop was organized by the IAEA in cooperation with the Government of the Syrian Arab Republic through the International Centre for Agricultural Research in the Dry Areas (ICARDA). In the framework of 'training the trainers', participants from Jordan, Iraq, Lebanon, the Kingdom of Saudi Arabia, Syrian Arab Republic and Yemen were immersed in an intense training program consisting of the following main topics:

- Importance of participatory plant breeding in crop improvement;
- Decentralized participatory plant breeding;
- Participatory Variety Selection (PVS);
- Farmer Initial Trials (FIT);
- Farmer Advanced Trials (FAT);
- Farmer Elite Trials (FET);
- Farmers' role in plant breeding (case studies);
- Technical aspects of seed multiplication and seed increase.

Consultants Meeting on Development of Mutant Germplasm for Enhancing Crop Productivity with Better Adaptation to Climate Change, Vienna, Austria, 10–14 May 2010

Technical Officer: M. Spencer

Four consultants with expertise in biotechnology (Prof. Peter Gresshoff, Australia), plant breeding and biotechnology (Dr. Thelma Padolina, The Philippines), crop physiology and modelling (Dr. Pasquale Steduto, FAO, Italy), and plant nutrition and physiology (Dr. Idupulapati Rao, CIAT, Colombia) attended the meeting along with staff of the sister sections of the Joint FAO/IAEA Division with relevant projects.

Considering that many regions are already weighed down with drought, flooding or resurgence, occurrence of diseases may threaten food security to unforeseen regions, given climate change and variability. Therefore, food security crops need to be 'climate proofed'. The specific objectives of the CRP include: (i) development of modern nuclear technology enhanced breeding protocols to enable improved responses to abiotic and biotic stresses, warranting sustainable food security under increasingly adverse and variable conditions; (ii) adaptation and application of modern and high throughput biotechnology packages combined to nuclear applications in soil, water and crop nutrition management for enhanced crop adaptation and flexibility. It was proposed to discuss the development of new high yielding mutant varieties with improved quality under low input cultivation in a range of agro-ecologies, through broadening adaptability.

A complete and clear matrix was drafted and discussed in order to respond to questions related to crop breeding under the foreseen climate change:

- What priority crops need to be climate proofed?
- Which type of climate stress should be prioritized?
- What research approaches can be used to develop a coordinated research project among Member States to improve genetic adaptation of crops to anticipated climate change?

Based on the observation that most of the research groups working on the same topic throughout the world are concentrating their efforts on CO_2 increase in the atmosphere and/or increased water scarcity together with the related stresses such as increased salinity and spread of diseases, the consultants decided to concentrate the efforts under this specific CRP on 'climate proofing' crops for increased temperature. In fact temperature is already known as a strong parameter impeding crops development in some regions of the world. The meeting also decided to concentrate the efforts on crops with high impact on food security: cereals (preferentially rice) and legumes (preferentially common bean).

Such an engaging title is meant to invite all scientists and breeders involved in the application of mutation induction and advanced biotechnologies for improving crop survival under the new conditions brought by global climate change.

A proposal entitled Induced Mutants for Climate-proofing Crops (IMCC): Enhancing Productivity and Adaptation to High Temperature Stress as Anticipated by Climate Change will be submitted for approval and review to the IAEA's Committee for Coordinated Research Activities (CCRAs).

Coordinated Research Projects (CRPs) and Research Coordination Meetings (RCMs)

Project Number	Ongoing CRPs	Scientific Secretary
D2.40.12	Enhancing the Efficiency of Induced Mutagenesis through an Integrated Biotechnology Pipeline	B. Till
D2.30.28	Improving Nutritional Quality by Altering Concentrations of Enhancing Factors Using Induced Mutation and Biotechnology in Crops	Y. Lokko
D2.40.13	Isolation and Characterization of Genes Involved in Mutagenesis of Crop Plants	P.J.L. Lagoda
D2.30.27	Molecular Tools for Quality Improvement in Vegetatively Propagated Crops Including Banana and Cassava	C. Mba
	New CRP to start in 2011	
	Induced Mutations for Climate-proofing Crops (IMCC): Enhancing Productivity and Adaptation to High Temperature Stress as Anticipated by Climate Change	M. Spencer

Enhancing the Efficiency of Induced Mutagenesis through an Integrated Biotechnology Pipeline, D2.40.12

Technical Officer: B. Till (formerly C. Mba & B. Till)

This CRP was initiated in 2008. The first RCM was held in Vienna, Austria, 25–29 May 2009. The second RCM is tentatively planned for 25-29 October 2010 in Gatersleben, Germany.

This CRP aims to evaluate and adapt methods for the interlacing of induced mutations with novel cellular and molecular biology techniques into 'biotechnology pipelines' for efficient and streamlined production and selection of crops with desired traits for integration into breeding programmes. Cellular and molecular biology techniques are aimed at addressing the bottlenecks imposed by the need to rapidly generate large mutant populations of suitable genetic backgrounds (homozygous for the mutation events, and devoid of chimeras). Additionally, tools for direct querying of mutations in target genes causative for desired traits will obviate the need for large field trials. The CRP is built on a modular principle so that modules can be easily combined and adapted to fit the constraints of specific species. We have chosen four model species: banana, barley, cassava and rice that cover major biological systems and production constraints. The outputs of protocols and guidelines are aimed at providing Member States strategies for the efficient use of induced mutations to develop superior crop varieties. The RCM will focus on achievements since the last meeting and in setting good and obtainable goals for future work. In this regard, extra focus will be put on banana and cassava as due to changes in participation, the CRP lacks specific research agreement holders for these crops.

Improving Nutritional Quality by Altering Concentrations of Enhancing Factors Using Induced Mutation and Biotechnology in Crops, D2.30.28

Technical Officer: Y. Lokko

This CRP started with a consultants meeting in 2008 in Vienna, Austria. The staff of the Joint FAO/IAEA subprogramme and four experts formulated a proposal for a new Coordinated Research Project (CRP) on Enhancing nutritional, nutraceutical and pharmaceutical value of crops using mutation induction techniques. The experts consulted were Dr. S.K. Rasmussen (Denmark) and Dr. D.X. Wu (China), plant breeders with expertise in breeding for improved micronutrient content; Prof. P. White (UK), a Plant Nutritionist with expertise on plant nutritional genomics (including biofortification); and Dr. N. Tomlekova (Bulgaria), a geneticist with expertise in improving beta carotene content in vegetables.

The first RCM was held in Vienna, Austria, 29 June– 3 July 2008. Eleven scientists from Botswana, Bulgaria, China, Denmark, Ghana, Germany, India, Kenya, South Africa, Ukraine, the United Kingdom (UK) and the United States of America (USA) attended the meeting in Vienna to discuss the individual project activities, adapt the work plans, and facilitate possible collaboration between the research teams. The second RCM is planned to be held in 2011.

Food security, nutrition and health are key issues in the national agenda of government planning in many countries in the world. Humans require more than 25 mineral elements. Recommended daily intakes and safe upper levels of many of these elements have been defined. The availability and intake of nutritious foods provides the required amount of calories, vitamins and minerals and ensures good health. In addition to forming the major components of human diets, providing the required calories and nutrients to sustain life, crop plants also contain most of the essential vitamins and, either directly or indirectly, deliver many of the essential mineral elements to the human diet. These vitamins and minerals are required to prevent common micronutrient disorders. However, the major staple crops are often deficient in some of these vitamins and minerals and, in many areas of the world the basic diet does not provide sufficient quantities. Thus, malnutrition, with respect to micronutrients like vitamin A, iron and zinc, affects >40% of the world's population. It is estimated that, of the 6 billion people in the world, 60-80% are Fe deficient, over 30% are Zn deficient and certain social groups do not receive sufficient Ca and Mg in their diets. Thus, the Copenhagen Consensus 2004 concluded that providing sufficient dietary micronutrients was among the most important research priorities for advancing global welfare.

Methods used to enable humans to get sufficient vitamins and minerals in their diets include supplementation (food and tablets) or fortification of food or crops by fertilisation. However, this has not been very successful, particularly in developing countries due to inadequate resource. A more sustainable approach is to cultivate genotypes that accumulate greater concentrations of vitamins and minerals in their edible tissues and/or have increased bioavailability of minerals, particularly when low in soils and fertilizers are expensive, by increasing the concentrations of promoter substances that enhance the uptake minerals by humans (e.g. carotenoids and tocopherols) and decreasing the concentrations of anti-nutrient compounds that inhibit the absorption of minerals (e.g. phytate and oxalates). Both promoter and anti-nutritional compounds are synthesized by the plant and their levels can be changed genetically.

The overall objectives of this coordinated research project (CRP) aims at utilizing the wealth of mutant germplasm in model crops, such as rice, tomato and barley, to understand and identify genes involved in the biosynthesis of nutritional quality enhancing factors, and develop efficient screening methods to facilitate the genetic improvement of nutritional quality. The goal is to transfer knowledge and technologies of beneficial mutants associated with nutritional factors from model crops to improve nutritional quality in other crops.

The results of the activities will be widely disseminated to provide a proof of concept on the use of ionomics, genomics and induced mutation in model crops to study genes affecting nutritional quality traits and their application in crop improvement. In the long term, induced mutants, genomic tools, and knowledge developed under this project will increase the efficiency and breeding for enhanced nutritional quality in the crops for the sustainable delivery of adequate levels of essential vitamins and minerals to reduce the negative health effects of vitamins and minerals deficiencies in Member States. This will ultimately lead to improved livelihoods and food security of the human populations that rely on these selected crops for sustenance.

Specifically the CRP will employ induced mutants, bioinformatics, functional genomics and ionomics, as well as appropriate genetic mapping populations, to identify molecular markers for marker-assisted selection (MAS) of nutritional quality traits. These traits are resistant starch (HR starch), increased carotenoid and tocopherol concentrations, and decreased phytate and oxalate concentrations. Mutants will be verified and assayed to confirm no detrimental effects on their mineral composition.

The specific objectives are to:

(1) Use new and existing mutants in rice, tomato and soybean with the target nutritional quality traits, to define target genes for manipulating these traits in other crops.

(2) Identify beneficial alleles for nutritional quality in the target crops.

(3) Identify the consequences of reduced levels of anti-nutrient factors on mineral content (Fe, Zn, Ca, and Mg).

(4) To generate mutant germplasm with reduced levels of oxalate in spinach, to understand and transfer knowledge of its biosynthesis to other leaf vegetables.

(5) Facilitate technology and germplasm transfer between member states, and establish a catalogue of beneficial mutants in biochemical pathways improving nutritional quality.

The expected research outputs (results) include the generation of the following resources by the end of the project:

(1) New mutant germplasm collections from elite varieties of spinach and target crops.

(2) Developed efficient phenotypic screening methods for resistant starch, increased carotenoids, decreased oxalate and increased tocopherols.

(3) Developed efficient genotypic screening methods for genes affecting synthesis of resistant starch, increased carotenoids, decreased oxalate, decreased phytate and increased tocopherols.

(4) Increased knowledge of the metabolic pathways and genes affecting phytate, carotenoids and tocopherol biosynthesis.

(5) Identification of genes affecting the production of resistant starch and oxalate crystals.

(6) Mutant lines with beneficial traits affecting resistant starch, increased carotenoids, decreased oxalate, decreased phytate and increased tocopherols and increased mineral concentration (Fe, Zn, Ca, Mg).

(7) Increased capacities in NARS to utilise induced mutations and genomic tool in breeding programmes.

(8) Published and disseminated research results.

The expected outcomes are threefold:

1) Availability of advanced mutant resources for nutritionists, breeders, geneticists.
2) Availability of efficient phenotypic and genotypic screening technologies and protocols for target nutritional quality enhancing factors.
3) Established research linkages between scientists in Member States to address genetic improvement of nutritional quality enhancing factors in crops.

Isolation and Characterization of Genes Involved in Mutagenesis of Crop Plants, D2.40.13

Technical Officer: P.J.L. Lagoda

This CRP started with a consultants meeting in 2008 in Vienna, Austria, gathering five experts, Drs. K. Riha (Austria), H. Puchta (Germany), A. Levy (Israel), B. Hohn (Switzerland), and A. Britt (USA), who were invited to present their work in the Concurrent Session number two of the International Symposium on Induced Mutations in Plants (ISIMP). They worked out the proposal for this CRP on Plant DNA Damage, Repair and Mutagenesis.

The first RCM was held in St. Louis, Missouri, USA in conjunction with the ninth International Plant Molecular Biology Congress (IPMB), 26–31 October 2009 Eight research contract holders (Argentina, Bulgaria, China, India, the Republic of Korea and Poland) and five agreement holders and consultants (Germany, Switzer-land and USA), participated in this CRP. The second RCM is planned to be held in the first half of 2011, ideally in conjunction with a relevant international meeting on DNA repair and plant breeding (yet to be determined). The yearly reports are being evaluated and the CRP is on track.

Although induced mutations has been widely used in crop breeding and basic research, the fundamental processes that lead to mutations and the molecular nature of mutations induced by physical mutagens remain largely unknown in plants. The rapid progress in functional genomics has provided unprecedented opportunities to study the mechanisms underpinning the response of plant genomes to physical and chemical mutagens. Recent advances in genomics have created an opportunity to apply our current knowledge of DNA repair and mutagenesis in model systems to crop plants. Furthermore, emerging reverse genetics tools enable direct analysis of consequences of various mutagenic treatments at molecular genetic levels.

Mutations can be obtained using different approaches. The classical approach consists in treating plant tissues with mutagenic agents (chemical or physical). Transposons or T-DNAs have also been widely used to produce mutants. Recently it has been demonstrated that plants defective in genes that control genome integrity display high rates of spontaneous mutation and can be used as sources of mutations. Heritable changes can also be caused by altering epigenetic imprints, using chemicals or mutants defective in epigenetic maintenance. Therefore, mutants defective in genes involved in plant mutagenesis, induced by physical or chemical mutagens, could be an excellent producer of mutations. While gamma rays are commonly used for mutation induction, new physical mutagens, such as ion beams, are emerging as powerful and unique mutagens for mutation induction.

Significant progress has recently been made in studies on the mechanisms underpinning the response of plant genomes to physical and chemical mutagens in the model plant Arabidopsis. Various genes have been identified to be involved in the biological process of response to external and internal DNA damages, although studies on genes responsive to physical mutagens are generally limited.

Understanding the biological control of the process of DNA damage, repair, and mutagenesis, is not only scientifically important, but also vital for manipulation of mutation induction using recently emerging molecular tools, and knowledge of molecular genetic features of induced mutation is necessary for the selection of proper mutagens suitable for specific purposes in mutation induction. However, we have:

(1) Little knowledge of the spectrum of mutations induced by different mutagens,

(2) Little knowledge of the variation in the spectrum across species, and

(3) Limited understanding of the impact of defects in DNA repair or damage response on the mutation spectrum.

In addition:

(4) Most knowledge of genes involved in repair of DNA is limited to model species and has not been applied to crop plants, and

(5) The manipulation of DNA repair processes has not, so far, been applied to mutation breeding.

The overall objective of this CRP is to understand the mechanisms of mutagenesis and molecular genetic features of induced mutation in plants, to provide the scientific basis for developing more efficient mutation techniques, and their proper use for crop improvement. This is translated into the specific research objective of isolating and characterizing genes involved in mutagenesis. Further finding out types of mutations induced by various physical mutagens in studied crop plants; and generating mutants deficient in DNA repair pathways in crops is one of the mandatory steps in achieving this objective. The results expected will facilitate assessment of their usefulness for efficiency enhancement of mutation induction.

The expected research outputs include:

(1) A Plant Mutagenesis Database, publicly accessible for all Member Sates. It will include plant homologs of DNA damage response and repair genes from a variety of species, and a list of existing mutants defective in these genes.

(2) Characterized homologs of genes involved in DNA repair and mutagenesis in crop plants.

(3) A better understanding of the spectrum (the molecular genetic feature) of mutations induced by various mutagens.

(4) Improved protocols for mutation induction and screening, i.e. proper mutation screening method for particular mutagens.

(5) Genetic resources that could be used for efficient mutation induction. This refers to mutant lines deficient in genes involved in mutagenesis.

Molecular Tools for Quality Improvement in Vegetatively Propagated Crops Including Banana and Cassava, D2.30.27

Technical Officer: B. Till (formerly C. Mba)

This CRP was initiated in 2004. The first RCM was held in Vienna, Austria 18–22 July 2005, the second in Thiruvananthapuram, Kerala, India, 5–9 February 2007 and the third in Vienna, Austria, 11–16 August 2008 in conjunction with the International Symposium on Induced Mutations in Plants (ISIMP). The fourth and final RCM is scheduled for 8–12 November in Brasilia, Brazil.

Preliminary highlights include first of all more than 20 high-standing scientific publications on the different relevant parts of this CRP. Molecular and cellular biology tools were developed to aid the understanding and exploitation of quality traits in banana and cassava, amongst these: expressed sequence tags (EST), simple sequence repeat (SSR) molecular markers, resistance gene analog (RGA) data on A, B, T, S, and O genomes of *Musa* (dessert and cooking banana, plantain) as well as genomic and proteomic approaches contributing to the identification of molecular tools linked to the inheritance of carotenoid content and starch quality in cassava.

A reference collection of DNA from 51 genotypes of wild and cultivated *Musa* (dessert and cooking banana, plantain) is now available for distribution through the Musa Genomics Resource Centre (MGRC, Olomouc, Czech Republic). Twenty-five genes potentially involved in host plant resistance to *Mycosphaerella fijiensis* (fungus that causes the banana black sigatoka disease) were identified. Novel post-harvest traits, extending the days to softness by two to four days over controls, and physiological traits, decreased density and with increased sized stomata were induced in *Musa* mutants. Ten anther-derived plants of *M. balbisiana* cv. 'Bichikala' (BB) are growing well in the field, with one having already produced a bunch that contains 27 hands with six fingers/hand. *Musa* mutants with significantly reduced plant heights, earliness of flowering, higher number of hands per bunch and increased number of bunches were identified from mutant populations generated through a coupling of embryogenic cell suspensions with gamma irradiation. Significant progress was made in the establishment of protocols for anther culture of diploid *Musa* and somatic embryos were developed successfully while work is ongoing with the regeneration of plants from these embryos. A banana germplasm collection representing the South Indian diploid banana cultivars was established at the Department of Botany, University of Kerala, Kariyavattom, Thiruvananthapuram, Kerala State, India. *Musa* mutants with modifications in stem height, bunch, hand, fruit, and peel weight and shelf-life were identified, mutants for tolerance to black sigatoka disease were identified under field conditions.

Advanced progress in the identification and validation of candidate genes involved in regulatory networks in cassava for differential starch composition and structure and pigmentation of roots was reported. A protocol was established for the regeneration and microtuberization of *in vitro* cultured cassava providing therefore the possibility for *in vitro* selection for root quality traits. Stable cassava mutants were developed with modifications resulting in the following important agronomic and quality traits: contents of carotenoids and dry matter, delayed post-harvest physiological deterioration (PPD) and waxy starch characteristics. Cassava mutants were identified for resistance to cassava mosaic disease, the most critical production constraint for the crop.

This CRP is coming to a close. On the global scale, seed propagated crops provide about 70% of the diet for the human population. However, the nutrition of a billion people relies on vegetatively propagated crops, particularly in tropical and subtropical regions. As sources of nutrition, cassava and banana play most important roles as staple foods. This CRP focused on the development and adaptation of molecular tools and induced mutations for significant and continuing quality improvement in vegetatively propagated crops. The final RCM will focus on reviewing and summarizing collected data and evaluating lessons learned from the CRP. Another output of the final RCM will be a timetable for the ultimate publication of protocols and guidelines to assist Member States in their work for the improvement of vegetatively propagated crops.

IAEA Coordinated Research Activities Web Site:

http://www-crp.iaea.org/html/forms.html

Technical Cooperation Field Projects

The Plant Breeding and Genetics subprogramme currently has technical responsibilities for the following technical cooperation projects that are managed by the IAEA's Department of Technical Cooperation.

Continuing Projects

Project Number	Country	Title and Objective(s)	Technical Officer
AFG/5/003	Afghanistan	Sustainable Increase in Crop Production in Afghanistan	Y. Lokko in collaboration with Soil and Water Management Section
ALG/5/023	Algeria	Protection of Date Palm Trees Against Bayoud Disease	M. Spencer
ALG/5/024	Algeria	Improvement of Cereals for Tolerance to Drought and Resistance to Disease	M. Spencer
ANG/5/006	Angola	Improvement of Food Crops Through Mutation Breeding and Biotechnology	M. Spencer
BGD/5/026	Bangladesh	Increasing Agricultural Production in the Coastal Area through Improved Crop, Water and Soil Management	M. Kinyua/Y. Lokko in collaboration with Soil and Water Management Section
BOT/5/003	Botswana	Mutational Improvement of Groundnut Varieties	M. Kinyua/M. Spencer
CAF/5/003	Central African Republic	Development of New Varieties of Cassava Through Mutation Breeding and Biotechnology Techniques	M. Spencer
COS/5/027	Costa Rica	Generation of Promising Strains of Beans through Induced Mutations in Calluses and Seeds to Increase Competitiveness	M. Spencer
CPR/5/017	China	Construction of Radiation-Induced Mutant Libraries and Function Analysis of Mutated Genes in Crop Plants	M. Spencer/Y. Lokko
ECU/5/023	Ecuador	Inducing Mutations in Agriculture with the Aid of Radiation	M. Spencer
ERI/5/004	Eritrea	Improving Crop Productivity and Combating Desertification	Y. Lokko in collaboration with Soil and Water Management Section
INS/5/035	Indonesia	Application of Nuclear Techniques for Screening and Improving Cash Crop Plants in Coastal Saline Lands	M. Kinyua/M. Spencer
INS/5/036 **Awaiting Financing**	Indonesia	Genetic Improvement of Artemisia Cina Using Irradiation Technique	M. Spencer/M. Kinyua
IRQ/5/017	Iraq	Optimization of Land Productivity Through the Application of Nuclear Techniques and Combined Technologies	M. Kinyua/P.J.L. Lagoda in collaboration with Soil and Water Management Section
JAM/5/010	Jamaica	Plant Breeding and Diagnostics Technologies	Y. Lokko

Project Number	Country	Title and Objective(s)	Technical Officer
MAR/5/018	Mauritius	Improvement of Banana and Tomato Varieties Through the Use of Nuclear Techniques for Mutation Induction and Biotechnology	M. Spencer
MYA/5/016	Myanmar	Development of Rice Varieties with Improved Iron Content/Bioavailability Through Nuclear Techniques	M. Kinyua/Y. Lokko
NIR/5/035	Nigeria	Adding Value to Root and Tuber Crops Through the Use of Mutation Induction and Biotechnologies	Y. Lokko
PAK/5/044	Pakistan	Improvement of Drought Tolerance in Chickpea Through Induced Mutations	M. Spencer
PER/5/030	Peru	Genetic Improvement of Quinoa and Kiwicha Using Mutation Induction and Biotechnology	Y. Lokko
QAT/5/002	Qatar	Developing Biosaline Agriculture in Salt-Affected Areas in Qatar	M. Kinyua/P.J.L. Lagoda in collaboration with Soil and Water Management Section
RAF/5/056	Regional Africa	Field Evaluation and Dissemination of Improved Crop Varieties Using Mutation Breeding and Biotechnology Techniques	M. Spencer
RAS/5/045	Regional Asia	Improvement of Crop Quality and Stress Tolerance for Sustainable Crop Production Using Mutation Techniques and Biotechnology (RCA)	Y. Lokko/M. Kinyua
RAS/5/048	Regional Asia	Mutation Induction and Supportive Breeding and Biotechnologies for Improving Crop Productivity (ARASIA)	P.J.L. Lagoda
RER/5/013	Regional Europe	Evaluation of Natural and Mutant Genetic Diversity in Cereals Using Nuclear and Molecular Techniques	Y. Lokko/M. Kinyua
SAF/5/010	South Africa	Development of New Maize and Sorghum Germplasm with Enhanced Nutritional Content	Y. Lokko
SAU/5/003	Saudi Arabia	Improving Fertilization under Saline Conditions for Sustainable Crop Production	M. Kinyua/P.J.L. Lagoda in collaboration with Soil and Water Management and Crop Nutrition Section
SEN/5/030	Senegal	Integrated Approach to Develop Sustainable Agriculture in Senegal	M. Spencer in collaboration with Soil and Water Management and Crop Nutrition Section
SIL/5/009	Sierra Leone	Improving Sorghum Productivity Through Nuclear and Biotechnology	M. Kinyua/Y. Lokko
SUD/5/030	Sudan	Increasing productivity of Selected Crops Using Nuclear Related Techniques	M. Kinyua/M. Spencer in collaboration with Soil and Water Management Section
TUN/5/023	Tunisia	Radiation-Induced Mutations for Improvement of Cactus	Y. Lokko
TUN/5/024	Tunisia	Development of Improved Strains of Olive Tree Through Mutation Breeding and Biotechnology	Y. Lokko

Project Number	Country	Title and Objective(s)	Technical Officer
UZB/5/004	Uzbekistan	Development of Mutant Cotton Breeding Lines Tolerant to Diseases, Drought and Salinity	Y. Lokko
YEM/5/008	Yemen	Introduction of Gamma Ray Irradiation Techniques for Agriculture Purposes	Y. Lokko
ZAI/5/016	Democratic Republic of the Congo	Mutation Techniques for Improving Nutritional and Medicinal Plants with a Curative Effect on Human Diseases and Alimentary Plants	M. Spencer
ZIM/5/013	Zimbabwe	Development of Drought Tolerant and Disease Resistant Grain Legumes, Phase I	Y. Lokko

Projects Started in 2009

Project Number	Country	Title and Objective(s)	Technical Officer
AFG/5/004	Afghanistan	Enhancing Crop Productivity through Mutation Breeding and Pest Control	Y. Lokko in collaboration with Insect Pest Control Section
BKF/5/007	Burkina Faso	Improving Voandzou and Sesame Based Cropping Systems through the Use of Integrated Isotopic and Nuclear Techniques	M. Spencer
BOL/5/018	Bolivia	Enhancing Food Security Using Conventional and Nuclear Techniques for the Acquisition of Climate-Change Tolerant Commercial Potato Seed	M. Spencer
COL/5/023	Colombia	Enhancing Mutagenesis and Biotechnology Used in the Improvement of Rice	Y. Lokko/M. Kinyua
COS/5/028	Costa Rica	Generating Promising Strains of Beans through Induced Mutations in Calluses and Seeds to Increase Competitiveness (Phase II)	M. Spencer
ECU/5/025 **Awaiting Financing**	Ecuador	Inducing Genetic Variability in Soya, Banana and Rice	M. Spencer
INS/5/037	Indonesia	Applying Nuclear Techniques for Screening and Improving Cash Crop Plants in Coastal Saline Lands	M. Kinyua/M. Spencer in collaboration with Soil and Water Management Section
INS/5/038	Indonesia	Using Induced Mutations to Improve Rice Productivity through a Hybrid Rice Breeding Programme	M. Kinyua/M. Spencer
INT/5/150	Interregional	Responding to the Transboundary Threat of Wheat Black Stem Rust (Ug99)	P.J.L. Lagoda/M. Kinyua
IVC/5/031	Cote d'Ivoire	Improving Plantain and Cassava Yields thought the Use of Legume Cover Crops	M. Spencer
KAZ/5/002	Kazakhstan	Improving Wheat and Maize Using Nuclear and Molecular Techniques	Y. Lokko/M. Kinyua
KEN/5/029	Kenya	Developing Appropriate Artemisia Varieties for Management of Malaria	Y. Lokko/M. Spencer
MAG/5/018	Madagascar	Improving Cereal Production (Rice and Maize) through Mutation Breeding for Tolerance/Resistance to Striga (*Striga asiatica*)	M. Spencer

Project Number	Country	Title and Objective(s)	Technical Officer
MAK/5/006	Macedonia, the Former Yugoslav Republic of	Improving Wheat, Barley and Triticale for Food and Feed in Drought-Prone Areas, Using Nuclear Techniques	Y. Lokko
MAL/5/028 **Awaiting Financing**	Malaysia	Enhancing the Production of Bioactive Compounds in a Local Herbal Plant by a Soilless Planting System and *In Vitro* Mutagenesis	Y. Lokko/M. Spencer
MYA/5/017	Myanmar	Studying Yield Improvement of Local Rice Varieties though Induced Mutation	M. Kinyua/Y. Lokko
MYA/5/019 **Awaiting Financing**	Myanmar	Developing Thermo-Insensitive (Cold-Tolerant) Green Gram Genotypes, Using Mutation Techniques	M. Kinyua/Y. Lokko
NAM/5/009	Namibia	Using Mutation Breeding and Integrated Soil Plant Management Techniques to Develop Sustainable, High Yielding and Drought Resistant Crops	Y. Lokko in collaboration with Soil and Water Management Section
NER/5/014	Niger	Improving the Productivity of Cowpea/Finger Millet Based Cropping Systems	M. Spencer in collaboration with Soil and Water Management Section
RLA/5/056	Regional Latin America	Improving Food Crops in Latin America though Induced Mutation (ARCAL CV)	M. Spencer/Y. Lokko
ROK/5/035	Republic of Korea	Using a Gamma Phytotron for Mutant Induction to Improve Food and Ornamental Crops	M. Kinyua/P.J.L. Lagoda
SAF/5/012	South Africa	Analysing the Level of Drought Tolerance in Mutant Gerplasms of Cowpea and Amaranthus Using Molecular Biotechnology	Y. Lokko
SEN/5/032	Senegal	Improving the Productivity of Jatropha Curcas Plantations in Semi-Arid Areas	M. Spencer
THA/5/049	Thailand	Increasing Productivity of Selected Crops Using Nuclear Related Techniques	Y. Lokko/M. Kinyua
TUR/5/025	Turkey	Using Molecular Techniques for Enhancing the Efficiency of Mutation Induction and Utilization of Mutants in Agriculture	M. Kinyua/Y. Lokko
URT/5/026	United Republic of Tanzania	Improving Rice Varieties through Mutation Breeding and Biotechnology in Zanzibar	M. Kinyua/Y. Lokko
UZB/5/005	Uzbekistan	Developing Mutant Cotton Breeding Lines Tolerant to Diseases, Drought and Salinity (Phase II)	Y. Lokko/P.J.L. Lagoda
YEM/5/010	Yemen	Using Induced Mutations and Efficiency Enhancing Biomolecular Techniques for Sustainable Crop Production	Y. Lokko
ZAM/5/026	Zambia	Improving Crop Varieties through Use of Nuclear Techniques	Y. Lokko in collaboration with Soil and Water Management Section

TC Projects Closed in 2009

Project Number	Country	Title and Objective(s)	Technical Officer
MYA/0/007	Myanmar	Nuclear Science and Technology Training Centre (Currently a Human Development Project)	Y. Lokko
SAF/5/008	South Africa	Mutant Amaranth, Bambara Groundnut and Cowpea with Enhanced Abiotic Stress Tolerance	Y. Lokko

For details, see the IAEA Technical Cooperation Programme's Website at:

http://www-tc.iaea.org/tcweb/default.asp

TC Project Highlights

Inducing Mutations in Agriculture with the Aid of Radiation (ECU/5/023)

The mission was performed by the Technical Officer, together with the valuable assistance of Dr. Augusto Tulmann Neto (Centre of Nuclear Energy Agriculture, University of Sao Paulo, Brazil), an expert on the application of mutation induction to crop improvement.

During this mission, meetings were held and field visits were organized to two of the main agricultural regions in Ecuador: Guayaquil – Boliche on the Western coastal region and Quito – Santa Catalina in the highland Andean regions 3000 m.

This project was initiated in 2007 and is progressing very well thanks to the fact that it is conducted in a very dynamic research institute: INIAP. This institute with a long history in agriculture development can proudly claim to have had a serious impact on the development of agriculture in the country; i.e. release of improved varieties of cocoa, rice, and maize, which are now major commercial commodities.

The institute is currently taking on the modern biotechnologies to enhance the efficiency of the breeding programmes. Specifically, plant tissue culture and molecular techniques are being applied to most of the crop breeding programmes. The first coordination meeting involved all the breeders and scientists in the TC project from Boliche and Quito and allowed a very thorough and clear overview of the expectations concerning the application of mutation induction. The technology is very well understood and embraced by all the scientists for improvement of Maize, Potato, Barley, Soybean, Rice and Banana. The targeted traits to be improved are:

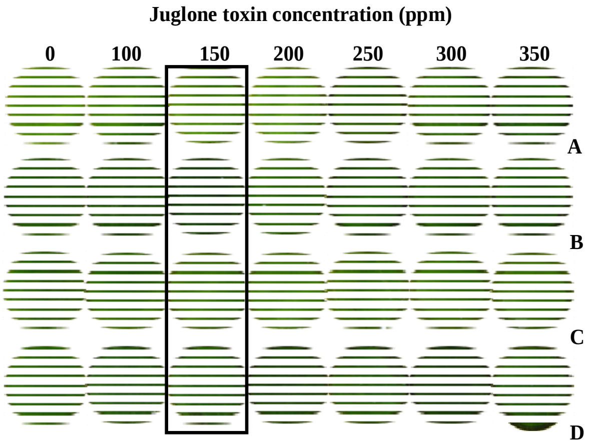
- Tolerance to water deficiency;
- Salinity;
- Nutritional quality; and
- Resistance to disease.

The various visits to rice fields and banana plantation demonstrated the excellent relationships between the INIAP breeders and the crops producers, who willingly offered the use of some of their cultivated areas as well as manpower to help in screening for positive mutant lines.

The visit with the FAO representative in Ecuador was extremely fruitful as it allowed a genuine sharing of information, which is the basis of cooperation between the two sister organizations and also allowed for the planning of future collaboration with the counterparts, including the participation in the national training course on 'The Use of Mutation Induction in Crops Improvement', to be organized in the fourth quarter of 2010.

Stop! No more massive pesticides!

Mutation derived banana plantlet micropropagated in vitro.



Screening test protocol for testing tolerance to Black Sigatoka. All Photos courtesy of Dr. Walter Oswaldo Reyes Borja, Ecuador

Madeleine Spencer
Technical Officer

Improving Crop Productivity and Combating Desertification (ERI/5/004)

The National Agriculture Research Institute (NARI), Halhale, is the main counterpart institution in this project. The project was initiated by the Institute's Division of Natural Resource Management, Soil Science Unit, and lead by a senior Soil Scientist together with a Senior Plant Breeder of the Division of Crop Improvement. In addition, there are research assistants and technicians in Agronomy, Plant Breeding and Soil Science. The main breeding objectives are to improve crop productivity of the major cereals sorghum and millet through the development of efficient breeding, water and fertilizer management practices in the arid and semi-arid areas of the country. Currently, average yields for millet and sorghum on farmers fields are very low, 3.5 and 6.5 ton/ha respectively, compared to potential desired yields of over 20 to 30 ton/ha. The major constraints responsible for these low yields are drought, pests, diseases and weeds, particularly the parasitic weed Striga, followed by the lack of improved varieties preferred by farmers and adequate seed delivery systems. Under its breeding programme the counterparts employ a range of breeding strategies including germplasm collections, introduction of exotic varieties through its collaborations with ICRISAT and ASARECA and recently induced mutations.

Under the ongoing project, the plant breeding component aimed to assist NARI in acquiring the technology and capacity in the use of induced mutation and biotechnology to develop improved varieties of sorghum and millet

Under the project, four staff members of the soil science unit of NARI have been trained in Soil Water Management and Crop Nutrition for a total of 23 months, and two staff of the plant breeding unit are being trained in a combined plant breeding and soil science programme for a total of 33 months. Radio sensitivity assays for the gamma irradiation on five elite local sorghum genotypes and two pearl millet genotypes were performed. The five sorghum varieties were: an improved variety ICSVII with good yield for multiple tillers (farmer desired trait) and four farmer preferred landraces Wedi Arba, Harriray, Hugurtay and Bezenay for improved yield, drought tolerance and resistance to Downey Mildew. The millet varieties Hagaz, a highly valued landrace for its taste with intermediate maturity (80-85 days), for earliness and disease resistance; and Kona an early maturing variety (70-75 days), to improve its yield and taste.

The M_1 seeds of gamma irradiated treatments of either, 250, 300, 400 and 500 Gy for sorghum and 150 and 250 Gy for millet were planted in 2009 and selfed to raise the M_2 seeds. A total of 1194 panicles of the two millet varieties and 2798 panicles of sorghum were harvested in 2009. For logistical reasons the M_2 populations and the advanced M_3 populations will be evaluated in batches over the next two years, during the main and off planting seasons. The M_2 sorghum population will be evaluated for desirable mutants and selfed to raise the selected M_3 lines.

The M_2 pearl millet populations will be evaluated on station in a farmer participatory study, and to avoid inbreeding, the desirable M_2 populations will be used in cross hybridization with the parents, breeder lines and mutants.

With long term support, the current project will make a significant impact in providing the farmers with improved varieties with increased yields and adaptability, the area of most concern being the availability of improved varieties seed delivery system.

The Institute's Crop Improvement Division has the national mandate for genetic improvement of cereals, legumes, oil and horticulture crops. The cereals and grain legumes breeding projects, including the TC project ERI/5/004, are being implemented by a dedicated team made up of a plant breeder and a number of assistant researchers. The commitment of these researchers and the National Agriculture Research Institute are highly commended. If the work continues at the current pace, and with adequate training for the research assistants, substantial progress will be made in obtaining the desirable mutant lines of sorghum and millet.

Yvonne Lokko
Technical Officer

News from Ug99

Responding to the Transboundary Threat of Wheat Black Stem Rust (Ug99) (INT/5/150)

Mutation activities target rust diseases with emphasis on Ug99 to contribute to an eventual *broadened gene base* for rust resistance. The IAEA project INT/5/150 will develop mutants that have resistance to Ug99, characterize the resistance, and apply DH techniques to advance generations. The expected flow of the programme is in main of four stages: M_0 to M_4. A large number of mutant lines (M_2+) will be generated by member countries, hence it is expected to test a minimum of 100 000 M_2's by limiting the countries contribution to 1-2 parent lines (M_2). Mutant lines from national programme (M_2+) will be tested at Moi University, where land and irrigation facilities were made available. The material will be exposed to natural rust infection (Ug99 +), but complimented with artificial inoculation. Selected resistant mutant (M_3+) will be tested at Njoro, where CIMMYT could provide assistance and national programmes will be able to visit and make selection as needed. Selected material will be repatriated to contributors for testing under local conditions for traits of interests as well as testing at rust hot spots that could be coordinated by ICWIP in CWANA

INT/5/150 has got off into a very good fast start. The participants are each doing their part: developing M_2s for screening at the secondary rust site. On the other hand preparations at the site have been going on well. Screening was carried out on differentials, four Kenyan varieties and barley material from Egypt.

The rust spores were suspended in distilled water with a few drops of wetting agent Tween-20 and applied to the spreader lines using a sprayer with a fine nozzle at booting stage. Inoculation was done in the evening just before or after dew formation to increase presence of free water necessary for spore formation and successful infection events.

Infection scores were taken four times at seven-day intervals heading stage using Cobb's modified scale (Peterson *et. al*, 1948) and coefficient of infection calculated by multiplying disease severity and a standard numerical notation for host response where:

Immunity (I) = 0.0, Resistant (R) = 0.2, Moderate resistant (MR) = 0.4, Mixed (M) = 0.6

Moderately susceptible (MS) = 0.8 and, Susceptible (S) = 1 (Rajaram *et al.*, 1988).

Results show that rust pressure is very high. All the barley lines, as well as the Kenyan varieties recorded high infection levels of between 40 and 100% disease score. The infection type was at best moderate susceptibility (MS). Most of the material screened showed susceptible (S) infection type.

Screening for stem rust resistance at the site at Eldoret Kenya

Infection for purposes of screening at seedling stage is carried out in a dew chamber

Dew chamber is essential to create good environment for rust spores to germinate and cause infection

This is one of the very desirable items acquired through the project. Other infrastructure being put into place is an irrigation system to cover two ha of land. This will accommodate germplasm for screening from the participating Member States. To-date about ten counterparts have requested for import permits indicating they have material ready to be exported to Kenya for screening. It is expected that soon the others will make their requests. Procurement for greenhouse facilities is also underway. This will greatly help in the confirmation of selections from the M_2s.

One of the more resistant barley lines screened at Eldoret on behalf of participating member state

Stem rust can be so devastating that wheat heads do not fill grain: no yields are expected from such a crop

Threshing of the heads, which will survive and fill grain will be a great challenge. Just to thresh an equivalent of 10% of what is expected if all counterparts send their screening materials, took the Kenyan team two weeks to thresh. This would convert to 75 days for the total material to be finished. The Technical Officer (TO) and the Programme Management Officer (PMO) of the project have understood the challenge, and it is expected that by the time we are threshing there will be five single-head threshers, purchased within the project. This will cut the time of threshing for all the material to just about a week.

The results present a clear indication that the stem rust variant is capable of parasitizing in most wheat and barley commercial varieties globally. There is need to screen more varieties from different parts of the world. A joint effort to identify and develop wheat and barley varieties resistant to this stem rust variant by combining biotechnological and conventional techniques should be strengthened.

As expected, participants have been impressed with the stem rust screening programme and have become aware of the eventual damage that this rust could cause if and when it reaches a country, where susceptible wheat varieties are grown. Linkages with national breeding programmes have been stressed by participants and hence country representatives will ensure direct communication with respective national breeding programmes.

Resounding success is anticipated from this interregional project.

Miriam Kinyua
Consultant

Developments at the Plant Breeding and Genetics Laboratory, Seibersdorf

Introduction

Avid readers of this newsletter will no doubt have registered a change in this section. Indeed, what was once the Plant Breeding Unit (PBU) is now the *Plant Breeding and Genetics Laboratory (PBGL)*. Underneath this name change is a restructuring that brings our group into NAFA (Nuclear Techniques in Food and Agriculture). This provides a streamlining of activities and even more synergy between our colleagues in the Plant Breeding and Genetics Section. In addition to such improvements, the lab is also excited about our new name as so much of our efforts are rooted in plant genetics. Another change during the past six months was less cause for joy; we said goodbye to our Unit Head, Dr. Chikelu Mba as he left Seibersdorf in March. While his presence in the lab is greatly missed, we are happy to retain close working relations as he begins his new post at FAO in Rome. We wish him all the best. Bradley Till has stepped in to serve as Acting Laboratory Head until the position is filled.

Our name, staffing, and management structure may have changed in the past six months, but our commitment to supporting Member States in their work to use induced mutations to develop superior crop varieties has not. We continue with our three pronged approach of training, technology development and adaptation, and providing technical services, while maintaining the goal of increasing the efficiency of using induced mutations. Below you will find highlights of our work.

Technology Development and Adaptation

A large portion of biological diversity on this planet is rooted in heritable differences in DNA sequence. Biological diversity has been evolving for billions of years through a process of mutation and natural selection. This slow process has been made rapid through mutation induction by treatment with ionizing radiation or chemicals. While less than 100 years old, induced mutations have had a big impact: more than 3200 mutant plant varieties are now registered. Like biological systems, technologies continue to evolve and we are in possession of new information and techniques that promise to help increase the impact of using induced mutations for crop improvement. How many, and what type of mutations are induced during a particular mutagenic treatment? What is the ideal population size needed to recover the desired phenotypes? How are reverse-genetic strategies best used for mutation breeding? What are the best platforms for screening mutants for biotic and abiotic stress resistance? Can we adapt the latest technologies so that they are suitable and cost-effective in laboratories in developing countries? These questions drive the adaptive R&D work of the laboratory.

Adaptation of reverse-genetic strategies for food security crops

For the past 80 years, mutagenesis has been used to develop improved crop varieties. Now that we are in what some call the ‘post-genomic’ era, how have things changed? Since the mid 20th century we have known that DNA was the heritable material, and for the last several decades our understanding of the function of genes has been rapidly growing. How do we best use this information for crop improvement? In the late 1990s, a reverse-genetic method known as TILLING (Targeting Induced Local Lesions IN Genomes) was introduced that combines mutagenesis with high-throughput mutation discovery. In this strategy, DNA libraries are developed of mutant populations that can be stored and screened for many years. With the right combination of mutation density and population size, multiple mutations in every gene in a genome can be obtained. Thus with TILLING, mutations can be targeted to any gene of choice, potentially providing a great efficiency gain in using induced mutations to develop novel traits in crops. Since inception, TILLING has been adapted to over 20 plant and animal species including many crops. We are seeking to adapt the method for less genetically tractable food security crops that are primarily vegetatively propagated. The models the PBGL uses for vegetatively propagated species are banana and cassava. We have finished with pilot screens of a population of EMS mutagenized triploid banana, and EMS and gamma irradiated cassava and are currently in the process of finalizing our data analysis.

Targeted reverse-genetic strategies are powerful approaches because the genes that control desired traits are known in advance. Interesting phenotypes found in reverse-genetic screens can be easily proven to be caused by disruptions in the target gene through standard genetic and molecular tests. The work to identify causative mutations from forward genetics or mutation breeding strategies is much harder. In theory, a single mutation in one of thousands of genes, small RNAs, or regulatory elements may be causing the trait of interest. The PBGL is engaged in evaluating the efficacy of a candidate gene screening approach to identify causative mutations in plants with well characterized phenotypes. We are currently screening gamma irradiated cassava samples that have previously been characterized to have defects in starch biosynthesis. 80 genomic DNA samples from irradiated and control plants were sent to the PBGL from Mr. Godwin

Amenorpe a graduate student at the University of the Free State, South Africa who is being mentored by Prof. Maryke Lubuschagne. Gene-specific primers in target regions have been designed and tested. Mutation discovery is carried out using the standardized protocols developed for TILLING and Ecotilling. This work is tied to previous work in the lab for the characterization of mutations in cassava that alter starch quality.

Lower cost assays for mutation discovery

The standard TILLING assay used by many labs relies on the use of a LI-COR DNA analyzer and expensive consumables. Such assays are therefore not affordable in all laboratories. As more plant scientists are moving towards mutation discovery assays to characterize their mutant populations, the PBGL has dedicated some efforts to developing lower-cost assays for mutation discovery. Two areas of focus for technology development by the PBGL have been methods for low-cost DNA extraction and mutation discovery. For many DNA extraction protocols, manual labour can be a major limiting factor on the amount of samples that can be extracted in a day. Another consideration is that many assays rely on the use of toxic chemicals. Commercial kits can bypass these problems but can cost up to 100 times more per sample than standard techniques. We are currently working on a manual method of DNA extraction that uses non-toxic materials and produces good quality and purity DNA suitable for mutation discovery assays**.** Protocol optimizations are in progress and initial experiments have yielded good quality DNA samples, but at a lower success rate than with a commercial kit. Further optimization of the protocol is required before it is suitable for distribution to counterparts in Member States.

Positive control kit for mutation discovery

At the request of Member States, we have developed a positive control kit which also serves as a lower cost alternative method for mutation discovery. This kit includes control DNA samples, gene-specific primers, celery juice enzyme extract containing the CEL I enzyme, enzyme buffer and a copy of the protocol (which can also be found on the mutant variety database website as described below). The kit allows labs that are having difficulties performing TILLING assays to test their methods and reagents against those used at the PBGL. The assay utilizes a standard agarose gel platform which is cheap and simple to perform. A kit for fluorescence detection by LI-COR analyzer is also available. This kit has been distributed to three labs in the past six months and has also been incorporated into two training courses.

Discovery of spontaneous mutations: Ecotilling

The characterization of natural nucleotide polymorphisms provides useful information on germplasm diversity, population genetics, and the range of potential alleles for breeding. Such information can also inform the choice of varieties for improvement via mutation breeding. In collaboration with counterparts at the KU Leuven, Belgium, and the Iwate Biotechnology Research Center, Japan, we have been engaged in ongoing activities for the characterization of nucleotide variation in 80 diploid and polyploid *Musa* accessions. The pilot phase of this work is now complete. Using 14 gene targets we have identified over 800 novel alleles in 80 accessions. We used the Ecotilling method for polymorphism discovery that employs enzymatic mismatch detection and fluorescent detection of DNA. We estimate the method is between 94 and 98% accurate and is suitable for the co-discovery of polymorphisms from the *acuminata* and *balbisiana* genomes. This work has been submitted for publication. Based on this work we are expanding our study to develop more streamlined methods for the characterization of *Musa* germplasm.

Comparative studies of different mutagens on seeds propagated crops: Case of wheat, barley and sorghum

A majority of officially released mutant crop varieties listed the Mutant Variety and Genetic Stocks (MVGS) (http://mvgs.iaea.org/default.aspx) have been produced by gamma irradiation. This exemplifies the utility and power of physical mutagens for crop improvement. While gamma irradiation has been incredibly powerful, new restrictions on the shipment of cobalt 60 sources may result in lower usage of this method. To evaluate if other sources can produce comparable results, we recently initiated a preliminary study to compare X- and gamma-ray irradiation. Greenhouse based assays have been performed with rice and we are currently evaluating field performance of mutagenized barley, wheat and sorghum. Our main objective is to produce optimized protocols for X ray treatment and subsequent early evaluation (at the seedling stage) of mutagenized plants.

Comparative phenotypic screening for drought tolerance in Musa accessions

Climate change and variations threaten the productivity of most important food crops across the world. The envisaged extreme increases in drought, soil salinity and several nutrient deficiencies are predicted to have serious consequences on world food crop supply. Therefore, there is an urgent need to develop strategies on how to make crops more resilient to environmental stresses. An understanding of the mechanisms for tolerance to abiotic stresses will be pivotal to achieving this aim. The understanding of the underlying mechanisms for tolerance to stress and the consequent development of tools for characterizing crop germplasm f will be pivotal for the efficient generation of crop genotypes with inherent capacities to tolerate extremities of weather conditions.

Bananas, including the dessert and cooking types, belong to the genus *Musa* of the family Musaceae and constitute one of the most important dietary components for millions of people in the world. They are grown principally in the tropical regions of the world by resource-challenged small scale farmers under low-input agricultural systems and are also important as major export commodity for a large number of countries in the developing world. A combination of under-developed agricultural systems and variable environmental conditions in producing countries makes this crop even the more vulnerable to potentially rapidly changing climatic conditions. We have been working on different screening techniques for drought with the goal of the establishment of an integrated efficient screening protocol. The project aims at the elucidation of the drought tolerance profiles of a set of 42 *Musa* genotypes used globally as the reference accessions in the crops genetic improvement and genomics, as well as a set of induced mutants serving as a pilot platform for adapted technologies.

A combination of novel physiological and molecular biology assays has been conducted in order to select the most efficient and fast assay for drought screening. In collaboration with the Soil Science Unit of ABL, the carbon isotope discrimination (CID) method was also evaluated for its efficacy in the identification of stress tolerant and susceptible *Musa* genotypes. The CID method had proved to be an effective tool for drought tolerance screening.

Protocols, guidelines and services

A new section of Mutant Variety and Genetic Stocks (MVGS) database has been developed specifically for protocols, guidelines and information on services and materials provided by the PBGL (http://mvgs.iaea.org/LaboratoryProtocals.aspx). In addition to protocols and advice on topics such as inducing mutations and mutation discovery, we also provide information and protocols for our positive control kit for TILLING and Ecotilling. Also on this site are instructions and request forms for the two major services we provide: genotyping and mutagenesis. This represents a streamlining of our services as scientists need only to go to this site and download standardized request forms that are submitted along with samples directly to the PBGL for processing. We continue to update this site and welcome requests for additional content.

Services in Support of Activities in Member States

The irradiation service requests from Member States that were executed from January to June 2019 are summarized below. In all, 11 Member States requested support with irradiating the propagules of 13 different plant species. Out of these, eight were food crops; two were ornamental plants. There was one request for an industrial crop and one for a model plant for functional genomics studies. A further nine requests for radio-sensitivity tests were fulfilled and performed on 43 different crop varieties.

Summary of irradiation services provided by PBGL between January and June

Member State	Crop species
Eritrea	• Sorghum *(Sorghum bicolor)*
Germany	• Sunsatia cranberry • Sunsatia lemon
Jordan	• Wheat • Barley
Madagascar	• Rice
Poland	• Barley
Senegal	• *Jatropha curcas* • *Arachis hypogea* (peanut)
Spain	• *Euphorbia lathyris*
Switzerland	• *Nicotiana tabacum*
United Republic of Tanzania	• Rice
Yemen	• Wheat • Lentil • Barley • Fenugreek • Garlic
Zambia	• Common bean *(Phaseolus vulgaris)*

Genotyping services include AFLP analysis of mutant varieties and DNA sequencing of identified mutations. Since the last newsletter, this work included analysis of samples from internal R&D projects, research fellowship projects (TC projects), other agricultural laboratories within the Joint Programme (Animal Production and Health Laboratory) and external requests direct from Member States (Ghana and Senegal). A total of 3488 samples were analyzed in the first half of 2010.

Training and Human Capacity Building

The PBGL remained active in the area of individual and group training in the last six months. The highlights include the following:

Individual trainees

A total of six individual trainees, made up of five fellows and one intern, joined the PBGL between January and June 2010 and worked on specific research projects under the tutelage of laboratory staff members.

Fellowships

Five fellows from five countries were supported by the IAEA Technical Cooperation (TC) Programme to enhance capacities in areas where skills critical for the implementation of TC projects were lacking in their home institutes. Details of the Fellows are provided in the following table:

Name	Country	Areas of training	Period
Ms. Lydia RAZAFINIRINA	Madagascar	• Induced mutations for improvement of rice, • Somatic embryogenesis for Malagasy rice varieties, • Ploidy analysis.	February – May 2010
Ms. Babita DUSSORUTH	Mauritius	• Induced mutations for improvement of banana, • Ploidy analysis, • Genetic diversity study of different accessions of banana varieties from Mauritius.	April – June 2010
Mr. Kennedy K. MUIMUI	Zambia	• Induced mutations for improvement of beans, • Characterization of putative mutants using molecular techniques.	February – May 2010
Mr. Papa Madiallack DIEDHIOUS	Senegal	• Induced mutations for improvement of *Jatropha* and peanut, • Somatic embryogenesis, • Characterization of putative mutans using molecular techniques.	February –April 2010
Mr. Efrem Gherezghiher TECLE	Eritrea	• Induced mutations for improvement of sorghum, • Characterization of Eritrean accessions, • Mineral analysis.	February – July 2010

Interns

One intern from Argentina worked on specific aspects of induced crop mutagenesis facilitated by biotechnologies.

Name	Country	Areas of training	Period
Mr. Federico FROESTL	Argentina	Screening cassava mutagenic population developed for TILLING technology adaptation for starch quality.	August 2009 – January 2010

Group fellowship

A group fellowship has been organized for the participants of the IAEA Regional Technical Cooperation Project RAS/5/048, Mutation induction and Supportive Breeding and Biotechnologies for Improving Crop Productivity. This project brings together the participating Member States of the Cooperative Agreement for Arab States in Asia for Research, Development and Training Related to Nuclear Science and Technology (ARASIA) for pooling resources in the use of induced crop mutations to address common themes.

Eight fellows from six countries were working on induced mutations in crop improvement, cell and tissue biology techniques, and use of molecular genetic techniques for the enhancement of crop improvement and germplasm management.

Name	Country	Areas of training	Period
Ms. Ekhlas AL-KAABI	Iraq	Group Fellowhsip	December 2009 – January 2010
Ms. Nawal ALHAJAJ	Jordan	Group Fellowhsip	December 2009 – January 2010
Mr. Ahmad EL BITAR	Lebanon	Group Fellowhsip	December 2009 – January 2010
Mr. Abdullah ALSALMAN	Saudi Arabia	Group Fellowhsip	December 2009 – January 2010
Mr. Saad ALZAHRANI	Saudi Arabia	Group Fellowhsip	December 2009 – January 2010
Mr. Basel SALEH	Syria	Group Fellowhsip	December 2009 – January 2010
Mr. Ali SALEM	Yemen	Group Fellowhsip	December 2009 – January 2010
Mr. Abdulwahab ALSALEHI	Yemen	Group Fellowhsip	December 2009 – January 2010

Scientific visitors

During the first half of 2010, the PBGL welcomed four scientific visitors from Member States.

Name	Country	Areas of training	Period
Mr. Tala GUEYE	Senegal	Induced mutations in crop improvement and related biotechnologies	1 – 5 February 2010
Ms. Khadidiaton Ndir NDOYE	Senegal	Induced mutations in crop improvement and related biotechnologies	1 – 5 February 2010
Mr. Evans KAIMOYO	Zambia	Induced mutations in crop improvement and related biotechnologies	1 – 5 February 2010
Mr. Kalaluka L. MUNYINDA	Zambia	Induced mutations in crop improvement and related biotechnologies	6 – 16 April 2010

Plant Breeding and Genetic Laboratory Staff Travel to the Member States

Mr. B. Till

- Was the keynote scientific speaker at the Biotechnology and Biological Science Research Council (BBSRC) China-UK workshop on TILLING and associated technologies, in Beijing, China, 12-16 April 2010.
- Served as a lecturer and demonstrator at the Regional Training Workshop on Training on DNA Sequencing and TILLING (TUR/5/025/01/01), in Ankara, Turkey, 26-30 April 2010.

Ms. J. Jankowicz-Cieslak

- Gave a talk on Integrating Reverse-genetics and Drought Phenotyping for *Musa* during the Vienna Plant Net Meeting in Vienna, Austria on 12 March 2010.

TILLING and Ecotilling positive control kit

The Plant Breeding Unit in Seibersdorf has developed a positive control kit for TILLING and Ecotilling that it is now available for researchers in Member States upon request. The kit contains genomic DNA with known nucleotide polymorphisms, gene-specific oligonucleotide primers, buffers and enzymes for mutation and polymorphism discovery. Along with the protocols, examples of high quality data produced with these materials are provided to serve as a reference point for assay optimizations.

Visit of the newly elected Director General, HE Amano Yukiya (天野之弥), to the Joint FAO/IAEA Agriculture and Biotechnology Laboratory (ABL), Seibersdorf, 17 December 2009

Just after printing Plant Breeding and Genetics Newsletter, No. 24, we had the pleasure and honour to host the newly elected Director General of IAEA, HE Yukiya Amano, at the Plant Breeding and Genetics Laboratory for a visit to the Joint FAO/IAEA ABL. HE Amano previously served as a Japanese diplomat and international civil servant for the United Nations and its subdivisions. Born in Kanagawa Prefecture, he started his studies at the University of Tokyo in 1968. After graduating from the Faculty of Law, he joined the Ministry of Foreign Affairs in 1972. He specialized in the international disarmament issue and nuclear non-proliferation efforts. In 1973–1974, he studied at the University of Franche-Comté and in 1974–1975, at the University of Nice, France. HE Amano held different posts in the foreign ministry such as the Director of the Science Division and Director of the Nuclear Energy Division in 1993. During his foreign service, he was posted in the Embassies of Japan in Vientiane, Washington and Brussels, in the Delegation of Japan to the Conference on Disarmament in Geneva and was Consul General of Japan in Marseille. In 2002, he was appointed Director-General for Arms Control and Scientific Affairs, and in 2004, he was appointed Director-General of the Disarmament, Non-proliferation and Science Department. In these positions, he was involved in international negotiations such as the Nuclear Non-Proliferation Treaty extension, the Comprehensive Nuclear-Test-Ban Treaty, the Biological Weapons Convention verification protocol, amendment of the Convention on Certain Conventional Weapons and the International Code of Conduct against Ballistic Missile Proliferation. He represented Japan as a governmental expert on the UN Panel on Missiles and in the UN Expert Group on Disarmament and Non-proliferation Education, both in 2001. In 2005, HE Amano served as the ambassador from Japan to the IAEA. From September 2005 to September 2006, he served as the Chairman of the IAEA Board of Governors. During this time, the IAEA and its Director General Mohamed ElBaradei received the Nobel Peace Prize. HE Amano represented the IAEA as the chairman at the Nobel Prize award ceremony held in December 2005. In September 2008, the Japanese government announced that it had nominated HE Yukiya Amano to be the next Director General of the IAEA. On 2 July 2009, he was elected by the Board of Governors as Director General for the IAEA in the sixth round of voting. On 3 July 2009 all 145 IAEA Member States formally appointed HE Yukiya Amano 'by acclamation'. On 1 December 2009, he began his first term as Director General of the International Atomic Energy Agency, and amongst one of his first activities as DG, he visited the Joint FAO/IAEA's Programme's Laboratories, a great honor, indeed.

Pierre J.L. Lagoda
Section Head

Chikelu Mba
Unit Head

Reports

DIR-NAFA (AGE) and Section Heads (SHs) Training on FAO Results Based Management, Programming and Budgeting, Budapest, Hungary, 29 January 2010

DIR-NAFA (AGE): Q. Liang

SHs: P.J.L. Lagoda, G. Viljoen, M.-L. Nguyen, J. Hendrichs and D. Byron

The Director of the Joint FAO/IAEA Division and the five Section Heads (Plant Breeding and Genetics, Soil & Water Management and Crop Nutrition, Animal Health and Production, Food and Environment Protection, Insect Pest Control) participated in the Facilitated Work Planning Orientation Training Session on Results Based Management (RBM) organized by FAO in Budapest, Hungary. As the Division of Nuclear Techniques in Food and Agriculture (NAFA) is a Joint IAEA/FAO Division, Programme and Budget submissions have to be completed for both organizations. The one-day training did not only involve staff from NAFA but also regional and national FAO staff members from Europe and Central Asia. At the invitation of the Assistant Director General (ADG), Ms. Maria Kadlecikova, staff also visited the FAO premises nearby where the FAO Regional Office for Europe and Central Asia and the Shared Services Centre, which carries out administrative services for the FAO European, Middle Eastern and African regions in fields such as management, human resources policy, finances, travelling and acquisitions are located. The training session described the essential principles, concepts and elements integral to results-based management and operational planning. The session dealt with validating and improving the current set of Unit Results, formulating a meaningful set of Unit Result indicators, identifying products, services and activities for each of the Unit Results, estimating costs and evaluating the feasibility of Unit Results and reviewing work plans and budgets across FAO's strategic framework in preparation for work plan approval. The programme included presentations, group and plenary discussions and group work. Even though the IAEA introduced Results Based Management in the year 2000, this one-day training was extremely important for staff of the Joint Division to comply with the requirements of the FAO Programme and Working Budget for 2010–2011. The facilitator was excellent and the content of the course was extensive. This training session was also a good opportunity to tighten the links between the Joint Programme and the FAO Regional Offices for Europe and Central Asia. Our colleagues will visit the FAO/IAEA Agriculture and Biotechnology Laboratory (ABL) at Seibersdorf as a follow-up.

FAO International Technical Conference on Agricultural Biotechnologies in Developing Countries: Options and Opportunities in Crops, Forestry, Livestock, Fisheries and Agro-industry to Face the Challenges of Food Insecurity and Climate Change (ABDC-10), Guadalajara, Mexico, 1–4 March 2010

Technical Officer: P.J.L. Lagoda

The ABDC-10 was hosted by the Government of Mexico and co-sponsored by the International Fund for Agricultural Development (IFAD). This conference brought together about 300 policy-makers, scientists and representatives of inter-governmental and international non-governmental organizations from 68 different countries, including delegations nominated by 42 governments. It was dedicated to 'agricultural biotechnologies', a term covering a broad range of biotechnologies used in food and agriculture for a variety of different purposes such as the improvement of plant varieties and animal populations to increase their yields or efficiency; characterization and conservation of genetic resources; plant or animal disease diagnosis; vaccine development; and improvement of feeds and the safety of foods. The Conference was cross-sectoral, covering crops, livestock, forestry, agro-industry and fisheries and aquaculture. As one of the major results, the conference agreed on the key elements necessary to put agricultural biotechnologies at the service of the developing world: increased investments, international cooperation and effective and enabling national policies and regulatory frameworks. Thus, every country should have a clear national vision for the role of biotechnologies, and examine the options and opportunities within the context of national economic, social and sustainable rural development and environmental strategies and objectives. This vision should be built in a process involving all stakeholders and be supported by effective communication and participation strategies to encourage and promote public involvement and empowerment in the decision making. The conference agreed on the need for effective and enabling national biotechnology policies and regulatory frameworks that facilitate the development and use of appropriate biotechnologies in developing countries. It also agreed on increased national investments by developing countries in the development and use of biotechnologies to support in particular, smallholders and producers. According to the participants, stronger partnerships among and within countries such as South-South and regional alliances, public-private and research partnerships for sharing experiences, information and technologies, will facilitate development and use of biotechnologies. In turn, making agricultural biotechnologies accessible to developing countries and ensuring that they respond to the particular needs of small scale farmers and producers will require the support of FAO and other relevant international organizations and donors. This is particularly needed to strengthen national capacities in the adaptation, development and use of appropriate agricultural biotechnologies directed to the needs of smallholders and producers in developing countries. Both the build-up and organization of the Conference were hallmarked by a strong spirit of partnership and collaboration through the involvement of different stakeholders, including several intergovernmental and non-governmental organizations and regional fora, which organized/supported parallel sessions at the conference. These included the Consultative Group on International Agricultural Research (CGIAR), the Global Forum on Agricultural Research (GFAR), the International Centre for Genetic Engineering and Biotechnology (ICGEB), the World Bank, the UN Conference on Trade and Development (UNCTAD), the UN Industrial Development Organization (UNIDO), the World Intellectual Property Organization (WIPO), the International Union for Conservation of Nature (IUCN), Oxfam International, the International Federation of Agricultural Producers (IFAP), the Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA), the Asia-Pacific Association of Agricultural Research Institutions (APAARI), the Forum for Agricultural Research in Africa (FARA), the Inter-American Institute for Cooperation on Agriculture (IICA) and the Technical Cooperation Network on Plant Biotechnology in Latin America and the Caribbean (REDBIO). The plenary sessions during the four days were dedicated to issues such as how to target agricultural biotechnologies to the poor; how to enable research and development (R&D) in agricultural biotechnologies; and how to ensure that the benefits of R&D are accessible in developing countries. IFAD, the CGIAR and the Secretary of the International Treaty on Plant Genetic Resources for Food and Agriculture also gave plenary presentations about relevant aspects of their work. Participants at ABDC-10 were encouraged to contribute to active discussions in the 27 parallel sessions, dedicated to sector-specific, regional or cross-sectoral issues, the majority of which were organised by different inter-governmental organizations and international NGOs. A 'Knowledge Share Fair' saw the participation of 22 different organisations, including international and national research institutions, intergovernmental and non-governmental organizations. In the framework of this Knowledge Share Fair, a seminar was organized, consisting of an introductory presentation on ‘The Magic of Mutation Induction’ and a Question/Answer session on ‘Nuclear Techniques in Food and Agriculture’ in the evening of 3 March. The entire conference was webcast on the FAO Web site for the four days. The conference distilled the following recommendations to International Organizations regarding the deployment of agricultural biotechnologies in developing countries:

- perform R&D on behalf of developing countries that lack the necessary resources
- assist national public R&D (especially long term projects, e.g. in plant breeding programs)
- assist in capacity development
- facilitate access to technologies (i.e. be a meeting place for developing and developed countries for technology dissemination and exchange)
- be responsive to the needs of the small farmers, e.g. support farmers’ participation
- establish and/or support broad regional and global projects addressing concerns beyond national/regional capacities
- support the establishment of enabling policies in agricultural biotechnologies

Genetic Stocks Management Meeting, Bologna, Italy, 28–29 April 2010

Technical Officer: P.J.L. Lagoda

The meeting objectives were to compile and review the procedures for managing, accessing and accessioning genetic stocks in publicly available collections and to make recommendations on streamlined management of genetic stocks focused on the following crops: rice, wheat, barley, maize, chickpea, cassava and Musa. The meeting then turned to discussions about policies and best practices for managing and making genetic stocks available to researchers and breeders through the global system (CGIAR + other genebanks). Specifically, the definition of 'genetic stocks (GS)' was the center of some controversy (type of GS), the ideal size of collections, and for what purposes GS are conserved, used and distributed (policy for distribution, IP issues as far as GMO were concerned), how best to document GS (Databases). More technical discussions related to the maintenance of genetic stocks: which form and under which conditions are GS maintained, the needed and ideal back ups and long term preservation, quality control - what is needed, when and who should do it (staff, infrastructure/space needed to maintain GS, costs). On the operative level, the distribution of GS as per role of the provider, quantity of seeds/distributed materials, regenerations and again quality control issues were the primers for some intense brainstorming sessions. As a result, some recommendations were distilled:

(1) An inventory needs to be made of where genetic stock collections are located and who is responsible for the distribution and maintenance of these stock collections for all key crops

(2) A letter should be prepared and distributed through the newsletters of the crop groups to highlight the urgency of inventorying and safeguarding genetic stock collections

(3) User communities should be a key part of the effort to inventory, collect and safeguard genetic stock collections for target crops

(a) The crop curators at the CG Centers should appoint a responsible person for crops under their care

(b) The CG Center curators know the crop communities and should work with them to identify the appropriate collections

(c) The CG system is not a traditional entry point for genetic stocks but they should play a key role in the preservation of these valuable genetic tools

(4) CG Centers should actively support the conservation of genetic stocks of value and importance as they are tools which can further the mission of sustainably increasing or improving livelihoods

(5) A database system is needed which can accommodate data from genetic stocks collections.

(a) This database should accommodate data from multiple crops so that comparisons between collections from different crops is facilitated

(b) The database needs to identify and list descriptors of use for genetic stock collections to keep terms in common

(6) A group such as this should meet more often to ensure proper identity, prioritizing and care for genetic stock collections.

Announcements

The 28th International Horticultural Congress – IHC, Lisbon, Portugal, 22–27 August 2010

The world conference on horticultural sciences is under the patronage of the International Society for Horticultural Science (ISHS). The theme of the Congress, Science and Horticulture for People, emphasizes horticulture's scientific components and interactions with scientists, producers, consumers and society-at-large. People are also the target of horticulture for development. Lisbon is a magical city on the Atlantic coast of Portugal, with a delightfully cool-summer Mediterranean climate. The city, home of fado, fine dining and monuments, is close to major growing regions of horticultural crops in the Iberian Peninsula.

For further details, visit:

http://www.ihc2010.org/content.asp?page=welcome

Alumni Corner

English version

Many thanks to IAEA

The objective of this report is to demonstrate the great direct and indirect influence to my scientific and professional career from various types of support I have received from the Joint FAO/IAEA Programme through the Plant Breeding and Genetics Section.

It all started with the Cooperative Project between the Brazilian National Nuclear Energy Commission (CNEN) and UNDP, developed at the 'Centro de Energia Nuclear na Agricultura' (CENA, Piracicaba, SP, Brazil) from 1972 to 1991, managed by the IAEA. In this project, CENA received a large investment, used to obtain equipment, scientific exchanges and supplies. Thanks to these resources, there was a significant development of the Radiation Genetics Section of CENA (currently the Plant Breeding Laboratory), where I was hired in 1972 to work with mutation induction applied to plant breeding, initially to work with common beans (*Phaseolus vulgaris* L.). To deepen my knowledge in the field, I was trained in mutation induction in Puerto Rico and Costa Rica in 1972/1973, which was sponsored by an IAEA fellowship. From 1973 through 1975, the IAEA sent every year an expert for two months from Sweden (Dr. Stig Blixt), who greatly contributed to the development of our research activities in the induction of mutations, using seeds. For the same purpose, another expert (Dr. F. Koo) from Puerto Rico came to CENA. It is worth mentioning that all my IAEA sponsored trainings were complemented with the conclusion of my Masters and Doctoral degrees in plant breeding, conducted at the Genetics Department of ESALQ/USP, under the supervision of Prof. Akihiko Ando, a pioneer in the use of mutation induction in plant breeding in Brazil. In 1977, another IAEA fellowship allowed a three-month training period in Sweden with Dr. Stig Blixt with pea mutants. Results from these trainings and exchange programmes with IAEA experts were used to write my Doctoral thesis (1975) and 'Livre Docência' (1979).

As there was great interest in application of mutation induction in vegetatively propagated plants in Brazil, the IAEA sponsored several scientific visits for training in Sweden, Italy, Portugal and the Netherlands in 1980. Afterwards, we hosted two experts from the Netherlands and Italy through the IAEA to help establishing this field of research.

To follow the development of the use of mutation induction based on *in vitro* plant culture and to adopt this method in Brazil, I received a three-month training at Seibersdorf, Austria in 1985 under an IAEA fellowship.

Another scientific visit was conducted in 1990 under the auspices of the IAEA to Austria, Israel, France and Italy to visit projects and discuss adopted methodologies in mutation induction of seeds, clonally and *in vitro* propagated plants.

Besides training and scientific exchange, during 14 years I was awarded with IAEA Research Contracts (RC) to develop work with mutation induction in legumes, cereals and vegetatively propagated plants. The RCs also offered the opportunity to visit various Latin American countries, and to participate in important Symposia organized by the IAEA in Vienna.

The large increase in activities allowed the enlargement of the Plant Breeding Laboratory of CENA with the arrival of Dr. Antonio Figueira, responsible for implementing a well-established molecular biology laboratory.

As a result of all the training, scientific visits, participation in Research Contracts, IAEA expert exchange and participation in scientific meetings, I gained extensive experience in the use of mutation induction in breeding of seed- and vegetatively propagated plants. I was responsible or collaborated in projects using *in vivo* or *in vitro* mutation induction of crops such as rice, soybean, wheat, tomato, tobacco, papaya, citrus, grape, black pepper, apple, pineapple, banana, fig and ornamentals. My experience was also used during the years in the organization or participation in seven specialization courses in Brazil and 10 abroad, besides many invitations to give talks or lectures in undergraduate and graduate courses. I was the National Coordinator of ARCAL in Brazil for many years. Currently, I teach a post graduate course on the use and induction of mutations *in vitro* and *in vivo* in plant breeding at CENA/USP, where I have also advised various graduate (Master and Doctoral students) and undergraduate students, mostly in mutation induction.

I have been an IAEA expert for *in vivo* and *in vitro* mutation induction for many countries in Europe, Latin America and Africa, and certainly because of all these activities, in 1998 I had the honor to be elected the Director of CENA (1998 to 2002), and currently I am the Director of one of the three Divisions of CENA. In 1999, I was responsible for a project in which CENA purchased a Gamma Cell irradiator, which has been intensively used for *in vivo* and *in vitro* irradiations by public and private institutions.

Therefore, the Plant Breeding and Genetics Section of the IAEA had a great direct and indirect influence in my academic and professional development during my 38 years of activities at CENA, and because of that I hereby express my gratitude and deep thanks!

Associate Professor Dr. Augusto Tulmann Neto
Laboratório de Melhoramento de Plantas
(Plant Breeding Laboratory)
CENA/USP, Brazil

Portuguese original version

Muito obrigado à IAEA

O objetivo deste relato será o de demonstrar a grande influência, direta e indireta para a minha carreira científica e profissional, dos vários tipos de auxílios que recebi da Joint FAO/ IAEA por meio da Seção de Genética e Melhoramento de Plantas.

De inicio deve ser destacado o convênio desenvolvido (Projeto BRA/71/556) de 1972 a 1991 no Centro de Energia Nuclear na Agricultura (CENA-Piracicaba-SP Brasil) entre a Comissão Nacional de Energia Nuclear do Brasil (CNEN) e a UNDP, o qual foi administrado pela IAEA. Por meio deste convênio o CENA obteve grande volume de recursos os quais foram utilizados para a compra de equipamentos, intercâmbio científico e materiais de consumo. Graças a isto houve um grande desenvolvimento da Seção de Radiogenética do CENA (atualmente Laboratório de Melhoramento de Plantas), na qual fui contratado para trabalhar em 1972 para desenvolver trabalhos de indução de mutação no melhoramento de plantas, inicialmente com a cultura de feijão (*Phaseolus vulgaris* L.). Para aprofundar conhecimentos na área, em 1972/73 por meio de uma bolsa de estudos concedida pela IAEA, recebi treinamento em indução de mutação em plantas propagadas por sementes em Porto Rico e Costa Rica. Nos anos de 1973 a 1975, a IAEA enviou por dois meses cada ano um expert da Suécia (Dr. Stig Blixt) que muito contribuiu para o desenvolvimento de nossas atividades em indução de mutação em sementes. Com a mesma finalidade recebemos depois desta data a visita de um outro expert, Dr. F.Koo, de Porto Rico, com o qual havia feito treinamento em 1972. Fato que deve ser destacado, foi a complementação desses treinamentos recebidos da IAEA, com o mestrado e doutorado que realizei na área de melhoramento de plantas no Departamento de Genética da ESALQ/USP, sob a orientação do Prof. Akihiko Ando, um dos introdutores do uso da indução de mutação no melhoramento de plantas no Brasil. Em 1977, obtive nova bolsa de estudos da IAEA, para permanência por 3 meses na Suecia, no Instituto no qual trabalhava o Dr. Stig Blixt, no qual recebi treinamento envolvendo genética com mutantes de ervilha. Os resultados de trabalhos feitos durante esses treinamentos e ou intercâmbio com esses especialistas foram utilizados para minhas teses de doutoramento (1975) e Livre Docência (1979).

Como no Brasil havia interesse na aplicação de indução de mutação em plantas de propagação vegetativa, a IAEA forneceu-me em 1980 uma nova bolsa de estudos a qual foi utilizada para treinamento na Suecia, Itália, Portugal e Holanda. Posteriormente, recebemos no CENA por meio da IAEA, para auxiliar o desenvolvimento desta área de pesquisas, dois experts da Holanda e um da Itália.

Para acompanhar o desenvolvimento do uso de indução de mutação envolvendo cultura de tecidos e utilizar esta técnica no Brasil, recebi em 1985 nova bolsa de estudos da IAEA, para treinamento, por período de 3 meses, em Seibersdorf-Austria.

Para observar projetos e discutir a metodologia empregada com os pesquisadores responsáveis por trabalhos em indução de mutação em plantas propagadas por sementes, de propagação vegetativa e uso de cultura de tecidos, a IAEA possibilitou-me em 1990 uma visita científica a Austria, Israel França e Italia.

Além destes treinamentos e intercâmbio com experts por meio de 3 Research Contracts da IAEA recebi durante 14 anos recursos para o desenvolvimento de pesquisas em indução de mutação em leguminosas, cereais e plantas de propagação vegetativa. Além desses recursos, tais RC proporcionaram a oportunidade de viagens para vários países da América Latina e participação em importantes Simpósios organizados pela IAEA em Vienna.

O grande aumento das atividades tornou possível a ampliação do Laboratório de Melhoramento de Plantas, com a incorporação do Dr. Antonio Figueira, o qual foi o responsável pela implementação de um bem montado laboratório voltado a Biologia Molecular.

Como resultado de todo este treinamento recebido, visitas científicas, participação em Research Contract, intercâmbio com experts da IAEA e participação em reuniões científicas, pude acumular grande experiência em indução de mutação no melhoramento de plantas propagadas por sementes ou de propagação vegetativa. Fui responsável ou colaborei com pesquisas envolvendo uso de indução de mutação *in vivo* ou *in vitro* em culturas tais como arroz, feijão, soja, trigo, tomate, tabaco, mamão, citrus, videira, pimenta do reino, maça, abacaxi, banana, figo e ornamentais. Tal experiência também foi utilizada com o passar dos anos, na organização ou participação em 7 cursos de especialização realizados no Brasil e 10 no exterior além de convites para ministrar dezenas de palestras ou aulas em cursos de graduação e pós-graduação. Exerci durante vários anos atividades como Coordenador Nacional do Projeto ARCAL no Brasil. Tenho atualmente a responsabilidade de ministrar no CENA disciplina de Pós-Graduação sobre Uso e indução de mutação *in vitro* e *in vivo* no melhoramento de Plantas, e em tal instituição tenho orientado dezenas de estudantes de iniciação científica, mestrado ou doutorado, e maioria deles desenvolveram pesquisas com indução de mutação.

Tenho atuado como expert da IAEA na área de indução de mutação *in vivo* e *in vitro* em países da Europa, América Latina e Africa e seguramente devido a esta soma dessas atividades, em 1998 tive a honra de haver sido eleito Diretor do CENA (1998 a 2002) e atualmente sou Diretor de uma das 3 Divisões que compõem a instituição. Em 1999 fui o responsável por um projeto no qual o CENA adquiriu um irradiador gamma cell e tal irradiador tem sido intensamente utilizado por instituições oficiais e privadas para irradiações *in vivo* e in *vitro*.

Portanto, a Seção de Plant Breeding and Genetics da IAEA nos 38 anos de atividades que exerço no CENA, teve influência direta e indireta em meu desenvolvimento profissional e acadêmico e por isto expresso minha gratidão e meu muito obrigado.

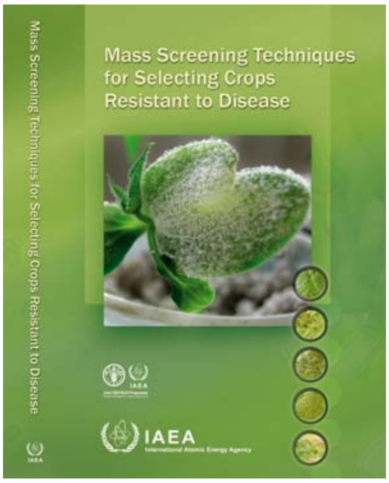
Prof. Associado Dr. Augusto Tulmann Neto
Laboratório de Melhoramento de Plantas
CENA/USP

Publications

Staff Publication in the Field of Plant Breeding and Genetics

Mass Screening Techniques for Selecting Crops Resistant to Diseases

Edited by M. Spencer and A. Lebeda



Abstract

The post 'green revolution' era of the 20th century with the numerous success stories in various parts of the world has fostered a new 'gene revolution' i.e. a more science based agronomy approach in order to warrant food security for an increasing world population in the actual context of global warming, climate variability and change, the sustainable intensification and improvement of crop production systems regarding the selection of resistance and/or tolerance to stresses should be more than ever the primary goal in plant breeding. This new vision of agriculture prompts the scientific community together with the policy makers to reconsider and redefine agriculture practices for the Third Millennium. Among the multiple threats to agriculture, the increase of temperature associated with the increased humidity, due to displacement of rain isohyets will have a tremendous impact on all living creatures including microbial pathogens. The FAO/IAEA Joint Division in NAFA/IAEA, by promoting the use nuclear techniques including mutation induction as tools for breeding new improved crop varieties has contributed to enhance the impact of this science based approach in agriculture in developing countries. The IAEA has provided several hundreds of agricultural research institutes in Member States the capacity in terms of human resources as well as in provision of high performance germplasm through the development of several thousands of interesting mutants in crop plants. These mutants with desirable characteristics have either been directly released for cultivation or used in hybridisation programmes with other mutants and/or cultivars to develop new elite genotypes/cultivars. The success of these mutation breeding programmes relies on the selection of 'positive mutant lines' bearing the trait of interest. On the other hand, it is clear now that many wild/original plant genetic resources vital for the present and future agricultural development are threatened by genetic erosion due to the spread of modern commercial agriculture. This, combined with the climate changes mentioned above, has increased the vulnerability of existing crops to pests, pathogens and environmental stresses. This situation led the FAO International Technical Conference on Plant Genetic Resources, the World Food Summit Plan of Action and the International Treaty on Plant Genetic Resources for Food and Agriculture to strongly recommended that increased attention be given to building capacities to characterize, evaluate, improve and use plant genetic resources in a sustainable manner. Subsequently IN the FAO/IAEA Joint Division, a project was designed under the Subprogramme 2.1.1: Sustainable Intensification of Crop Production with the overall objective to develop early mass screening techniques to obtain banana plants tolerant to fungal diseases. In fact, the selection of the proper mutants has been the bottleneck in all mutation induction breeding programmes and the difficulty is even enhanced when it comes to screening for disease resistance. It is therefore absolutely necessary to establish reliable, rapid and high throughput screening techniques for disease resistance in local germplasm as well as in putative mutant lines. Recent project represent a continuation of some previous IAEA activities which were focused on induced mutations against plant diseases. Thus, papers presented in this book highlight increasing cross-cutting techniques using plant tissue culture, irradiation-induced mutation, molecular markers technology, isolation and characterization of mutants for the selection of disease resistant lines. The compilation of this volume has demanded an active participation of a number of breeders, plant physiology and phytopathology specialists. The formidable task of correspondence with authors of the chapters in this volume and the splendid cooperation among participants in the preparation of the manuscripts have led to very extensive and well documented chapters in accordance with the guidelines provided by IAEA publications. As editors, we would like to acknowledge our thanks to Drs. Pierre J.L. Lagoda and Manoela Miranda for discussions, suggestions and critical reading of the manuscript. The book contains a total of 20 chapters. The first two chapters review the impact of induced mutations and in vitro selection on breeding of disease and pest resistant cultivars. Various aspects must be considered while choosing the most suitable *in vitro* selection technique for a given plant-pathogen interaction. The choos-

ing of selection agent is very much dependent on their origin, method of preparation, content of active substances, and effective use for screening or in vitro selection. Furthermore the book covers radiation-induced mutations, in vitro and in vivo mass screening methods developed for fruits, legumes, vegetables, and tuber crops, and with greater emphasis on banana (Musa spp.) having 6 chapters owing to it as a source of nutrition, food security and great impact on socio-economic aspects. Methods of screening against the most deadly disease of banana (Black sigatoka and Fusarium wilt), which are of great threat to banana sustainable production, are well covered. The book also includes various screening techniques (in vitro selection against Black sigatoka in banana by using fungal toxin juglone) for the selection against the deadly diseases of crops such as vegetables (melon and other cucurbits, onion, tomato, lettuce), industrial crops (black pepper), legumes (chickpea, peas, soybean), fruits (apple, pine apple), and tropical crops (cassava, cowpea, maize, and yam). This book will be of great value to international scientists and plant breeders engaged in disease resistance mutation breeding and biotechnology programmes for sustainable food production, enhancing food security, nutrition, and employment generation. All manuscripts were reviewed by the competent reviewers and revised accordingly.

2010

Chapter 8 - Methodologies for Generating Variability - Part 4: Mutation Techniques

M. Maluszynski, I. Szarejko, C.R. Bhatia, K. Nichterlein and P.J.L. Lagoda, pp 159-194. in: Plant Breeding and Farmer Participation, S. Ceccarelli, E.P. Guimarães and E. Weltzien (Editors)

Introduction – Economic Impact of Induced Mutations

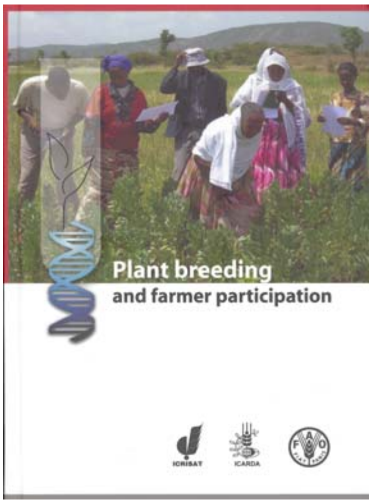
The use of various mutagens to generate genetic variation in crop plants has a history almost as long as that of conventional breeding. Induction of variability by irradiation of barley seeds with X rays was already demonstrated in 1928 by Stadler. The application of this phenomenon has come a long way to become a real tool, not only in crop breeding but also in basic research on the plant genome, its structure and function. Breeders were the first to recognize the potential of induced mutations through analogy with spontaneous mutants, often selected as new plant types in many crops, from cereals to apples, not to mention ornamental and decorative plants. Many mutants with desired traits were selected in the second or third generation after mutagenic treatment and subsequently released as new cultivars after agronomic evaluation in regional and national trials. These or other mutants developed with mutations in desired traits, even though not released as new cultivars, have been used in cross-breeding programmes as a source of particular alleles, often allelic to the spontaneous ones, but in a desired genotype. Among them were sourced for characters such as short stature and lodging resistance; disease resistance; oil quality; and increased nitrogen fixation. These mutated genes are especially valuable as the best currently grown cultivar was usually selected for mutagenic treatment. A desired mutation in a good genetic background is a very attractive component in breeding programmes. This approach is much simpler and faster than crossing with an exotic source, and it is one of the main reasons for the wide use of mutated alleles in the breeding of numerous species.

ISBN 978-92-5-106382-8

BOOK REVIEW

Plant Breeding and Farmer Participation

Edited by S. Ceccarelli, E.P. Guimarães and E. Weltzien



This book provided a comprehensive description and assessment of the use of participatory plant breeding in developing countries. It is aimed at plant breeders, social scientists, students and practitioners interested in learning more about its use with the hope that they all will find a common ground to discuss ways in which plant breeding can be beneficial to all and can contribute to alleviate poverty.

Foreword

Participatory Plant Breeding (PPB) originated in the early 1980s as part of a movement promoting the concept of participatory research, in response to criticisms of the failure of post-green-revolution, experiment-station-based research to address the needs of poor farmers in developing countries. Rooted in debate over the social consequences of the narrow focus of the scientific type of research, PPB gained recognition as an activity mostly promoted by social scientists and agronomists based in anti-establishment non-governmental organizations (NGOs). In consequence, rather than being perceived from the beginning as an additional option available to breeders, PPB for a long time had the image of being one of two contrasting types of plant breeding, with PPB being more ‘socially correct’ than conventional plant breeding.

Even now, nearly thirty years later, this view is still common. Few professional breeders accept that farmers can be full partners in a plant breeding programme, even though everyone agrees that it was farmers that domesticated crops about 10 000 years ago and, in some regions of the world, continued to modify and manipulate them to the present day. Even before the re-discovery of Mendel’s laws of inheritance, the work of a number of amateur breeders become an inspiration for Darwin’s theories. In several respects, the relationship with farmers on which PPB is based is similar to the ways in which plant breeders worked with producers in North America and Europe in the early twentieth century. At that time it was commonplace for breeders to spend time interacting with producers, and to test new materials collaboratively in farmers’ fields in order to understand what producers considered to be desirable traits for an improved variety. However, the combination of industrialization of agriculture and formal training for plant breeders created a gap between breeders and farmers, a gap that was exported to developing countries in the post-war era. As the profession of plant breeding lost the habit of interacting closely with producers, concern for how to address farmers’ needs and constraints fell by the wayside. PPB revived this as a central issue, because by the late 1970s it was increasingly evident in developing countries that post-green-revolution ‘improved’ varieties were too often failing to satisfy farmer requirements and were being shunned.

Today there is widespread recognition that the conventional package of new varieties and external inputs, while successful in the more favourable production areas, has often failed to benefit small scale farmers in marginal areas. As a result, the vital role of PPB as an additional strategy is better understood. Experience has taught that PPB is complementary to conventional plant breeding rather than an alternative type of plant breeding. Demand for a complementary approach has expanded considerably because of pressure to ensure the relevance of research to poor farmers and their diverse agricultural systems, and because PPB allows selection for the specific adaptation required for such a diversity of target environments. Today, about 80 participatory breeding programmes are known worldwide, involving various institutions and various crops. In 2000, an international review of plant breeding research methodologies concluded that PPB should be an ‘organic’ part of every plant breeding programme aimed at benefiting small scale farmers in difficult, high-risk environments. In fact, traditional farming and low-input systems, including organic agriculture, are a very heterogeneous population of target environments and not easily served by centralized, conventional plant breeding.

The book demonstrates that PPB is in essence no different from conventional plant breeding, being based on the very same principles of Mendelian, quantitative and population genetics, and therefore has complemented the traditional approach to plant breeding with a number of chapters addressing issues specifically related to the participation of farmers in a plant breeding programme.

The authors of the various chapters have been carefully selected to represent three groups of scientists: the first comprises internationally recognized experts in genetics as related to plant breeding, and in the various aspects of plant breeding (from general methodological issues to more specific issues, such as breeding for resistance to biotic and abiotic stresses, high yield potential, molecular breeding and genotype x environment interactions); the second group is represented by professional breeders who have actually practiced participatory plant breeding with a number of different crops and in a number of socially and climatically different areas, using the range of methods presented by the first group; and, finally, the third is represented by a group of scientists with specific expertise in areas not usually covered in classical plant breeding books, such as variety release mechanisms, seed diffusions, institutional issues associated with PPB, and intellectual property rights. A chapter documenting the impact that participatory plant breeding has had after about thirty years of practice has been chosen to be the logical conclusion of the book.

The book is aimed at plant breeders, social scientists, students and practitioners, with the hope that they all will find a common ground to discuss ways in which plant breeding can be beneficial to all and can contribute to alleviate poverty.

Finally, we would like to acknowledge everyone who has, directly or indirectly, contributed to the book: the CGIAR Participatory Research and Gender Analysis Program (PRGA) for the initial idea of producing such a book, the contributors of the chapters for sharing their scientific experience and for enduring a number of revisions of their respective chapters, Dr. P.G. Rajendran for his help in the initial editorial efforts and Directors-General of our Institutions for their continuous support. Final editing and preparation for publication was done by Mr. Thorgeir Lawrence.

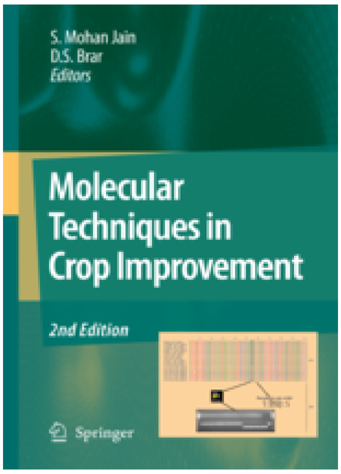
ISBN 978-92-5-106382-8

Non-IAEA Publication in the Field of Plant Breeding and Genetics

Molecular Techniques in Crop Improvement

2nd Edition

S.M. Jain and D.S. Brar (Eds.)



About this book

The first edition of this book, Molecular Techniques in Crop Improvement (2002) provided comprehensive information on the latest tools and techniques of molecular genetics and applications in crop improvement, and highlighted molecular genetics from the perspective of plant breeders. Since then, major advances have been made in molecular tagging of genes/QTLs governing complex agronomic traits, identification of candidate genes and in applying marker assisted breeding for tolerance to biotic and abiotic stresses and quality traits. Recent advances in transgenic technologies, genome sequencing and functional genomics offer tremendous opportunities to support plant breeding programs. We have covered new developments in molecular biology and their potential applications in plant breeding in this second edition. The book has a total of 31 chapters and divided into 4 sections: (A) Plant breeding in the genomics era, (B) Molecular markers and their application, (C) Genomics, and (D) Transgenic technologies. The book features major topics, which are QTL analysis, comparative genomics, functional genomics, bioinformatics, DNA marker technology automation, gene-based marker systems, application of molecular markers for tolerance to biotic and abiotic stresses as well as in germplasm conservation, gene pyramiding, gene silencing, TILLING, CISGENESIS, microarray, metabolomics, proteomics, transcriptomics, microRNAs, marker-free transformation, gene targeting/homologous recombination, and genetic engineering. This book will be especially useful to scientists engaged in molecular genetics and plant breeding. It will also be a valuable book for the graduate and post graduate students specialising in crop science, genetics, plant breeding and biotechnology.

ISBN 978-90-481-2966-9

Hardcover

2009

Publications within Coordinated Research Projects (CRPs) 2009

Effects of Mutagenic Agents on the DNA Sequence in Plants (D2.40.11)

Contreras Rojas M., Pérez J.C., Ceballos H., Baena D., Morante N. and Calle F. (2009) Introduction of inbreeding and analysis of inbreeding depression in eight S_1 cassava families. Crop Sci. 49:543-548.

Rice Starch Quality Research and Utilization. Edited by Wu D.X. and Shu X.L. China Agriculture Publishing House. May 2009.

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van der Vyver C. (2009) Submited paper: 'RDA, RAPD and SSR analysis of radiation-induced genome alterations in *Vigna unguiculata'*, Annals of Botany.

Wang M., Caetano-Anollés G. (2009) The evolutionary mechanics of domain organization in proteomes and the rise of moduarity in the protein world. *Structure* 17:66-78.

In press:

Dimitrova A., Todorovska E., Christov N., Stoilov L., Atanassov A. and Gechef K.. Molecular characterization of ionizing radiation-induced mutational alterations in barley. Genetics and Breeding.

Gecheff K., Manova V., Bonchev G., Kitanova M., Vlahova M. and Stoilov L. Position-specific effects in the action of mutagenic agents on the chromosomes of barley (*Hordeum vulgare* L.) Genetics and Breeding.

Sanchez, T., A. Rosero, A.P. Tofiño, K. Denyer, A. Smith, H. Ceballlos, N. Morante, and J.C. Pérez. (2009). Induction and identification of useful mutations for root quality traits in cassava. FAO/IAEA International Symposium on Induced Mutations in Plants. 12-15 August, Vienna, Austria.

Pyramiding of Mutated Genes Contributing to Crop Quality and Resistance to Stress Affecting Quality (D2.30.25)

Chen H., Qian N., Guo W.Z., Song Q.P., Li B.C., Deng F.J., Dong C.G. and Zhang T.Z. (2009) Using three overlapped RILs to dissect genetically clustered QTL for fiber strength on chro.24 in Upland cotton. Theor Appl Genet. 119: 605-612.

Song X.L. and Zhang T.Z. (2009) Identification of Quantitative Trait Loci Controlling Plant Architectural Traits in Cotton. Plant Sci. 177: 317-323.

Wu C.T., Zhou B.L. and Zhang T.Z. (2009) Isolation and characterization of a sterile dwarf mutant in Asian cotton (*Gossypium arboretum* L.). J Genetics & Genomics 36: 343-353.

Ivanova B. and Bojinov B. (2009). Identification of QTLs for fiber quality in a Bulgarian cotton breeding collection. Genetics and Breeding (Blg.), accepted.

Mondal S. and Badigannavar A.M. (2009). Molecular diversity and association of SSR markers to rust and late leaf spot resistance in cultivated groundnut (*Arachis hypogaea* L.). Plant Breeding. DOI:10.1111/j.1439-0523.2009.01635.x.

Badigannavar A.M., Mondal S. and D'Souza S.F. (2009) Success story of radiation based induced mutagenesis in groundnut (*Arachis hypogaea* L.). International Conference on Peaceful Uses of Atomic Energy, Sept 29 – Oct 1, 2009, New Delhi. Vol .II Pp: 544-545.

Do Khac Thinh, Nguyen Thi Cuc, Hung Phi Oanh & Dao Minh So et al, (2009) Mutation Breeding and Socio-economic Effectiveness in Southeastern & Highlands 2009, Proceedings of National Conference of Vietnam on Application of Nuclear Techniques, organized, 20-22th August, 2009, Nha Trang, Vietnam.

Guzy-Wrobelska J., Nawrot M., Janiak A., Adamska K., Matyszczak I. and Szarejko I. (2009) Molecular mapping of genes responsible for root architecture in barley. The 4th Conference of Polish Society of Experimental Plant Biology. Experimental Plant Biology. Why not?! 21-25 September, 2009 Kraków.

Park H.H., *et al.*, (2009). Analyzing seed protein in a high lysine barley mutant using proteomics approach. Spring Annual Meeting of The Korea Society of Crop Science, pp. 133.

List of Plant Breeding and Genetics Section's Publications

Plant Mutation Reports

Year	Edition	Contents (a sampling of the papers are listed below):	Reference No.
2008	Vol. 2, No. 1	• Induced genetic variability in kacholam • Mutagenesis of guar • Cocoyam radiation sensitivity • Virus resistant rice variety • Cold tolerant mutant rice • Proton radiation • Tomato adapted to low water supply • Increasing crossability of mungbean	ISSN 1011-260X
2007	Vol. 1, No. 3	• Mutation breeding and genetics in Korea • Genetic enhancement of groundnut • Virus resistant banana • Ion beams implantation on wheat • Trombay mutant groundnut varieties • Lodging tolerant rice variety	ISSN 1011-260X
2006	Vol. 1, No. 2	• 30 years rice mutation breeding and genetics • Mutant groundnut varieties in Bangladesh • Shortening durum wheat plants • Seedless mutant sweet orange • Colorful chrysanthemum mutations • Radiosensitivity of cassava *in vitro* culture	ISSN 1011-260X
2006	Vol. 1, No. 1	• Rice mutation breeding in China • Long grain aromatic rices and induced mutations • Significant contribution of mutation techniques to rice breeding in Indonesia • Use of induced mutants in rice breeding in Japan • Katy deletion mutant populations • Rice mutation breeding in Vietnam	ISSN 1011-260X

Mutation Breeding Newsletter and Reviews

Year	Edition	Contents (a sampling of the papers are listed below):	Reference No.
2005	No. 1	• High yielding mutants in cotton • Drought resistant tomato • Groundnut resistant to foliar diseases • Lodging resistant glutinous rice • First ever oilseed mustard mutant	ISSN 1011-260X

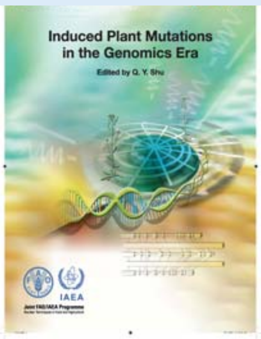
Mutation Breeding Review (published until 2004)

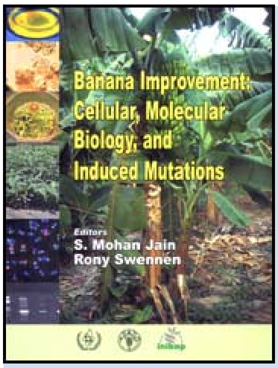
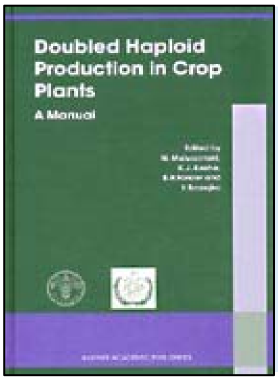
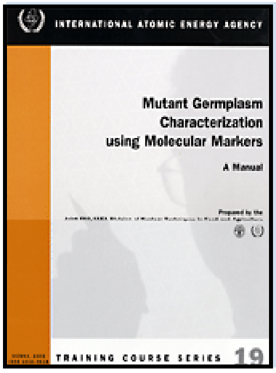
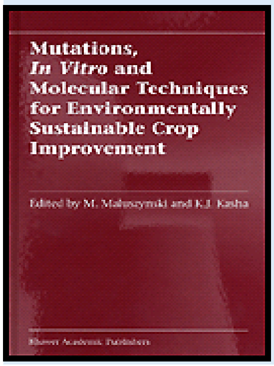
Year	Edition	Title	Reference No.
2004	No. 14	Officially released mutant varieties in China	ISSN 1011-2618
2001	No. 13	Grain legume cultivars derived from induced mutations, and mutations altering fatty acid composition	ISSN 1011-2618
2000	No. 12	Officially released mutant varieties — The FAO/IAEA database	ISSN 1011-2618
1999	No. 11	Oilseed cultivars developed from induced mutations and mutations altering fatty acid composition	ISSN 1011-2618

Mutation Breeding Newsletter (published until 2003)

Year	Edition	Title	Reference No.
2003	No. 46	Index Issue No. 21-44	ISSN 1011-260X
2001	No. 45	Issue No. 45	ISSN 1011-260X
1999	No. 44	Issue No. 44	ISSN 1011-260X

Books

Year	Edition	Title	Book Cover	Reference No.
2009		Induced Plant Mutations in the Genomics Era		ISBN-978-92-5-106324-9

Year	Edition	Title	Book Cover	Reference No.
2004		Banana Improvement: Cellular, Molecular Biology, and Induced Mutations		ISBN 1-57808-340-0
2003		Doubled Haploid Production in Crop Plants — A Manual		ISBN 1-4020-1544-5
2002	Training Course Series No. 19	Mutant Germplasm Characterization using Molecular Markers — A Manual		ISSN 1018-5518
2002		Mutations, *In Vitro* and Molecular Techniques for Environmentally Sustainable Crop Improvement		ISBN 1-4020-0602-0

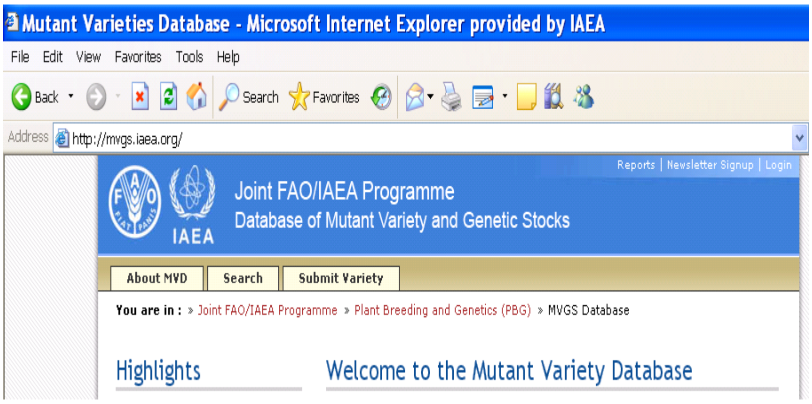
Technical Documents

Year	Type of Publication	Title	Reference No.
2009	IAEA-TECDOC-1615	Induced mutation in tropical fruit trees	ISBN 978-92-0-1027-09-2
2006	IAEA-TECDOC-1493	Mutational analysis of root characters in food plants	ISBN 92-0-103106-8 ISSN 1011-4289
2004	IAEA-TECDOC-1384	Low cost options for tissue culture technology in developing countries	ISBN 92-0-115903-X ISSN 1011-4289
2004	IAEA-TECDOC-1426	Genetic improvement of under-utilized and neglected crops in low income food deficit countries through irradiation and related techniques	ISBN 92-0-113604-8 ISSN 1011-4289
2003	IAEA-TECDOC-1369	Improvement of new and traditional industrial crops by induced mutations and related biotechnology	ISBN 92-0-101603-4 ISSN 1011-4289
2001	IAEA-TECDOC-1195	Sesame improvement by induced mutations	ISSN 1011-4289
2001	IAEA-TECDOC-1216	Induced mutations in connection with biotechnology for crop improvement in Latin America	ISSN 1011-4289
2001	IAEA-TECDOC-1227	*In vitro* techniques for selection of radiation induced mutations adapted to adverse environmental conditions	ISSN 1011-4289
2001	IAEA-TECDOC-1253	Radioactively labeled DNA probes for crop improvement	ISSN 1011-4289
1998	IAEA-TECDOC-1010	Application of DNA based marker mutations for improvement of cereals and other sexually reproduced crop plants	ISSN 1011-4289
1998	IAEA-TECDOC-1047	Use of novel DNA fingerprinting techniques for the detection and characterization of genetic variation in vegetatively propagated crops	ISSN 1011-4289
1997	IAEA-TECDOC-951	Improvement of basic food crops in Africa through plant breeding, including the use of induced mutations	ISSN 1011-4289
1996	IAEA-TECDOC-859	Use of mutation techniques for improvement of cereals in Latin America	ISSN 1011-4289
1995	IAEA-TECDOC-800	*In vitro* mutation breeding of banana and plantains	ISSN 1011-4289
1995	IAEA-TECDOC-809	Improvement of root and tuber crops in tropical countries of Asia by induced mutations	ISSN 1011-4289
1994	IAEA-TECDOC-781	Mutation breeding of oil seed crops	ISSN 1011-4289

For details on IAEA Publications, visit: http://www-pub.iaea.org/MTCD/publications/publications.asp

New FAO/IAEA Database of Mutant Varieties and Genetic Stocks

Welcome to our new FAO/IAEA Database of Mutant Varieties and Genetic Stocks! At the moment, we just completed construction of the part for Mutant Variety Database, which is still in the process of information up-dating. We will add the other part for Mutant Genetic Stocks in due time. The new database has improved over the FAO/IAEA Mutant Variety Database in many ways. We are working to make the new database as the global information source of mutant varieties and mutant genetic stocks, as well as activities and events related to plant mutation breeding and research.



The key feature of the database is that you can register your mutant varieties from your desktop. For this purpose, you need first register an account; then you will be authorized to submit or edit a mutant variety.

We would greatly appreciate your support by registering your mutant variety in our database. Once the variety is registered, it will have its own 'homepage' (see below). Therefore, you can use it as an important platform to showcase your new varieties (The introduction of this variety may be shown in local language).

Please visit the website http://mvgs.iaea.org and send us your valuable suggestions and comments regarding the structure and content of this database. Please also send us other information, related to plant mutation breeding and mutant varieties, genetic stocks; we may post them on the website.

YOU MAY STILL SEND US INFORMATION ON YOUR MUTANT VARIETY AND WE WILL UPLOAD THEM INTO THE SYSTEM, IF IT IS DIFFICULT FOR YOU TO DO SO.

IMPORTANT!

AUTHOR'S GUIDELINES FOR MANUSCRIPT SUBMISSION TO PLANT MUTATION REPORTS

Articles will be indexed and abstracted in CABI!

Scope

Plant Mutation Reports (PMRs) publishes (mini) reviews, short communications and complete research papers in all areas of plant mutation research which focuses on mutagenesis, mutation induction, mutant characterization, and mutant applications. It also publishes description papers on mutant germplasm and mutant varieties. Papers on social-economic impact analysis of induced mutations and mutant varieties are also accepted.

Style

The manuscript should be concisely written with the following sections:

Title page

- Title: the title should be as short as possible, but should contain adequate information regarding the contents.
- Authors: Initials of given name followed by full family name.
- Affiliation(s)/Address(es):
- Email address: the corresponding author's email address should be given.

Abstract and keywords

A brief and informative summary of the paper not exceeding 150 words. Optional for short communications. Each paper should have 3–5 keywords.

Main text

- Review articles may be organized according to their specific requirements.
- Research articles should include: Introduction, Materials and Methods, Results (and) Discussion (this could be combined for Short communications).
- New mutant germplasm should include a short description of initial material used and the mutagen and doses applied; selection process; mutated characteristics and its genetic and agronomic analysis. Description of mutant variety should, in addition, include its performance in yield trials for varietal release and the releasing committee, when applicable.

Acknowledgements

- Acknowledgements of grants, support etc, should follow the text and precede the references.

References

The literature references should be cited either as John (1990) for single author paper, John and Johnson (2000) for papers with two authors, or John *et al.* (2000) for papers with more than two authors throughout the text, and alphabetically listed in the Reference following the style shown below:

- Periodicals: Shamsuzzaman K.M. and Shaikh M.A.Q. (1991) Early maturing and high seed yielding chickpea mutant. Mut Breed Newslett 37: 4-5.
- Books (edited by someone other than author of article): Maluszynski M. (1990) Gene manipulation in plant improvement. In: Gustafsson J.P. (ed), Induced Mutations in Plant Improvement. Plenum press, New York. Pp239-250.
- Books (identical author and editor) van Harten A.M. (1998) Mutation Breeding, Theory and Practice. Cambridge University Press, Cambridge, U.K. pp. 237-240.

Figures and Tables

- All tables and figures, e.g. photographs, graphs and diagrams should be referred to as either 'Table' or 'Fig.' and be numbered consecutively (1, 2, etc.) in the text.
- In tables, footnotes are preferred over long explanatory material in the heading or table body. Such explanatory footnotes, identified by superscript letters, should be placed immediately below the table.
- Do not use boxes; use horizontal lines only. Figures and tables should be placed on separate pages.

Units and symbols

The standard SI units and symbols should be used throughout (www.scenta.co.uk/tcaep/science/siunit/index.htm).

Publication

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Submission

Electronic submission through email is encouraged. Before a permanent address is set for this, you may submit it to the IAEA's official email address: Official.Mail@iaea.org.

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