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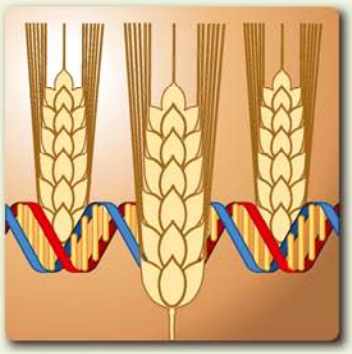

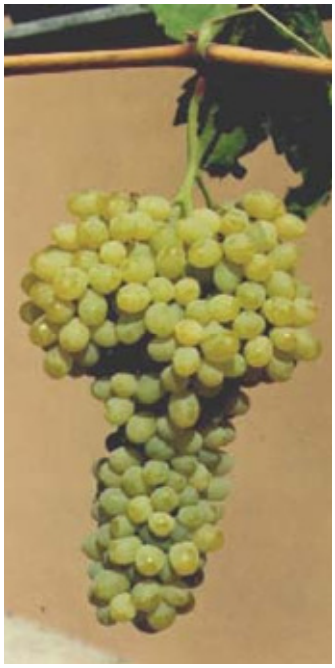

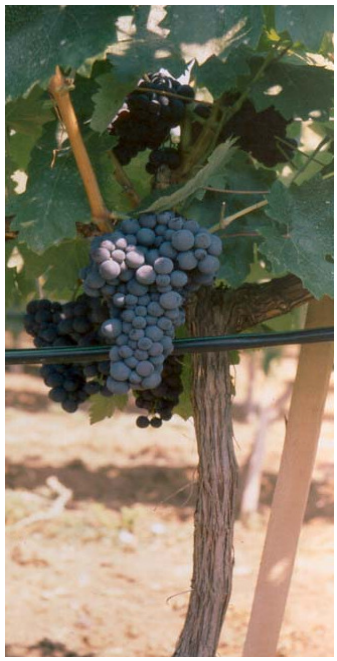

Improvement of indigenous grape cultivars by mutation breeding (for details please refer to TC Project Highlights – TUR/5/023)

Contents

To Our Readers

A major milestone for our subprogramme will be the upcoming International Symposium on Induced Mutations in Plants, which will be held 12-15 August 2008 in Vienna, Austria. This will be the eighth in the Joint FAO/IAEA Programme's Symposium series dedicated exclusively to harnessing and disseminating information on current trends in induced mutagenesis in plants, the first of which was held in 1969 and the most recent in 1995. These previous symposia dealt with themes relating to the development of efficient protocols for induced mutagenesis and their role in the enhancement of quality traits, as well as resistance to biotic and abiotic stresses in crops and the integration of in vitro and molecular genetic techniques in mutation induction.

Topics which to be addressed at this symposium will be:

- Molecular genetics and biology of physical, chemical and transposon-induced mutagenesis;
- New mutation techniques, e.g. ion beam implantation, and their integration with other molecular and biotechnological techniques;
- Induced mutations in crop breeding programmes;
- Mutation induction for gene discovery and functional genomics, including targeting induced local lesions in genomes (TILLING) and other reverse genetic strategies;

IAEA International Atomic Energy Agency

- Mutational analysis of important crop characters (tolerance to abiotic stresses, resistance to diseases and insects, quality and nutritional characters, etc.);
- Socio-economic impact of widespread mutant varieties.

It is envisaged that this symposium will not only attract eminent basic research scientists but also active plant breeders from all over the world. Therefore, the symposium will at once provide the platform for the exposition and rigorous discourse on current research and technology development in this field and establish linkages among scientists in order to develop knowledge-based breeding strategies and mechanisms for sharing information and resources. It will also be a venue for project managers of international and national organizations, as well as multinational and private companies engaged in plant breeding activities, to gain insights into the applications of, and current trends in, mutation techniques.

Already more than 600 on-line inscriptions from 90 Member States (12 national and international institutions) confirm the high interest in this event. We have received proposals for some 108 oral presentation and more than 300 posters, and we expect interesting discussions and many fruitful collaborations to come of this symposium. Registration for participation in this important event may still be made through the Scientific Secretary, Dr. Qingyao SHU (mailto:q.shu@iaea.org) and the Conference Services Section team (mailto:k.morrison@iaea.org), who will forward you the necessary information.

In other news, we are currently supporting the development of 39 new national, regional and interregional technical cooperation projects for the new triennium 2009-2011 of TC. This new batch of exciting new proposals from Member State reflect your concerns regarding food security, quality and nutrition, but also the growing demands for assistance in mitigating the effects of harsh environments, climate change and variability, and also the interest in non-classical breeding targets such as breeding for pharmaceutically active components and for biofuels. The growing food prices lately, fostering numerous bloody food riots urge us all to do our best to find ways for thwarting food insecurity. Our contribution will be to enhance crop adaptability and biomass productivity. In fact competition for resources (soil, water, financial, human) between the 7Fs (concept from Prof. 'Pat' Heslop-Harison) – Food, Feed, Fuel (Bioenergy), Fibre (including timber, chemicals such as biodegradable plastics), Flowers (ornamentals, horticulture), Fun (including playing fields, landscaping, recreational areas, lakes, environment), Pharmaceuticals (pharming, neutraceuticals) - might be seen as the major 'Gordian Knot' to be cut in the near future, under the menace of climate change and variability, increasing energy and calorie demand.

This year 2008 has been particularly challenging year for the Joint FAO/IAEA Programme (NAFA/AGE) on the institutional level as FAO moves toward reform and responding to its Independent External Evaluation. More than ever we need your support as this year progresses, and we are grateful to know that you support our work. Please allow me here to thank all of you who have consistently offered their support. **'A friend in need, is a friend indeed.'**

Pierre J.L. Lagoda
Head,
Plant Breeding and Genetics Section

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Forthcoming Events

IAEA/RER Regional Training Course on PCR Based Molecular Marker Systems, RER/5/013, Katowice, Poland, 30 June–11 July 2008

Technical Officers: Y. Lokko and Q.Y. Shu

Under the regional TC project RER/5/013, 'Evaluation of Natural and Mutant Genetic Diversity in Cereals Using Nuclear and Molecular Techniques', a training course on methods PCR Based Molecular Marker Systems would be organized by the International Atomic Energy Agency (IAEA) in cooperation with the Government of Poland through the University of Silesia, Department of Genetics.

The objective of the course is to provide participants with theoretical and practical aspects of various molecular markers techniques, methods of their generation and application to breeding and genetics of cereals

Third Research Coordination Meeting on Molecular Tools for Quality Improvement in Vegetatively Propagated Crops including Banana and Cassava, Vienna, Austria, 11–16 August 2008

Technical Officer: C. Mba

Eighteen scientists will participate in this meeting. They are made up of 12 Research Contract holders from Bangladesh, Brazil, China, Cuba, Ghana, India, Indonesia, Kenya, Mexico, Nigeria and the Philippines; five Research Agreement holders from the Czech Republic, the United Kingdom and two CGIAR centres – the International Centre for Tropical Agriculture (CIAT), Cali, Colombia and the International Network for the Improvement of Banana and Plantains (INIBAP) Bioversity International, Montpellier; and the Scientific Secretary from the Joint FAO/IAEA Programme.

The CRP, commenced in 2005 and foreseen to last for five years, aims at deploying molecular resources and information on the genetic make up of banana and cassava (e.g., genomics tools) in concert with induced mutagenesis in the service of efforts to produce improved varieties of both crops. Also, the collaborative efforts of the participants is being directed at the development of exhaustively characterized populations, including those of induced mutants, structured for the discovery of genes influencing traits of interest. To date, significant progress had been made in participants' activities relating to the development and harnessing of molecular tools for using induced mutations to enhance quality traits in both crops and this RCM meeting will provide the platform for reviewing the status of implementation of agreed upon work plans, making adjustments and deciding on the direction for the last phase of the project in the face of current trends relevant to the endeavours.

Fourth Research Coordination Meeting on Physical Mapping Technologies for the Identification and Characterization of Mutated Genes Contributing to Crop Quality, Vienna, Austria, 11–15 August 2008

Technical Officer: Y. Lokko

Eleven Scientists from Argentina, Bulgaria, China, Czech Republic, Germany, Iceland, Pakistan, Poland, United Kingdom, United States of America and Vietnam, working on this Coordinated Research Project (CRP) will be meeting in Vienna, for the final Research Coordination Meeting (RCM). They will review the progress made during the five years of this project. The meeting will be held in conjunction with the International Symposium on Induced Mutations in Plants, from 12-15 August.

The CRP addresses issues related to the use of advanced molecular and mutation technologies in crop improvement, and aims to accelerate the improvement of quality traits through the use of physical mapping and complementary genomic technologies for the characterization of natural diversity and induced mutants.

In the course of its activities, significant results have been generated by participants including, advanced mutant lines of sweet pepper, cotton, rice and rapeseed, as well as fine-mapping of quality traits in rice and rye.

Third Research Coordination Meeting on Identification and Pyramiding of Mutated Genes: Novel Approaches for Improving Crop Tolerance to Salinity and Drought, Vienna, Austria, 11–16 August 2008

Technical Officer: M. Spencer

Twenty scientists from Bulgaria, China, Cuba, Egypt, Ghana, India, Indonesia, Israel, Italy, Pakistan, Thailand, Tunisia, Turkey, United States of America, Vietnam and an international organization, International Rice Research Institute (IRRI), Manila, Philippines, will attend this meeting. They have been working for two years on identifying and selecting promising mutant lines through induced mutation and *in vitro* techniques to address tolerance to drought and/or salinity. Several advanced mutant lines (M4 to M7) of different crops, including Soybean, Rice, Chickpea, Wheat, and Arabidopsis are being tested

and characterized for tolerance to drought and/or salinity. Several molecular markers and genomic regions associated with salinity and/or drought tolerance were also identified.

International Symposium on Induced Mutations in Plants (ISIMP), Vienna, Austria, 12–15 2008

Technical Officer: Q.Y. Shu

This forthcoming international meeting has received great enthusiasm from the plant research community. More than 600 researchers have already registered online or were nominated by their national authorities. A provisional programme, which includes more than 100 oral and about 300 poster presentations, is already on the symposium's website:

http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=167.

We are looking forward to a fruitful scientific gathering.

Consultants Meeting on Plant DNA Damage, Repair and Mutagenesis, Vienna, Austria, 12–16 August 2008

Technical Officer: Q.Y. Shu

This meeting will be organized in conjunction with the ISIMP. All invited consultants will give an oral presentation in the session of Plant mutagenesis – DNA damage, repair and genome stability. Although induced mutations have been widely used in crop breeding and basic research including mutational analysis of important biological systems, the fundamentals that lead to mutations remain largely unknown in plants. Understanding of 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. The rapid progress in functional genomics has provided unprecedented opportunities to study the genes and the mechanisms underpinning the response of plant genomes' repair mechanism to physical and chemical mutagens. Through this consultants meeting, a coordinated research project proposal will be developed with a clear framework of overall and specific objectives, the research strategy and scope, and expected outputs.

IAEA/RCA Regional Training Course on Mutation Breeding Approaches to Improving Salinity, Drought and Heat Stress Tolerance, RAS/5/045, Beijing China, 13–22 October 2008

Technical Officer: Q.Y. Shu

The regional training course will be organized by International Atomic Energy Agency (IAEA) in cooperation with the Government of China through the Institute of Crop Science, Chinese Academy of Agricultural Sciences, Beijing. The training course is open to breeders, geneticists from RCA Member States in Asia and Pacific Region working on crop improvement and mutant characterization in each participating country. They are the national team members of the IAEA/RCA regional technical cooperation project RAS5/045 'Improvement of Crop Quality and Stress Tolerance for Sustainable Crop Production Using Mutation Techniques and Biotechnology'.

The objective of this training course is to provide young scientists involved in the Project with advanced knowledge and skills related to mutation breeding for improving tolerance to salinity, drought and heat stress in crop plants, and with methodologies and protocols for the evaluation of crop tolerance to these abiotic stresses. The training course will include lectures, practical exercises, on site visits and group discussions.

Past Events

Regional Training Course (RTC) on Basic Molecular Markers and Data Analysis, RAF/5/056, Thiès, Senegal, 7–18 April 2008

Technical Officer: M. Spencer

The two-week RTC was opened in Thiès, by several high ranking officials from the Government of Senegal: Prof. Christian Sina Diatta, Minister of Biofuel, Renewable Energies, and Scientific Research of Senegal; Prof. Sylvie Gassama, AFRA National Project Coordinator for Senegal; Prof. Khaled Masmoudi, Université de Sfax, Tunisia, assigned by the IAEA as lecturer; Dr. Dogo Seck, Director of CERAAS (Centre de recherche sur l'amélioration de l'adaptation à la sécheresse) the training course venue; and Dr. Abdoulaye Dieng, Director of UFR-SADR, Thiès.

Prof. Sylvie Gassama, the AFRA National Project Coordinator, gave a brief summary of AFRA project strategies and objectives. She encouraged the participants to continue to maintain close collaboration amongst them and also with their respective national coordinators. This would help to strengthen the position of AFRA and IAEA as invaluable partners for the development of all Member States in Africa.

Prof. Christian Sina Diatta, stressed the impact of biotechnologies including nuclear techniques in the struggle

of African countries to meet the Millennium Goals by 2015. He suggested the participants to gain the skills that Africa still lacks in order to face efficiently the global competition.

The training course was then officially opened and Prof. Diatta invited the Senegalese hosts to once again showcase the Senegalese 'Teranga' to ensure a successful meeting and an enjoyable stay in the country for all the guests.

In the past decade the IAEA, through the RAF-AFRA series of TC projects has participated in valuable capacity building in the regional Member States. Under RAF/5/056, following the last coordination meeting in Mauritius in 2007, it was noted that most participating countries have functional plant tissue culture laboratories and are conducting *in vitro* mutation induction associated with plant micropropagation programmes in order to stabilise and increase the number of new and improved mutant lines. In several countries, where mutant varieties have been released or are in the process of being released, they need proper characterization. This training course on 'Basic molecular markers application and data analysis' would provide all participants with the knowledge and skills required to initiate adequate molecular characterization research programmes under RAF/5/056.

The training course included lectures and hands-on experiments on two main aspects:

- Basic knowledge of the genomic DNA and its function in the plant cell as it relates to crop breeding
- Analysis of molecular marker data for a correct interpretation of the results in mutation induction and/or introgression breeding programmes.

The expected outputs are:

- Update the knowledge of molecular marker technologies, especially the use of selected molecular markers techniques depending on the crops, objective of the programmes, and the financial situation of their home countries
- Increased knowledge and skills to apply computer statistical data analysis techniques.

Efficiency enhancing bio-/molecular techniques such as *in vitro* culture and molecular markers, associated to mutation induction in crop improvement programmes can assist with plant multiplication, improvement and selection with unprecedented accuracy and speed. It appears that the choice of molecular techniques for instance depends upon:

- A thorough discussion regarding the various technologies and their appropriateness to the specific project and its specific goals
- The comparison of the molecular technologies with existing conventional methods in the specific crop given the realities of life in developing countries
- The relative costs (e.g., financial, social, and political) of molecular techniques vs. the relative benefits (e.g., productivity and food security).

The 24 participants came from Algeria, Burkina Faso, Democratic Republic of Congo, Cameroon, Egypt, Ghana, Kenya, Madagascar, Mauritius, Niger, Uganda, Sierra Leone, Senegal, Sudan, Tunisia, Zambia, and Zimbabwe.

The first week of the course, including lectures and practicals, was devoted to: Application of molecular biology tools for the analysis of genetic variability in a breeding population including mutation derived lines. The lectures and practical experiments were conducted by Prof. Khaled Masmoudi, Biotechnology Center - Université of SFAX, Tunisia; Dr. Khadidiatou Ndir, University of Thiès, Senegal; and Dr. Ndiaga Cissé, ISRA CNRA, Bambey, Senegal.

The agenda of the second week was lectures and practical exercises on: Data analysis – proper data interpretation generated by the breeding programmes and/or molecular characterisation experiments. The main lecturer was Prof. Juan Fernando Fernandez-Manjares (University of Paris Sud) assisted by Ms. Yaye Couna Sylla, (IT staff CERAAS), Dr. Mame Codou Gueye du CERAAS, Dr. Mansour Thiao de l'IRD/UCAD, and Mr. Mbaye Ndoye Sall, CERAAS.

The enthusiastic involvement of the participants was fully satisfactory and the training was concluded by handing out certificates by Dr. Abdoulaye Dieng, Director of UFR-SADR, Thiès.

IAEA/RER Regional Training Course on Methodology in Drought Tolerance Research, RER/5/013, Aleppo, Syrian Arab Republic, 20 April–2 May 2008

Technical Officers: Y. Lokko and Q.Y. Shu

Cereals are the most important grain crops in South-Eastern Europe; their production is greatly affected by various biotic and abiotic stresses, particularly drought. New varieties with enhanced tolerance to drought stress are in high demand to ameliorate cereal production in the affected areas; however, due to the complex nature of

drought stress and its effect on various physiological activities of plants, development of drought tolerance has been hampered by the lack of necessary knowledge of biological control as well as of methods and techniques that can be efficiently used in breeding programmes in developing countries. Under the regional TC project REP5/013 'Evaluation of Natural and Mutant Genetic Diversity in Cereals Using Nuclear and Molecular Techniques', a training course on methods in drought tolerance research was organized by the IAEA in cooperation with the International Centre for Agricultural Research in Dry Areas (ICARDA). The objective of the course was to provide up-to-date knowledge of the genetics and physiology of plant drought tolerance; methods, techniques and skills to assess agronomic and physiological traits related to drought tolerance and their use in breeding for drought tolerance; and expertise and know-how of design and management of breeding programmes for drought tolerance in cereals. Nine IAEA-supported trainees from Bulgaria, Georgia, Macedonia, Poland, Romania, Ukraine Serbia and Uzbekistan, and two local research scientists took part in the 10-day course which included lectures, practical field and laboratory demonstrations.

The course which included hands-on laboratory and field demonstrations featured lectures on a range of topic including Participatory Breeding; Use of Triticum wild relatives, stress physiology and molecular markers to breeding for drought tolerance in durum wheat; Using synthetic hexaploid to breed for increased yield potential under drought in wheat; Breeding for drought in wheat. Others were on Techniques for screening drought tolerance ;Monitoring Soil Moisture and Wheat Yield under Dry Conditions Using a Wireless Sensor Network; Use of Infra-red Thermography for Measuring Water Deficit Stress in Wheat; *In vitro* screening approached for drought screening; and Breeding for drought tolerance in Chickpea; Breeding for drought tolerance in Food legumes.

Consultants Meeting on Integrated Approach to Develop Sustainable Agriculture in Senegal, SEN/5/030, Vienna, Austria, 22–25 April 2008

Technical Officer: M. Spencer

Mr. Mokdad Maksoudi, Department of Technical Cooperation (TC), IAEA, highlighted the objective of the meeting: To develop the work plan of the project and to initiate implementation of activities scheduled for 2008, within the allotted budget. Mr. Marius Putineanu, Project Management Officer (PMO), TC project SEN/5/030 assured the continued assistance to Senegal in reaching their economic development, Millennium Goals by 2015.

The Technical Officer highlighted the FAO/IAEA Joint Division activities in crop improvement through induced mutations. Mr. Gerd Dercon presented activities in Soil and Water Management and Crop Nutrition Section and mainly focused on integrated nutrient management under drought conditions.

Mr. Ibrahim Ndoye and Mr. Tahir Diop (Université Cheikh Anta Diop de Dakar/ISRA/IRD) and their respective research programmes made presentations on cowpea and nitrogen fixation for the improved crop nutrition and the use of Mycorrhiza for maximizing mobilization of phosphorus for crops in poor soil conditions.

The meeting also conducted a SWOT analysis of the TC project SEN/5/030 in order to identify the constraints and consider the solutions to allow a full development of the TC project. The following activity was to conduct a thorough review and to update the current project work plan, which has not yet seen much implementation to date.

A visit to IAEA laboratories (Plant Breeding and Soil Science Units) was organized for the visitors to see different laboratories (irradiation facilities, *in vitro* and molecular markers techniques). The laboratory tour and presentations was organized by Mr. Chikelu Mba, Head, Plant Breeding Unit, and Mr. Gudni Hardarson, Head, Soil Science Unit.

The Log frame matrix was revised for scheduling plan of action and inputs for project implementation.

National Training Course on Application of Biotechnology in Plant Breeding - Focusing on Rice, VIE/5/015, Ho Chi Minh City, Vietnam, 19–25 May 2008

Technical Officer: Q.Y. Shu

The training course was held in the Institute of Agricultural Sciences for Southern Vietnam (IAS), Ho Chi

Minh City, 19 to 25 May 2008. Twenty-six participants from 18 research institutes, universities and seed companies from all over Vietnam attended this course. The training course covered topics such as rice breeding, mutation induction, molecular markers and their application in rice breeding and mutant characterization. Several case studies were provided by the two IAEA experts (Drs. Shihua CHENG and Jieyun ZHUANG, China National Rice Research Institute, Hangzhou, China), and local scientists, including Drs. Bui Chi Buu and Do Khac Thinh (Institute of Agricultural Sciences for Southern Vietnam). The training course was jointly supported by IAEA, IAS and Vietnam Atomic Energy Commission (VAEC), with donations from private companies.

Status of Coordinated Research Projects

NEW CRP – Enhancing the Efficiency of Induced Mutagenesis through an Integrated Biotechnology Pipeline

Technical Officers: C. Mba and B. Till

A programmatic strategy aimed at supporting the capacity of the Unit to network on thematic areas impacting directly on its ability to deliver solutions tailored to the needs of Member States has resulted in the development of a new CRP aimed at driving innovations. The sub-Programme is in the process of empanelling the CRP, '*Enhancing the Efficiency of Induced Mutagenesis through an Integrated Biotechnology Pipeline*'. The justification for the CRP, the expected outputs and the implementation mechanism are summarized in the excerpt from the project document below:

A combination of the imminent threats posed by global climate change and the challenges engendered by the ever more sophisticated demands for specific niche agricultural products dictate the imperative of 'designing' new crop varieties. These novel crop types must be adaptable to extreme and unusual weather conditions; be efficient users of nutrients; while on the other hand also meet the requirements for enhanced nutritional quality and possess those traits that confer added-value. A combination of these characteristics will attract premium prices and hence enhanced livelihoods for farmers. On account of these, current research in plant sciences is characterised by a sharp resurgence in the use of induced mutagenesis both for the upstream application of crop improvement and in the more basic work of discovery and elucidation of gene functions. This reflects the recognition of induced mutagenesis, especially through ionizing irradiation, as a safe-to-use, environmentally-friendly tool whose end results are devoid of controversies associated with comparable technologies. Induced mutagenesis effects subtle changes to the genetic make up (genome) of an individual while leaving the rest of the genome largely intact, making it a method of choice for introducing changes to otherwise elegant crop types. The downside of this resurgence has been the obvious lack of a commensurate improvement in the efficiency of delivery levels of the processes involved. This CRP proposes to address this through the assemblage, adaptation and interlacing of novel cellular and molecular biology techniques to achieve a seamless dovetailing of validated processes into a modular pipeline. Cellular and molecular biology techniques will address 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); and by facilitating the direct querying of target genes for changes obviate the need for field trialling of large populations. Additionally, robust; cheap and easy to use analytical methods will be 'hooked' up to these novel methods to enhance efficiency of the delivery processes. The main outputs will be guidelines on how to integrate above suite of techniques into a seamless induced mutagenesis process. These will be based on selected crops of relevance to Agency's mandates and with differing biological systems and production constraints. With appropriate analytical tools that will be developed, estimation of unintended mutation events (that may be deleterious) will form part of the holistic package to accompany induced mutants as they are delivered to plant breeders for integration into crop improvement programmes.

Applications for participation in the CRP are currently being received and it is expected that the first RCM will be held later in the year. Information relating to modalities for applying for participation in this CRP and general information relating to the IAEA's CRP mechanism can be found at http://www-crp.iaea.org/.

Physical Mapping Technologies for the Identification and Characterization of Mutated Genes Contributing to Crop Quality

Technical Officer: Y. Lokko

This CRP was initiated in 2002. The first RCM was held in Vienna, Austria, 31 March–9 April 2003. The second RCM was held in Reykjavik, Iceland, 22–26 August 2005. The third RCM took place in Cordoba, Argentina, 19–23 March 2007.

The fourth and final RCM is planned to be held in Vienna, Austria, 11–15 August 2008 in conjunction with the International Symposium on Induced Mutations in Plants (ISIMP).

Effects of Mutagenic Agents on the DNA Sequence in Plants

Technical Officer: P.J.L. Lagoda

This CRP was initiated in 2003. The first RCM was held in Vienna, Austria, 1–5 March 2004. The second RCM was held in Seoul, Republic of Korea, 14–18 November 2005. The third RCM took place in Stellenbosch, South Africa, 24–28 September 2007. This CRP will be completed at the end of 2008.

Pyramiding of Mutated Genes Contributing to Crop Quality and Resistance to Stress Affecting Quality

Technical Officer: Q.Y. Shu

This CRP was initiated in 2004. The first RCM was held in Vienna, Austria, 13–17 September 2004. The second RCM was held in Nanjing, China, 10–14 April 2006. The

third RCM took place in South Perth, Australia, 15–19 October 2007.

The project deals several crop plant species, including some of the major staples (rice, barley, wheat), cotton, potato, and other less well-studied 'orphan' crops (okra and groundnut). The targeted traits represent a wide range such as yield and quality characters, as well as biotic and abiotic stresses that have an impact on crop quality. Good progress has been achieved in all of the target crops. Mutants and advanced breeding lines derived from mutants have been produced for most species under study. In some cases, where mutants are not available (e.g., potato), the natural diversity of the crop is being used to exploit naturally occurring variability. Mapping populations have been established for the genetic analysis of mutant phenotypes, and significant progress has been made in accurate localization of genes and QTLs for target traits. Moreover, there is a substantial development of other germplasm for breeding and further genetic analysis (e.g., NILs, RILs, advanced backcross lines, intogression lines). A wide range of marker technologies (RAPD, AFLP, ISSR, SSR, SNP, MFLP, isozyme) are being used by the participants to tag and pyramid mutant genes. Encouragingly, there has been progress in the use of multiplex marker technologies (e.g., multiplex SSR), especially in wheat and barley. There are plans to move towards more advanced methodologies (e.g., eQTL, cDNA-AFLP, microarrays, and high-throughput SNP-based markers) in the near future. Some groups (e.g., rice) are making good use of the available genome sequence data, and such resources should prove useful for targeted marker development. Other groups are employing candidate gene approaches in attempts to isolate genes corresponding to target traits. Many publications have been generated from the participants of this CRP. Several new varieties derived from mutant lines will be available by the end of the project. Moreover, the project should produce many molecular and biochemical markers for use in plant breeding programmes. The project has made significant progress in pyramiding multiple genes (including mutated genes) and QTLs using molecular marker technologies.

Identification and Pyramiding of Mutated Genes: Novel Approaches for Improving Crop Tolerance to Salinity and Drought

Technical Officer: M. Spencer

This CRP was initiated in 2004. The first RCM was held in Vienna, Austria, 14–18 March 2005. The second RCM was held in Accra, Ghana, 6–10 November 2006.

The third RCM is planned to take place in Vienna, Austria, 11–16 August 2008 in conjunction with the International Symposium on Induced Mutations in Plants (ISIMP).

Molecular Tools for Quality Improvement in Vegetatively Propagated Crops Including Banana and Cassava

Technical Officer: C. Mba

This CRP was initiated in 2004. The first RCM was held in Vienna, Austria, 18–22 July 2005. The second RCM took place in Thiruvananthapuram, Kerala, India, 5–9 February 2007.

The third RCM is planned to take place in Vienna, Austria, 11–16 August 2008 in conjunction with the International Symposium on Induced Mutations in Plants (ISIMP).

For more information, see 'Forthcoming Events'.

Assessment of Nutrient Uptake from Biofortified Crops in Populations from Developing Countries

Technical Officers: T.P. Trinidad and P.J.L. Lagoda

This CRP was initiated in 2005. The first RCM was held in Vienna, Austria, 17–19 May 2006.

The second and last RCM will take place in Vienna, Austria, 12–15 August 2008 in conjunction with the International Symposium on Induced Mutations in Plants (ISIMP).

IAEA Coordinated Research Activities Web Site:

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

Technical Cooperation Projects

Active Projects

Project Number	Title and Objective(s)	Technical Officer
AFG/5/003	Sustainable Increase in Crop Production in Afghanistan ***Objectives:*** To increase the productivity and production of crops through the development of improved nitrogen fertilizer and water management practices using nuclear and supportive biotechnologies. Phase I (2007-2008) will aim at refurbishing the national soil fertility laboratory and developing national capacities to provide fertilizer recommendations. In phase II (2009-2010), the laboratory will be upgraded and staff will be trained to conduct experimental work using nuclear techniques for improving water and nitrogen fertilizer management for wheat in target areas; recommendations on these will be formulated and disseminated to the farmers. In phase III (2011-2012), plant breeding programmes initiated in phases I-II will be developed on the basis of integrated soil-water-plant approaches using nuclear and supportive biotechnologies.	P.J.L. Lagoda in collaboration with Soil and Water Management Section
ALG/5/023	Protection of Date Palm Trees Against Bayoud Disease ***Objectives:*** Rehabilitation and development of date palm oasis using mutation induction in Algeria.	P.J.L. Lagoda
ALG/5/024	Improvement of Cereals for Tolerance to Drought and Resistance to Disease ***Objectives:*** To increase the cereal production (wheat and barley) by introducing at the farmer's level new high yield varieties tolerant to biotic and abiotic stresses.	P.J.L. Lagoda
ANG/5/006	Improvement of Food Crops Through Mutation Breeding and Biotechnology ***Objectives:*** To establish a national capacity to develop crop varieties with increased vitamin and mineral content and improved yield, quality, disease resistance and stress tolerance.	M. Spencer
BGD/5/026	Increasing Agricultural Production in the Coastal Area through Improved Crop, Water and Soil Management ***Objectives:*** To increase agricultural production in coastal areas through integrated and efficient management of crop, water, soil and land resources.	Q.Y. Shu
BOT/5/003	Mutational Improvement of Groundnut Varieties ***Objectives:*** Development of high yielding groundnut mutant varieties with high tolerance to abiotic stress.	Q.Y. Shu
CAF/5/003	Development of New Varieties of Cassava Through Mutation Breeding and Biotechnology Techniques ***Objectives:*** To develop manioc varieties with resistance to the African Cassava Mosaic Virus (ACMV) through mutation breeding and biotechnology techniques.	M. Spencer

Project Number	Title and Objective(s)	Technical Officer
CPR/5/017	Construction of Radiation-Induced Mutant Libraries and Function Analysis of Mutated Genes in Crop Plants ***Objectives:*** To establish large-scale screening of induced mutations using molecular high-throughput techniques for mutant germplasm characterization and construct-induced mutant libraries for new variety development, genomics, proteomics and mutational analysis of gene networks in order to increase the efficiency of nuclear irradiation-induced mutation breeding of major crops (especially rice and wheat) in China.	P.J.L. Lagoda
COS/5/027	Generation of Promising Strains of Beans Through Induced Mutations in Calluses and Seeds to Increase Competitiveness ***Objectives:*** To contribute to an increase in the competitiveness and productivity of beans by strengthening the National Programmes for Bean Improvement.	M. Spencer
ECU/5/023	Inducing Mutations in Agriculture with the Aid of Radiation ***Objectives:*** To improve varieties of maize, potato and barley using mutagenic techniques leading to an increase in the productivity of these subsistence crops.	M. Spencer/P.J.L. Lagoda
ERI/5/004	Improving Crop Productivity and Combating Desertification ***Objectives:*** To improve and sustain crop productivity through the development of efficient breeding, water and fertilizer management practices in arid and semi- arid areas in the eastern and western lowlands of the country.	P.J.L. Lagoda in collaboration with Soil and Water Management Section
GHA/5/032	Enhancing Production and Use of Cassava ***Objectives:*** To develop cassava varieties with high-quality starch, tolerance to African Cassava Mosaic Virus (ACMV), and excellent cooking quality; and to develop soil and nutrient management strategies in the sustainable production of cassava.	M. Spencer/Y. Lokko
INS/5/031	Mutation Breeding of Horticultural Crops ***Objectives:*** To develop commercially viable induced mutant varieties of horticultural crops such as cut flowers, garlic, and citrus by gamma irradiation; to increase farmers' income by growing better quality mutant varieties; and to create more employment opportunities.	M. Spencer
INS/5/035	Application of Nuclear Techniques for Screening and Improving Cash Crop Plants in Coastal Saline Lands ***Objectives:*** To improve crop productivity for sustainable agricultural development in coastal areas through crop genetic improvement and development of soil, water and nutrient management practices.	Q.Y. Shu
IRQ/5/015	Induction of Mutations in Crops Through *In Vitro* Culture ***Objectives:*** To develop mutants of crops with high yield and tolerance to salinity, drought and heat, using in-vitro techniques.	P.J.L. Lagoda
IRQ/5/017	Optimization of Land Productivity Through the Application of Nuclear Techniques and Combined Technologies ***Objectives:*** To improve use and efficiency of water and fertilizer and to establish criteria for optimum fertilizer dose and water salinity for sustainable crop production followed by an effective plant breeding programme for new cultivars and improved plant resistance techniques.	P.J.L. Lagoda

Project Number	Title and Objective(s)	Technical Officer
JAM/5/010	Plant Breeding and Diagnostics Technologies ***Objectives:*** To enhance capacities in crop improvement in Jamaica so as to increase food production using induced mutations and related biotechnologies.	Y. Lokko
MAR/5/018	Improvement of Banana and Tomato Varieties Through the Use of Nuclear Techniques for Mutation Induction and Biotechnology ***Objectives:*** Enhanced national capacity to develop varieties of bananas and tomatoes through mutation induction and biotechnology.	M. Spencer
MYA/0/007	Nuclear Science and Technology Training Centre (Currently a Human Development Project) ***Objectives:*** To establish a nuclear science and technology training centre for scientists, engineers, technicians, and graduate students in the field of nuclear science and technology; and to develop local human resources for application of nuclear techniques in various fields.	P.J.L. Lagoda
MYA/5/016	Development of Rice Varieties with Improved Iron Content/Bioavailability Through Nuclear Techniques ***Objectives:*** To combat iron deficiency through food based strategies.	P.J.L. Lagoda
NER/5/012	Improvement of the Productivity and Sustainability of Cowpea with Finger Millet ***Objectives:*** To develop improved drought-resistant lines and amelioration of soil and water management practices using nuclear, isotopic and mutation breeding techniques for cowpea.	M. Spencer
NIR/5/035	Adding Value to Root and Tuber Crops Through the Use of Mutation Induction and Biotechnologies ***Objectives:*** To improve crop productivity for sustainable agricultural development in coastal areas through crop genetic improvement and development of soil, water and nutrient management practices.	Y. Lokko
PAK/5/044	Improvement of Drought Tolerance in Chickpea Through Induced Mutations ***Objectives:*** To develop drought-tolerant and high-yielding desi chickpea mutants for the low-moisture chickpea growing areas in Pakistan through induced mutation.	M. Spencer
PER/5/028	Use of Nuclear Techniques to Improve Cotton Production ***Objectives:*** To improve cotton production, particularly that of short vegetative period, using nuclear and related techniques.	Y. Lokko
PER/5/030	Genetic Improvement of Quinoa and Kiwicha Using Mutation Induction and Biotechnology ***Objectives:*** To improve the national capacity to increase the yields and market competitiveness of quinoa and kiwicha.	Y. Lokko
PHI/5/029	Enhancing Agricultural Productivity Through Radiation Technology in Mindana ***Objectives:*** To develop new mutant varieties of fruit crops such as mangosteen and cashew with high yield, improved quality, short stature, early maturing, and non-seasonal; and to develop new rice mutant varieties with resistance to pests and tolerance to abiotic and biotic stresses through radiation-induced mutations and molecular techniques.	M. Spencer/Y. Lokko

Project Number	Title and Objective(s)	Technical Officer
QAT/5/002	Developing Biosaline Agriculture in Salt-Affected Areas in Qatar ***Objectives:*** To develop biosaline agriculture in salt-affected areas in Qatar through: 1) sustainable utilization of saline groundwater and land resources, 2) introduction of salt-tolerant plant species, selected for their comparative advantages over others (as to water-using efficiency, greening of desert, forage and fodder use, etc.), 3) creating national capacities to utilize isotopic, nuclear and other modern techniques, and 4) transfer of the technologies to beneficiaries and end users.	P.J.L. Lagoda in collaboration with Soil and Water Management Section
RAF/5/049	Field Evaluation of Bayoud-Resistant Date Palm Mutants ***Objectives:*** To assist Algeria, Morocco, and Tunisia in producing date palm trees with improved fruit yield, short height, and resistance to Bayoud disease.	M. Spencer
RAF/5/056	Field Evaluation and Dissemination of Improved Crop Varieties Using Mutation Breeding and Biotechnology Techniques ***Objectives:*** To assist AFRA member states in the development and dissemination of improved mutation induced staple and market oriented crops.	M. Spencer
RAS/5/045	Improvement of Crop Quality and Stress Tolerance for Sustainable Crop Production Using Mutation Techniques and Biotechnology (RCA) ***Objectives:*** The objectives of this project are to develop and transfer methodologies and technologies for the induction and identification of mutated genes contributing to important crop quality characters and stress tolerance to RCA Member States, and to develop improved breeding material using molecular marker-assisted selection.	Q.Y. Shu
RAS/5/048	Mutation Induction and Supportive Breeding and Biotechnologies for Improving Crop Productivity (ARASIA) ***Objectives:*** An improved regional partnership in the field of mutation induction to enhance breeding for food security and socioeconomic development.	P.J.L. Lagoda
RAS/7/014	Monitoring of Food Fortification Programmes Using Nuclear Techniques ***Objectives:*** The objectives of the project are twofold: 1) to evaluate and monitor the food fortification intervention programmes in five participating Member States, and 2) to develop rice mutants with low phytic acid from the country's high-yield rice varieties.	P.J.L. Lagoda
RER/5/013	Evaluation of Natural and Mutant Genetic Diversity in Cereals Using Nuclear and Molecular Techniques ***Objectives:*** 1) Genetic improvement of barley (*Hordeum vulgare*), pea (*Pisum sativum*), beans (*Phaseolus vulgaris* L.) and cotton through induced-mutations. 2) Animal nutrition and reproduction. 3) Vegetal physiology, soils and fertilizers applied to potatoes, barley and other crops.	Y. Lokko/Q.Y. Shu
SAF/5/008	Mutant Amaranth, Bambara Groundnut and Cowpea with Enhanced Abiotic Stress Tolerance ***Objectives:*** To screen, evaluate, and identify mutant amaranth, bambara groundnut and cowpea with enhanced abiotic stress tolerance, in collaboration with resource poor farmers.	Y. Lokko

Project Number	Title and Objective(s)	Technical Officer
SAF/5/010	Development of New Maize and Sorghum Germplasm with Enhanced Nutritional Content ***Objectives:*** To develop and characterize new maize and sorghum germplasm with enhanced nutritional value that are suitable for subsistence farming systems. To develop human capacity in the region to use mutation breeding to improve the nutrition of cereals.	Y. Lokko
SEN/5/030	Integrated Approach to Develop Sustainable Agriculture in Senegal ***Objectives:*** To screen, select and develop improved cowpea and sesame cultivars for nitrogen fixation and natural phosphorus uptake under drought conditions using mutation induction and biotechnologies.	M. Spencer in collaboration with Soil and Water Management and Crop Nutrition Section
SIL/5/007	Development of High-Yielding Rice Varieties for Low-Input Agriculture Systems Using Mutation Techniques ***Objectives:*** To develop high-yielding rice varieties adapted to low-input agriculture systems using mutation techniques in order to enhance the capacity for crop improvement, rice in particular, and increase food (rice) self-sufficiency in Sierra Leone.	Q.Y. Shu
SIL/5/009	Improving Sorghum Productivity Through Nuclear and Biotechnology ***Objectives:*** To assist in the development of new mutant lines of sorghum with increased yield and disease resistance.	Q.Y. Shu
SUD/5/030	Increasing productivity of Selected Crops Using Nuclear Related Techniques ***Objectives:*** To use nuclear techniques to expand production of established varieties in banana and wheat lines and to increase the productivity of new varieties in sugarcane and tomatoes in Sudan through introduction of new production packages (new variety, new cultivation technology and crop management system).	Q.Y. Shu
TUN/5/023	Radiation-Induced Mutations for Improvement of Cactus ***Objectives:*** To develop improved varieties of cactus by induced mutations, which are relatively high in nitrogen for use as feed for sheep and goats.	P.J.L. Lagoda
TUN/5/024	Development of Improved Strains of Olive Tree Through Mutation Breeding and Biotechnology ***Objectives:*** To develop a routine protocol for mass micropropagation of high yielding olive varieties.	P.J.L. Lagoda
TUR/5/023	Application of Nuclear and Gene-Based Biotechnology in Agriculture ***Objectives:*** To establish a biotechnology laboratory for molecular characterization of induced mutants and thus enhance the efficiency and widen the application of induced mutations in crop improvement, i.e. quality, yield, biotic stress and disease tolerance in Turkey.	Q.Y. Shu
URT/5/023	Enhancing Crop Productivity Through Radiation Technology ***Objectives:*** To develop improved varieties of basic crops such as rice, banana and barley through tissue culture, radiation-induced mutations and molecular techniques, and enhance the crop breeding capacity in United Republic of Tanzania.	Q.Y. Shu
UZB/5/004	Development of Mutant Cotton Breeding Lines Tolerant to Diseases, Drought and Salinity ***Objectives:*** To develop new mutant prebreeding cotton lines and enhance breeding capacities for resistance to the major fungal diseases, drought and salinity in Uzbekistan.	Y. Lokko/P.J.L. Lagoda

Project Number	Title and Objective(s)	Technical Officer
VIE/5/015	Enhancement of Quality and Yield of Rice Mutants Using Nuclear and Related Techniques ***Objectives:*** To further develop and extend improved mutant varieties and advanced mutant lines of rice for export and high-grade domestic consumption.	Q.Y. Shu
YEM/5/007	Use of Induced Mutations and *In Vitro* Culture for Improving Crops ***Objectives:*** To use radiation-induced mutation technology, in combination with modern biotechnology, to produce improved mutants of major crops that have higher yields and that can adapt to the changing climate and water resources.	P.J.L. Lagoda
YEM/5/008	Introduction of Gamma Ray Irradiation Techniques for Agriculture Purposes ***Objectives:*** To support the use of gamma ray irradiation techniques, such as mutation induction enhanced breeding, for service and applied research purposes.	P.J.L. Lagoda
ZAI/5/016	Mutation Techniques for Improving Nutritional and Medicinal Plants with a Curative Effect on Human Diseases and Alimentary Plants ***Objectives:*** To build the basis for a long-term national strategy to fight malaria and improve food security.	M. Spencer
ZIM/5/013	Development of Drought Tolerant and Disease Resistant Grain Legumes, Phase I ***Objectives:*** To develop drought and/or disease tolerant mutant grain legume varieties suitable for resource poor smallholder farmers in Zimbabwe.	Y. Lokko

Recently Closed Projects

Project Number	Title and Objective(s)	Technical Officer
COS/5/025	Development of Induced Mutations and Biotechnology for Improved Productivity and Competitiveness ***Objectives:*** To contribute to improved quality of life of the small-scale bean farmers and strengthening of the food security in Costa Rica through increased productivity and competitiveness of the national bean production system by means of the control of the bean web blight disease (*Mustia hilachosa*).	M. Spencer
INS/5/030	Sustainable Agriculture Development in Yogyakarta ***Objectives:*** To increase overall crop production by integrating newly developed drought-tolerant crops into existing cropping systems; to identify drought- and salt-tolerant crop varieties by radiation-induced mutation techniques; to identify promising fertilizer management practices for improved crop rotations by using nuclear techniques such as nitrogen-15 labeled fertilizers; and to develop sustainable agricultural practices for increased crop production in Gunung Kidul area in Yogyakarta.	M. Spencer
NIR/5/031	Radiation-Induced Mutations for the Development of Cowpea Varieties ***Objectives:*** To develop pest tolerant/resistant cowpea varieties using radiation-induced mutation and advanced screening techniques for insect pests to improve the cowpea yield, quality, and diversity.	P.J.L. Lagoda

IAEA Technical Cooperation Programme's Web Site:

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

TC Project Highlights

Monitoring of Food Fortification Programmes Using Nuclear Techniques, RAS/7/014

On 21-23 May 2008, breeders and nutritionists from the five participating Member States, China, Indonesia Pakistan, Thailand and Vietnam, met at the VIC to conclude a highly successful Regional Technical Cooperation Project, RAS/7/014. The objectives of the project were two-fold: i) to evaluate and monitor the food fortification intervention programmes in five participating Member States, and ii) to develop rice mutants with low phytic acid from the country's high-yield rice varieties.

Micronutrient deficiencies (e.g., iron, vitamin A, iodine, zinc, folic acid, vitamin B complex) continue to be a major problem in this region affecting millions of people, particularly children and women. Several of these deficiencies are linked to chronic diseases affecting large sectors of the population resulting in not only health consequences but also impairing economic progress in the region. Present strategies to address these deficiencies include supplementation, food fortification, and where possible, dietary diversification and bio-fortification. Numerous capabilities are in place in the region to move forward with these strategies. Besides the capabilities, major initiatives, such as the one with the Asian Development Bank (ADB) to explore health and economic benefits by eliminating micronutrient deficiencies, are being proposed. From a technology point of view, nuclear and isotopic techniques are at an advanced stage to provide the measurement capabilities in support of food composition and bio-availability studies and evaluation of field trials related to food fortification and bio-fortification.

Seed-derived dietary phytic acid contributes to iron and zinc deficiency in populations that rely on cereal grains such as rice and legumes as staple foods. Recently developed methods for breeding 'low phytic acid' (LP) varieties of crops are available and highly feasible for application to rice improvement. Nuclear techniques for generation of heritable variation and simple and accurate screening methods for isolating LP types are readily available. This work supports and complements ADB initiatives for fortification of foods, and for bio-fortification programmes aimed at increasing the iron and zinc content of rice and other grains. Furthermore, a large

component of the environmental impact of agricultural production, its impact on water quality and water pollution, results from the poor use of seed phosphorus due to the presence of phytic acid phosphorus.

In the area of nutrition, a regional project was initiated by Agency in East Asia and Pacific region in 1999 with the objective to ensure the efficacy of nutrition intervention schemes with the help of isotope techniques. The project has so far yielded some practical results. Studies used stable isotopes to measure the effectiveness of staple foods fortified with multi-nutrients, namely iron and zinc. China, Indonesia, Malaysia, Pakistan, Philippines, Thailand, and Vietnam participated in the study. The investigations carried out in Indonesia using stable isotopes to measure the effectiveness of fortified wheat flour have attracted the co-sponsorship of UNICEF. The results from Indonesia are also being used by other participating countries, such as China and Pakistan, in performing their studies to advise their national Governments and policy makers in improving or formulating their nutrition policies. In China, anaemic children who were given iron-fortified sauce, returned to normal blood iron levels within a period of three months. The results and achievements of the nutritionist component of RAS/7/014 will be published by IAEA NAHU.

In the area of rice breeding, a regional Project on Mutational Enhancement for Genetic Diversity in Rice (RAS/5/037) was launched in 1999 with the objective to sustain rice-breeding programmes through germplasm enhancement, leading to increased productivity and resistance to biotic and abiotic stresses. The project has been implemented through national rice breeding centres in ten countries from the region (Bangladesh, China, Indonesia, Republic of Korea, Malaysia, Myanmar, Pakistan, Philippines, Thailand, and Vietnam). Preliminary results of the trials organized under this project indicate that numerous mutant varieties are suitable for cultivation in countries other than the country of release. Additionally, many mutated rice genes developed by participants will be used in cross breeding programmes of all participating countries.

Salient Facts

In complement to the ADB project on iron dense rice, RAS/7/014 confirms that more than 90% of the micronutrients (e.g., Fe and Zn) are found in the bran. The same is true for phytic acid. Milling practices thus produce 'white rice' depleted in both minerals and phytic acid. Cooking practices further might flush out additional micronutrients.

The project produced 27 advanced mutant lines (up to M_{10}). Each country has submitted or will submit at least one advanced mutant low phytic acid rice line for national trials in order to release it as a new variety.

Most importantly, one of the low phytic acid mutant lines (reduction of more than 50%) presents increased Fe and Zn in the milled rice. Thus it is possible to produce a mutant rice variety with reduced phytic acid, acceptable yield and with increased Fe and Zn, which is shifted from the bran to the endosperm, thus mitigating to some extend the loss of micronutrients through milling.

Outcomes

The LPA trait created in rice as a result of the project will at least improve the nutritional quality of whole-grain rice as a human food. It may also improve the value of milled, white rice as a human staple food, depending on the intensity of milling, and depending on the mutant. Indeed, some advanced mutant lines from this project not only present an increase in micronutrients, but also a shift from the bran to the endosperm.

These resources, consisting of genetically different mutant Low Phytic Acid lines, are available to nutritionists for bioavailability studies.

The mutants developed under this project will definitely enhance the nutritional quality of the rice bran for animal feed. This will have positive effects on animal nutrition and health (e.g., poultry) and thus also for human nutrition.

It is expected, that the environment will be discharged of the excess Phosphorus excreted in the manure of non-ruminant husbandry, due to the fact, that 95% of Phosphorus content in the rice is from phytic acid. Thus, eutrophication might be thwarted.

This project produced numerous resources for breeding and variety development. The advanced lines, and certain intermediates, are for direct varietal development, or as pre-breeding material, and the developed molecular markers for Marker-assisted Selection (MAS).

The lessons learned direct the breeding strategies towards assaying not only the amount of micronutrients (e.g., Fe, Zn), but also selecting mutants which harbor a significant shift of minerals from the bran to the endosperm

The project generated an impressive quantity of worthwhile resources going beyond the applied interest of crop breeding. In addition to advanced mutant lines for (pre)-breeding improved rice varieties with reduced phytic acid content, the intermediate products (advanced mutant lines) showing High Inorganic Phosphorus (a marker for low phytic acid content) at a homozygous and heterozygous stage, in addition to the advanced mutant lines, constitute, as a collection, an invaluable resource for mutational analysis of the phytic acid pathway. It constitutes a resource paramount for functional genomics, forward and reverse genetics.

Pierre J.L. Lagoda
Technical Officer

Application of Nuclear and Gene-based Biotechnology in Agriculture, TUR/5/023Vietnam

Main Counterpart: Saraykoy Nuclear Research and Training Center, Turkish Atomic Energy Authority

The project aimed at establishing a biotechnology laboratory for molecular characterization of induced mutants to enhance the efficiency and widen the application of induced mutations in crop improvement, e.g., quality, yield, biotic stress and disease tolerance in Turkey. In past few years, supported by both the IAEA and relevant Turkish governmental ministries, the counterpart has made significant progress on capacity building and breeding of crop varieties for various traits.

An advanced laboratory for molecular and mutation breeding has been established. The laboratory has advanced facilities for tissue culture (including cell suspension culture), molecular marker analysis and TILLING studies, in addition to field and greenhouse facilities for breeding.

Vietna

Plant breeding research group of TUR/5/023

The counterpart has established extensive collaborations within Turkey for several crop breeding programmes, some of which already developed officially released mutant varieties.

The chickpea mutation breeding project has produced many mutant lines with improved and desirable agronomic and quality traits; one mutant line has been registered as a new variety, namely TAEK- SAĞEL in 2004. It is a high yielding variety with superior quality and disease resistance.

A barley mutation breeding has been implemented for the Central Anatolian region. The objectives are to improve lodging resistance, high yielding potential, and better tolerance to salt, drought and other abiotics stresses. A special system for observation and screening of mutants with altered rooting characteristics was developed, and a few putative mutant lines with enhanced salt tolerance were selected through hydrophonic culture.

Tailor-made growing chamber for screening barley root development mutants

A durum wheat mutation breeding project has been carried out for the Central Anatolian region with the aim of improving lodging resistance, yield and quality characteristics. Three mutant dwarf durum wheat lines and three bread wheat mutant lines with yellow rust tolerance are selected and under evaluation.

Dwarf durum wheat mutant line in yield trial

Collaborating with research institutes under the Ministry of Agriculture, the counterpart has been improving a sweet cherry variety through mutation breeding. Turkey is the largest cherry exporter in the world. However, the large trees make the harvest a difficult and laborious job. The project aims at developing compact, self-fertile and high quality genotypes. Mutant plants with improved

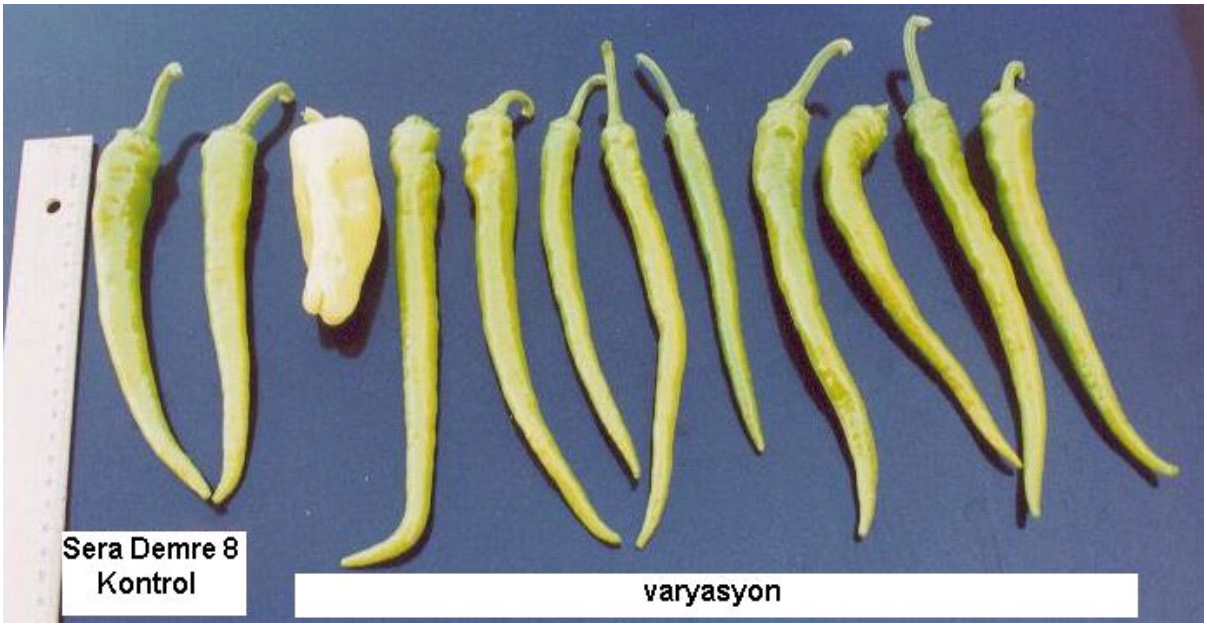
fruit size (32mm diameter) and yield and dwarf type were observed, they have been under field evaluation.

Mutant sweet cherry fruits

In collaboration with University of Ankara, Faculty of Agriculture, mutation techniques have also been used for the improvement of **indigenous grape cultivars, including the** Kalecik karası variety for good colour for wine, the Sultani çekirdeksiz variety for fruit size for drying, and the Uslu variety for standard fruit size for table consumption. Early maturing, seedless and high yielding mutant lines were selected and have been under trial.

In collaboration with the Ministry of Agriculture, the counterpart has also made a significant progress in mutation breeding of green pepper (for high quality), potato (for high quality tubers, early maturity), safflower *(C. Tinctorius* L. - for high yield and high oil content), Garlic (for of high yield and resistance to nematodes), Melon (for resistance to *Fusarium oxysporium).* Mutation techniques are also used for the improvement and domestication of mountain rye; nine advanced lines with changed habitus and productivity have been developed.

Qingyao Shu
Technical Officer



Mutation breeding of green pepper

Mutation breeding for crop improvement in Yemen, YEM/5/001, YEM/5/003, YEM/5/007

Yemen is considered to be one of the oldest agricultural civilizations in the world. The total arable land is estimated to be 1,663,858ha. Irrigated land is about 565,385ha. (45% of the total arable land). The country is divided into three major agro-ecological zones depending on the elevation at sea level and annual rainfall. These zones are: The Highlands, the Coastal area, and the Eastern plateau. The major water resources in the country are rainfall, underground water and seasonal springs. Yemen is facing a major challenge of water shortages and thereby it is highly desirable to change the selection criteria of yield per unit area to yield per unit of water used. Now our top priority is to develop drought resistant varieties in national breeding research programmes. In order to address our agricultural constraints, we started a mutation breeding programme in 2001 with the assistance of the International Atomic Energy Agency (IAEA), Vienna, as a Technical Cooperation projects. The main objective

was to improve the local cultivars to broaden their genetic variability by gamma irradiation and to select the desirable mutants, such as drought tolerant, lodging resistant, early maturation, disease resistant, and high yield.

The local and improved varieties of crops such as wheat, lentil, sesame and cotton were used for the mutation breeding programme. Their seeds were sent to Seibersdorf, IAEA for gamma radiation treatment. They were irradiated with different doses of gamma rays to induce mutations for traits such as earliness, drought, disease and lodging resistance, and yield.

Five wheat mutants were developed from the parent variety 'Gemmiza-9' by treating with doses of 250 and 300 Gy, and they were planted at the Al-era Research Experimental Station and the farmer's field for three consecutive seasons, 2005, 2006 and 2007. The results showed that there is one wheat mutant that was early maturing type as compared to the original variety and the check. This mutant line was resistant to yellow rust disease; they scored 10mr, while it is recorded for others 50 mr and 70 mr including the original variety. It yielded 3963 Kg/ha with 2556 and 2678 Kg/ha for original variety and control.

Specialists sharing ideas about some promising mutant lines with different characters grown in Al-kada Research Station 2007

In order to evaluate the yield and agronomical characteristics of local wheat mutants for the local variety (Arabi-1) which was characterized by low yield and susceptible to lodging under rainfed conditions, a field experiment was conducted at the Al-era Research Farm in Sana'a during the 2004 season and the farmers' fields during 2005 and 2006 in three areas: Khulan Affar, Shibam and Bani-Mater. The results indicated that the mutants (MA-2-1, MA-2-8 and MA-2-9) gave more yield (2196, 2197 and 2131kg/ha.) and differed significantly with the others and the check which gave 1441 kg/ha. These mutants were resistant to lodging and recorded more ear length and number of grains per ear.

Evaluation of promising mutant lines of local arabi-Al-erra farm - season 2004

Seeds of the Somalia variety were irradiated with 250 Gy. The mutants obtained were resistant to yellow rust and high yielding. Those mutants were grown in the research farm for final evaluation and producing enough seeds for transfer them to the farmer's field.

Sonalika mutant lines in Dhmar Research Station – Season 2008

Seeds of one local lentil cultivar (D 2001) were irradiated with a dose of 150,200 Gy. The irradiated plants were screened through the five years of mutation breeding. Finally we developed six mutants .These six mutants already were grown in the farmer's field for two consecutive seasons in 2005-2006. The results showed superior-

ity of two mutants for yield and earliness characteristics, Takah-1 and Takah-2, compared with the others mutants and mother plants. They yielded 1680 and 1517 kg/ha, respectively, compared with 888 kg/ha for control (mother plant).

We have also developed two mutants from another experiment. These mutants were evaluated in the farmer's field during the 2007 season. The next summer season 2008 will be for final evaluation. The best mutants will be selected to multiply seeds and disseminate to the farmers.

Another yield trial for six mutant lines high branches and early mature of lentil in farmers field – Season 2007

Seeds of local sesame were exposed to different gamma radiation doses: 300, 400 and 500Gy. An evaluation was done M5 for earliness, resistance to shattering and number of branches, and increase in the component of yield. The results showed that there are some mutant lines with different desirable characteristics such as earliness, resistance to pod fly, high yield, and high density of capsules on the stem with short and tall stature.

Mother plant (non-irradiated)

Specialists sharing ideas about some promising mutant lines with different characters grown in Al-kada Research Station – Season 2007

Cotton seeds of a variety ACALSJ2 were irradiated with 400, 500 and 600Gy doses of gamma radiation and were grown at the Tihama Experimental Research Station as the M1 generation. In segregating the M2 population, seeds of 88 plants were collected to raise the M2 generation and 28 plants were selected to develop the M3 population. In the subsequent generation the number of selected plants narrowed down to 18 plants and 12 plants in the M5 generation to raise the M6 population. In this generation, five mutants showed stability of the selected traits such as earliness and high yield. All the selected mutants are in the process of seed multiplication for their evaluation in the farmer's field. Based on the farmer's field evaluation, steps will be taken to register them as mutant varieties.

In this crop we developed some mutants having an increase in number of pods, weight of pods and productive branches compared to the control (non irradiated plants). All this material will be tested at the research farm in the coming season, 2007, for evaluation and the best will be selected for transferring into the farmer's field.

Some promising mutant lines grown in Al-Kadan Research Farm – Season 2007

Saif A. Abdulwahed, Al-Kibisi Mutahar, Al-Samiri A. Aref, Nagi Zaid, Kaid A. Hazza, Almaktari Abdulkawi, Al-Basha Rashad, Agricultural Research and Extension Authority

Ongoing Activities at the Plant Breeding Unit, Seibersdorf

Introduction

The Plant Breeding Unit's activities, is largely modulated by the obvious resurgence in the use of induced mutagenesis in Member States (MSs) for both crop improvement and functional genomics. The prognosis is that with the continuing exponential increases in the ready availability of annotated genome sequences, induced mutagenesis will continue to play even greater roles in both crop improvement and in the elucidation of gene functions. Additionally, the uncertainties of global climate change dictate the imperative of proactive strategies that will result in developing superior crop varieties that will adapt to harsh climatic conditions without compromising yield and quality. This scenario couples with the need for crop varieties whose end products (by virtue of diversified end use) contribute to obviating the increasing strain on the supply of food-based substrates for the competing needs of biomass for human nutrition, animal feeds and bioenergy. Induced mutations hold the promise for effecting subtle changes to the genetic make-up of high yielding crops to make them hardier and more responsive to needs for varied industrial applications.

This increased use of induced mutations, especially in developing Member States (as evidenced in TC projects and levels of participation in CRPs), come with the need for guidance through validated protocols in order to keep pace with this resurgence in enthusiasm for the technology. PBU is therefore presented with both the opportunity and challenge for developing efficient methodologies for the production of mutants and the detection of the relevant mutation events. The Unit's activities relating to adapting technologies for dissemination to Member States, support for human capacity development and the provision of services are therefore tailored to address this emerging trend. The programmatic reasoning behind this strategy has been that the outputs of these interventions would translate ultimately to enhanced capacity in MSs for using induced crop mutagenesis to address specific own country crop productivity constraints.

We present below the highlights of our activities aimed at enhancing Member State capacity for induced crop mutagenesis in the first half of 2008.

Technology Adaptation and Validation

Through our work adapting and validating relevant technologies that enhance the efficiency of induced mutagenesis, we aim at the dissemination of holisticpackages in this area to Member States. To achieve this, we are using our three-crop platform of banana, rice and cassava to establish robust methodologies for achieving precision in linking genotyping data to phenotypes. This incremental process currently involves building upon the capacity in the Unit for the identification of polymorphisms through DNA banding profiles in order to achieve greater precisions in the processes relevant to our present programmatic strategies. These relate to the use of reverse genetics in 'targeted' induced mutagenesis and the use of transcriptome profiling to link genotype to phenotype through the identification of candidate genes.

Driven by above, our activities in the past year (2007) therefore led to the development of a suite of high-throughput protocols for the reverse genetics strategy for detecting genomic aberrations at the sequence level, Targeting Induced Local Lesions IN Genomes (TILLING, for induced mutations) and Ecotilling (for spontaneous mutations). This was done for gene sequences related to traits of interest in banana, rice and cassava. Additionally, we added transcriptome profiling of the putative mutants to the technologies we deploy in genotypic characterization of mutants as a means for a more holistic understanding of the genic actions driving the mutations.

The foci of our activities in 2008 aim at building upon these platforms that have been established in the Unit and scaling them up to incorporate more gene targets and genotypes for the three crops. To date, the proof of principle trial phase for rice Ecotilling is completed, and we have screened 154 rice accessions with eight gene targets. We are beginning work to validate identified nucleotide polymorphisms. Initial results from banana and cassava Ecotilling are promising, suggesting that our optimized methods are suitable for a variety of different species. We are also expanding the scope of the transcriptome profiling of banana genotypes challenged with isolates from *Mycosphaerella fijiensis*. In addition, we are using the transcriptome analysis strategy to study response of rice Germplasm to salinity stress. For this, the samples include known rice genotypes (including induced mutants) with differential reactions to salt stress.

Human Capacity Development for Member States through Training the Trainer

The strategy for contributing to the development of a critical mass of skilled personnel in the use of induced mutagenesis in Member States is two-pronged, group and individual training activities. Our training activities during the first half of 2008 included the following:

Group Training

Regional Training Course (RTC) on the Application of Technology Packages to Breeding Based on Mutation Induction and Efficiency Enhancing Biotechnologies, RAS/5/048, Seibersdorf, Austria, 7–11 April 2008

Technical Officer: C. Mba

The group training activity was held at the IAEA Laboratories, Seibersdorf. The one-week training course was organized under the auspices of the ARASIA regional Technical Cooperation project, Mutation Induction and Supportive Breeding and Biotechnologies for Improving Crop Productivity, RAS/5/048. It was aimed at availing the participants of the opportunity of interacting with relevant staff of the Joint FAO/IAEA Programme in the setting of a research and development facility and by so doing gain theoretical understanding and hands-on practical experience on the suite of available technologies relevant for the implementation of the TC project. Another key aim of the course was to provide the setting for interaction amongst the key researchers in the project from the participating countries and thereby achieve the much desired cohesion needed for facilitating cooperation amongst them.

ased on the timeframe for the course and profile of participants, the instructional methodologies adopted were the presentation of theoretical bases of concepts in lecture formats; the demonstration of laboratory and computer-based procedures; and limited hands-on practical exercises. These activities emphasized the strategies for the use of biotechnologies to enhance the efficiency of the induction of mutations; the detection of mutation events; and the tracing of the inheritance of mutated segments of the genome in progeny. The last two involved both molecular marker systems in germplasm characterization as well as reverse genetics for detecting polymorphisms and transcriptome profiling for the identification of candidate genes.

The course modules are presented below by the instructional method used:

Training Course Modules by Instructional Method

Module	Instructional Method
Induced mutagenesis: methodologies, best practices; minimum requirements	Lecture
Induced mutagenesis: overview of procedures; detection of mutants and handling of mutagenic populations	
Using gamma irradiation for inducing mutations	Demonstration
Enhancing the efficiency for the induction and detection of mutation events	Lecture
Overview of strategies for *in vitro* techniques (apical meristem cultures; somatic embryogenesis; doubled haploidy)	Lecture
Introduction to molecular markers Overview of PCR-based techniques: RAPDs	Lecture
DNA extraction (introduction of steps)	Lecture
Initiation of aseptic cultures using apical meristems initiation of aseptic cultures using anthers	Demonstration & Practical exercises
DNA extraction and visualization	Practical exercises
Overview of PCR-based techniques: SSRs Overview of hybridization-based techniques: RFLPs	Lecture

Module	Instructional Method
Overview of PCR-based techniques: AFLP	
Introduction to the analysis of molecular genetic data	Lecture & Demonstration
Flow cytometry	Lecture/Demonstration
Overview of high throughput transcriptome assays	Lecture
Methodologies and analytical tools	Lecture & Demonstration
Overview of TILLING and Ecotilling: guiding principles and methodologies	Lecture
Resources and analytical platforms for TILLING and Ecotilling	Lab tour
Data analysis	Demonstration/Lecture
Standard Material Transfer Agreement (SMTA) mechanism for plant genetic resources	Seminar
Review of expectations vs. achievements	Interactive
Setting up an induced mutagenesis programme	Interactive

Aside from the presentation on the Standard Material Transfer Agreement (SMTA) mechanism for plant genetic resources given by a Rome-based staff of FAO, all the other resource persons for the technical and scientific modules were staff of the Joint FAO/IAEA Programme.

There were 15 participants from 6 member countries of the Co-operative Agreement for Arab States in Asia for Research, Development and Training Related to Nuclear Science and Technology (ARASIA), namely, Iraq, Jordan, Lebanon, Saudi Arabia, Syrian Arab Republic and Yemen. Additionally, 4 Fellows and 1 Intern in the Plant Breeding Unit also took part in the course.

It was deduced from the participants' expectations from the course that the following are the major crop production constraints for which induced mutagenesis would be a useful tool amongst the suite of other interventions being deployed in crop improvement in the region:

- Abiotic stresses, including drought and salinity, the 2 major production constraints for crops in the ARASIA region including soybean, sunflower, maize, barley, wheat, potato, rice, sorghum, garlic, and tomato.
- Biotic stresses, especially the wheat stem rust – caused by the Ug99 strain of *Puccinia graminis* -, a burgeoning pandemic that potentially poses the single most important threat to wheat production.

Another deduction from the participants' expectations related to the need for the integration of efficiency-enhancing biotechnologies in the development of mutant stocks and the detection of useful mutation events. In this regard, PCR-based molecular genetic marker systems and reverse genetics strategies for detecting polymorphisms were identified as missing critical capacities in the Member States.

The participants also identified mechanisms for handling mutagenic populations as skill that needed strengthening as induced mutagenesis becomes widely used in the Member States.

At the end of the course, the comments by the participants (barring those relating to length of the course) indicated that:

- The aim of making the participants aware of, and providing them with the opportunity for a modest familiarization with, key technologies relevant to induced crop mutagenesis was largely achieved;
- The course was useful for all the participants and would contribute to enhanced capacity for implementing ongoing projects in participating member states;
- Most of the participants had clear ideas as to the areas of ongoing activities that would be strengthened through the judicious deployment of relevant biotechnologies.

From the staff members' viewpoints, it was deduced that the interaction with member states' scientists made possible through the course provided an invaluable opportunity for enriching perspectives that drive the Secretariat's work.

Individual Training

Four Fellows and one Intern worked in the Unit on different themes relevant to work in their respective Member States relating to induced crop mutagenesis. The Fellows were sponsored under the Technical Cooperation Programme of the Agency. The details of these trainees are presented below:

Vietnam

Name	Affiliation/Country	Area of Training	Period
Ms. Rana Ibrahem Elias	Atomic Energy Commission of Syria/Syrian Arab Republic	• Induced mutation and molecular characterization of mutant germplasm using different molecular marker systems, and detection of mutations using TILLING.	January to July 2008
Ms. Parichart Sangkasaad	Biotechnology Research and Development Office/Thailand	• Molecular characterization of mutant germplasm using PCR-based molecular marker systems	March to May 2008
Mr. Anatole Ndemapou	Institut Supérieur de Développement Rural (ISDR) de M'baiki/Central African Republic	• Mutation induction in vegetatively propagated crops (including *in vitro* systems) and use of PCR-based molecular markers for germplasm genotyping.	March to August 2008
Ms. Zainab Al Hussain	The ministry of Science and Technology – Directorate of Agricultural Research/Iraq	• Induced mutagenesis using *in vitro* systems and basic molecular marker techniques for germplasm characterization.	March to July 2008

Fellows/Cost-Free Interns

The following consultants provided expert advice to support ongoing activities during the period under review.

Name	Country	Area of Training	Period
Mr. Danilo Gabriel Moreno	Ecuador	• Induced mutations and related biotechnologies for crop improvement and functional genomics	June 2007 to July 2008

Direct Services in Support of Induced Mutations Activities in Member States

Capacities for carrying out critical activities relating to induced crop mutagenesis vary between Member States. In order to mitigate shortcomings where internal capacity is lacking, the Unit provides services that directly support in-county activities. The most common request is for assistance in irradiating plant propagules while other requests include molecular genetic fingerprinting of mutants and the use of flow cytometry for ploidy level determination. In the first half of 2008, five Member States requested for irradiation services for 10 crop species thus:

Sierra Leone	Pearl millet and sorghum
Turkey	Sesame and eggplants
Germany	Ornamental plants and beet
Senegal	Sesame
Serbia	Maize, wheat and *amaranthus*

Plant Breeding Unit's Staff Travel to the Member States

Mr. C. Mba travelled to the Cali, Colombia headquarters of the International Centre for Tropical Agriculture (CIAT), 24-28 March 2008 in order to participate in a workshop showcasing the cassava induced mutants developed through collaborative activities between CIAT and the Agency. The recommendations to the Agency include a call for continued support to its cassava work while seeking for other counterparts beyond the CGIAR centres for field trialling of the putative mutants.

Ms. R. Afza travelled to Quito, Ecuador, 16-24 February 2008 on an expert mission for the Technical Cooperation Project (TCP), ECU5023, 'Inducing mutation in Agriculture with the aid of radiation'. The assignment was aimed at providing assistance to the national counterparts at the Instituto Nacional Autonomo de Investigaciones Agropecuaras (INIAP) in establishing a mutation breeding program for the genetic improvement of maize, potato and barley.

Mr. B. Till attended the Plant and Animal Genome XVI conference in San Diego, California, USA, 12-16 January 2008. He presented a poster and gave an oral presentation on the Plant Breeding Unit's work on banana TILLING and Ecotilling at the Banana (Musa) Genomics Consortium Workshop of the conference.

Mr. B. Till taught a TILLING workshop at the Institute for Plant Breeding, Christian-Albrechts-University in Kiel, Germany that was sponsored by the University from 1 to 4 April 2008. Twelve participants, representing research efforts in a variety of crops including wheat, barley, rye, rapeseed and sugar beet, attended. This well-received workshop covered all aspects of the TILLING method from sample preparation to data analysis. The Joint Programme will be articulating modalities for handling such off-campus training activities in the future.

Vietnam

Announcements

International Symposium on 'Induced Mutations in Plants (ISIM)' International Atomic Energy Agency, Vienna, Austria, 12-15 August 2008

1. Background

The year 2008 will mark the 80th anniversary of mutation induction in crop plants. The application of mutation techniques, i.e. gamma rays and other physical and chemical mutagens, has generated a vast amount of genetic variability and has played a significant role in plant breeding and genetic studies. The widespread use of induced mutants in plant breeding programmes throughout the world has led to the official release of more than 2600 mutant crop varieties. A large number of these varieties (including cereals, pulses, oil, root and tuber crops, and ornamentals) have been released in developing countries, resulting in enormous positive economic impacts.

The International Symposium on Induced Mutations in Plants (ISIM) will be the eighth in the Joint FAO/IAEA Programme's Symposium series dedicated exclusively to harnessing and disseminating information on current trends in induced mutagenesis in plants, the first of which was held in 1969 and the last in 1995. These previous symposia dealt with themes relating to the development of efficient protocols for induced mutagenesis and their role in the enhancement of quality traits, as well as resistance to biotic and abiotic stresses in crops and the integration of in vitro and molecular genetic techniques in mutation induction.

Since 1995, there has been an increased interest within the scientific community, not only in the use of induced mutations for developing improved crop varieties and for the discovery of genes controlling important traits and understanding their functions and mechanisms of actions, but also in deciphering the biological nature of DNA damage, repair and mutagenesis. A symposium that brings together the key players in basic research, as well as in the development and application of technologies relating to the efficient use of induced mutations for crop improvement and empirical genetic studies, is therefore justified and necessary.

2. Main Topics

Topics to be addressed at the symposium:

- Molecular genetics and biology of physical, chemical and transposon-induced mutagenesis
- New mutation techniques, i.e. ion beam implantation, and their integration with other molecular and biotechnological techniques
- Induced mutations in crop breeding programmes
- Mutation induction for gene discovery and functional genomics, including targeting induced local lesions in genomes (TILLING) and other reverse genetic strategies
- Mutational analysis of important crop characters (tolerance to abiotic stresses, resistance to diseases and insects, quality and nutritional characters, etc.)
- Socio-economic impact of widespread mutant varieties.

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Symposium Web Page

Please visit the IAEA symposium web page regularly for new information regarding this symposium: http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=167

EUCARPIA 18th General Congress

Modern Variety Breeding for Present and Future Needs, Valencia, Spain, 9-12 September 2008

Scientific Topics and Sessions

The scientific topics of the Congress include modern approaches to the conservation of genetic resources and prebreeeding, improvement of breeding methods and techniques and their practical application to breeding for higher yield, resistance to stresses and improvement of quality, evaluation and release of breeding material, im-

plications of intellectual property rights in breeding programmes, public perception of plant breeding and biotechnology.

These topics will be organized in four sessions:

1. Conservation of genetic resources and prebreeding

Present status and progress in the collection, conservation, characterization, evaluation, documentation, and enhancement of genetic resources and agricultural biodiversity.

2. Breeding for yield and resistance to biotic and abiotic stresses

Advances in breeding for higher yield under optimal and marginal conditions, and resistance or tolerance to biotic and abiotic stresses that limit the crop production.

3. Breeding for quality

Advances in breeding for improved sensorial and nutritional quality, functional foods, and breeding for quality for industrial purposes.

4. Evaluation and release of breeding material and new breeding objectives

Developments in the evaluation and release of improved materials, implications of intellectual property rights in breeding programmes, public perception of plant breeding and biotechnology, and trends in breeding for future needs.

Congress Web Page

For more information please visit the Congress Web Page: http://www.comav.upv.ex/congreso/index.html

Publications

Recent Staff Articles Published in Scientific Journals

A revisit of mutation induction by gamma rays in rice (*Oryza sativa* L.): Implications on microsatellite markers for quality control

Fu, H.W., Li, Y.F. and Shu, Q.Y.

Molecular Breeding (on-line), DOI 10.1007/s11032-008-9173-7

Abstract

Mutation techniques have been used for generating genetic variation and breeding new varieties during the past decades. However, the skepticism has also persisted during the course on the sole mutational origin of genetic variation in mutated populations. We addressed this issue using three unique rice genetic lines in this study. First, we confirmed that gamma rays had significant effect on the growth of M1 plants, leading to significant reduction of fertility, seed set and plant height at doses 200 Gy and above. Second, we proved that out-crossing derived genetic variants existed in M2 population (0.8%) and among selected putative mutants (0–33.3%), in addition to induced mutants. Third, we demonstrated that true induced mutant lines had identical microsatellite haplotypes to their parents. We proposed microsatellite assay as a method to exclude any genetic contaminants from induced mutants, with appropriate numbers for different levels of power based on reported microsatellite mutation rate and microsatellite polymorphic index.

(2008)

Recent Staff Articles Presented at a Meeting

Plant molecular mutation breeding

Presented by Q.Y. Shu, at the 5th International Crop Science Congress and Exhibition (13-18 April 2008), Jeju, Republic of Korea

Abstract

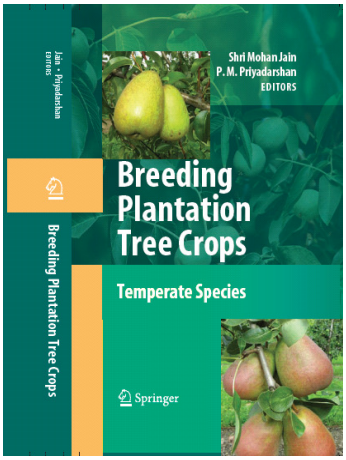
The advance in molecular genetics and DNA technologies has brought plant breeding including mutation breeding into a molecular era. Plant molecular mutation breeding is here defined as mutation breeding in which molecular or genomic information and tools are used in the development of breeding strategies and in the implementation of the breeding process. It is built upon the science of DNA damage, repair and mutagenesis, plant molecular genetics and genomics of important agronomic traits as well as induced mutations. Mutagenic treatment, supermutable genetic lines, molecular markers and high throughput DNA technologies for mutation screening such as TILLING (Targeting Induced Limited Lesions IN Genomes) are the key techniques and resources in molecular mutation breeding. Molecular mutation breeding will significantly increase both the efficiency and efficacy of mutation techniques in crop breeding. A perspective molecular mutation breeding scheme is proposed for discussion.

(2008)

Recent Non-IAEA Publications in the Field of Plant Breeding and Genetics

Breeding Plantation Tree Crops: Tropical Species

Jain, S.M. and Priyadarshan, P.M. (Eds.)



Abstract

Tree species, spread across a wide range of genera, are indispensable to human life. Their breeding, poised to satisfy human needs, presents significant challenges. Tree crops face a variety of agronomic and horticultural problems in propagation, yield, appearance, quality, diseases and pest control, abiotic stresses and poor shelf-life. Additionally, shrinkage of cultivable land and the pressure of growing demand have resulted in growth of tree crops under marginal conditions that call for concerted efforts for their genetic improvement. Increased attention to the environment, sustainability and diet in recent years in turn magnifies the importance of study of these crops. With the use of modern molecular and biotechnological tools, the task of improving yield in tree crops is foremost in the acumen of future global agricultural research for sustainable production.

This two-volume book series deals with both tropical and temperate tree crop species, and represents an effort toward compilation of all available worldwide research on these subjects. This volume covers fruits and nuts (banana, mango, guava, papaya, grape, date palm, litchi, avocado, and cashew), oil crops (coconut, oil palm and

olive), industrial crops (rubber) and beverages (coffee, tea and cocoa). The contributing authors are internationally-known specialists who provide first hand comprehensive knowledge. All contributory book chapters have been peer reviewed and revised accordingly. This book series is an indispensable reference for scientists, researchers, teachers, students, policy makers and planters.

(2008) ISBN 978-0-387-71199-7

Hardcover

Publications within Coordinated Research Projects (CRPs) as of 2004

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Mutation Breeding Newsletter (published until 2003)

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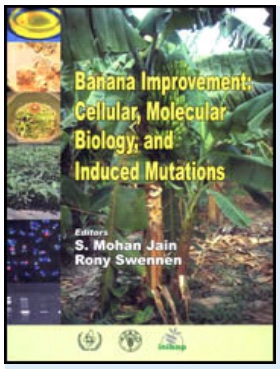
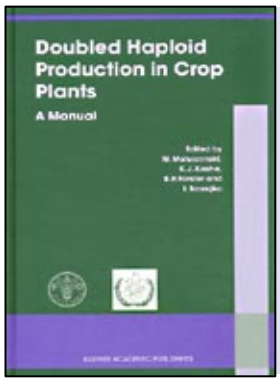
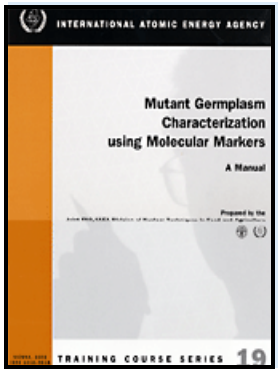
2004		Banana Improvement: Cellular, Molecular Biology, and Induced Mutations		ISBN 1-57808-340-0
2003		Doubled Haploid Production in Crop Plants – A Manual		ISBN 1-4020-1544-5
2002	Training Course Series No. 19	Mutant Germplasm Characterization using Molecular Markers – A Manual		ISSN 1018-5518

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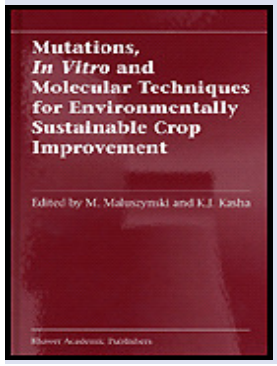
2002		Mutations, *In Vitro* and Molecular Techniques for Environmentally Sustainable Crop Improvement		ISBN 1-4020-0602-0

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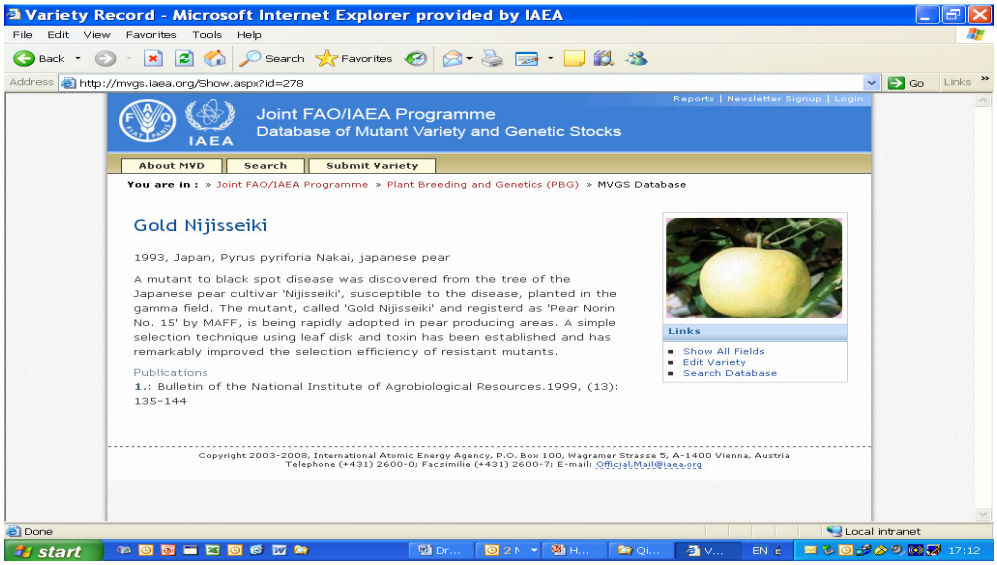

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