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Fruiting in micropropagated date palm tree, variety 'Deglect Noor' –TC project RAF/5/035

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To Our Readers

Pierre J.L. Lagoda

Much has happened in the last six months. It is not difficult to rank these events by order of importance because the major one concerns the retirement of Prof. Miroslaw Maluszynski as Head of the Plant Breeding and Genetics Section of the Joint FAO/IAEA Division (NAFA/AGE). Prof. Maluszynski "retired" to his former position as Head of the Department of Genetics at the University of Silesia (Poland). How to honour a man like Prof. Maluszynski? All words will sound hollow compared to his achievements. So let his achievements speak for themselves, and you counterpart, colleague, consultant or expert, trust your memories and your heart. I just want to mention that Prof. Maluszynski received the Distinguished Service Award from the IAEA for his dedication in heading the Plant Breeding and Genetics Section. He left grateful Technical Officers who had the honor to serve the Member States under his guidance.

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And here I will stop before this column resembles an obituary, because Prof. Maluszynski has not finished to be scientifically active, indeed. You will meet him at one or the other Conference, Seminar or Symposium around the world. And my guess is that you already have asked for printouts of his newest scientific works.

Now, who am I, talking to you?

My name is Pierre J.L. Lagoda (Luxembourg). Being a trained molecular biologist, who turned to tropical crops 12 years ago, focusing on molecular genetics and breeding of banana and plantain (CIRAD, France), my latest interests lie in comparative genomics (*Musa* – rice). I am the new Head of Plant Breeding and Genetics Section but I am not telling you that I will replace Prof. Maluszynski, because my feet are too small to fill his shoes. I am just starting to tiptoe along the broad path he has laid out for us. Just let me express here my gratefulness to Prof. Maluszynski for leaving me a tidy ship and a sturdy crew. And that much is needed for the interesting voyage into the unknowns. Many a task lie ahead, but the route is only roughly charted. I will do my very best to tackle the challenges ahead, like breeding crops in harsh environments, quality traits, biotic/abiotic stresses, and monitoring scientific progress in mutation induction and related biotechnologies in order to adapt the most performing techniques to support and enhance breeding programmes in Member States.

Another salient event was the nomination of Dr. Chikelu Mba (Nigeria) as the new Head of the Plant Breeding Unit at Seibersdorf. Dr. Mba is a trained plant breeder and geneticist and former research fellow at CIAT (Colombia) and former Coordinator of the Cassava Biotechnology Network.

This biennium (2004–2005) is also marked by the creation of the Agency's Subprogramme of Sustainable Intensification of Crop Production Systems (E1) through the merger of the Soils and Plant Breeding and Genetics Subprogrammes together with part of the Entomology Subprogramme activities.

Implementation of a new Coordinated Research Project (CRP) on the "Effects of Mutagenic Agents on the DNA Sequence in Plants", and the successful submission of a new CRP proposal on "Pyramiding of Mutated Genes Contributing to Crop Quality and Resistance to Stress Affecting Quality" were among the major activities of our Subprogramme during the last six months. We actively participated in the International Year of Rice (IYR 2004) events such as the Meeting of the Informal International Working Group on the International Year of Rice (IIWG) and the FAO Rice Conference on "Rice in Global Markets and Sustainable Production Systems" (Rome, Italy), both in February this year. A lot of work has been concentrated this last semester on the preparation of Programme and Budget for the biennium 2006–2007 and the appraisal of TC proposals for the biennium 2005–2006.

The Mutation Breeding Newsletter and the Mutation Breeding Review will merge to become the Mutation Breeding Newsletter & Reviews (MBN&R). Starting at the end of July, the MBN&R will appear on a regular basis. Whether the frequency will be annual or every semester will depend on your input.

Pierre J.L. Lagoda

Happy Anniversary

Congratulations to NIAB (National Institute for Agriculture and Biology, Faisalabad, Pakistan) for 30 years of fruitful striving for the agricultural development of Pakistan.

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Forthcoming Events

Coordination Meeting of the Regional Project on the "Field Evaluation of Bayoud Resistant Date Palm Mutants" RAF/5/049, Sfax, Tunisia, 7–11 June 2004

Technical Officer: S.M. Jain

This project is the extension of RAF/5/035 entitled Control of Bayoud Disease in Date Palm. The last coordination meeting was held in 2002. The next coordination meeting of this project will be held in Sfax, Tunisia. Project coordinators from Algeria, Morocco, Tunisia, as well as IAEA staff will attend this meeting. During this meeting, an overall in-depth analysis of the project will be done. Further continuation of the project will solely depend on the continuous supply of FOB toxin to all participating countries for the isolation of Bayoud resistant date palm mutants. The supply of toxin has top priority on the agenda.

National Training Course on "*In Vitro* Large-Scale Plant Production and Cryopreservation of Mutants" MAL/5/024, Bangi, Malaysia, 12–16 July 2004

Technical Officer: S.M. Jain

The purpose of this course is to train plant breeders/biotechnologists in large-scale plant production and multiplication, long-term storage of mutant lines, hardening of *in vitro* plants, low cost of plant production, and greenhouse technology. The training will comprise of theory lectures on bioreactor technology and their applications in plant multiplication, secondary metabolite production; cryopreservation; low temperature storage, hardening of *in vitro* plants, greenhouse types and maintenance; cost reduction of plant production; practical demonstration in bioreactor and cryopreservation; a visit to a biotechnology company and trips to an experimental station and a micropropagation laboratory. The local course director and project counterpart of the project MAL/5/024 will select 15 qualified participants from local institutes, engaged in mutation assisted breeding of ornamental plants and/or banana.

Regional (AFRA) Training Course on "Screening Techniques for Drought Tolerance and Salinity" RAF/5/050, Tangiers, Morocco, 12–16 July 2004

Technical Officer: S. Nielen

This training course is for plant breeders/agronomists from institutes included in the project RAF/5/050 and engaged in research teams involved in the development of mutant germplasm of major crops with improved drought tolerance. The purpose of the course is to share experience with other collaborating scientists from the region. Presentations delivered by the participants and lectures provided by international experts will be the basis for continuous improvement of the drought screening guidelines, which have been drafted of the previous workshop in Lusaka, Zambia, November 2003. Practical exercises on appropriate screening techniques for drought and salinity tolerance and a field visit to a research station will be used to address specific technical problems as well as introducing these techniques to participants without previous experience. Drought screening techniques will focus on those traits that have been identified at the Lusaka meeting as being most relevant as measurement to determine tolerance to drought stress.

Second Interregional Training Course on "Application of Induced Mutations and Biotechnology for Crop Salt Tolerance Improvement" INT/5/147, Beijing, China, 2–6 August 2004

Technical Officer: S.M. Jain

The purpose of this course is to impart training to plant breeders in mutation techniques, molecular markers, and biotechnology including doubled haploid technique and *in vitro* plant regeneration for accelerating the breeding cycle for developing salt tolerant lines by applying appropriate screening techniques. Trait specific molecular markers will help in expediting molecular marker-assisted breeding of salt tolerant varieties. The training course will be comprised of theory lectures, field trip to the farmer's field and experimental station, and practical demonstration on microspore cultures and *in vitro* mutagenesis. The participants in this course will be selected from nominees submitted by the Governments of their respective countries in the framework of project INT/5/147.

National Training Course on "Molecular Markers and Screening Techniques for Biotic Stress Tolerance in Black Pepper" SRL/5/034, Matale, Sri Lanka, 30 August–3 September 2004

Technical Officer: S.M. Jain

The main objective of the training course is to train plant breeders/biotechnologists in molecular markers for the identification of trait specific markers and other applications; screening techniques for biotic stress tolerance in order to select and maintain drought/heat tolerant black pepper mutants. The training will be comprised of theory lectures on molecular marker technology and their applications in plant breeding; identification of trait specific markers, e.g. drought tolerance; characterization of black pepper germplasm; screening techniques for drought tolerance at early stage of plant development in the greenhouse and later on at the field level. The participants in

this course will be selected from the national nominees in the framework of project SRL/5/034. All participants must be engaged in mutation-assisted breeding and biotechnology dealing with genetic improvement of black pepper. Participants must have university training in plant breeding and a working knowledge of molecular biology and biotechnology.

Regional Training Course on "Induced Mutations for Crop Quality Improvement" RAS/5/040, Beijing, China, 30 August–8 September 2004

Technical Officer: Q.Y. Shu

The training course is open to breeders, geneticists and biochemists from RCA Member States in Asia and the Pacific Region working on crop improvement and mutant characterization in each participating country, who have been actively involved in the regional project RAS/5/040, on mutation techniques for food, pulse and oil improvement. The objective of this training course is to provide young scientists involved in the project with advanced knowledge and skill related to evaluation, selection and improvement of crop quality traits. It will also help the scientists to improve and update their knowledge of mutation induction and selection and improvement of important quality characters, their genetic, genomic, biochemical and physiological basis and the methodologies of national and international standard evaluation protocols. The regional project, focusing on the enhancement of genetic diversity in food, pulses and oil crops through application of mutation techniques and establishment of mutant germplasm network was established in 2002 and is being implemented in 15 participating institutions from nine Member States.

Fourth Research Coordination Meeting on the "Molecular Characterization of Mutated Genes Controlling Important Traits for Seed Crop Improvement", Faro, Portugal, 6–10 September 2004

Technical Officer: P.J.L. Lagoda

The CRP was initiated in 1999 with the aim of assisting Member States to apply molecular genetics of mutated genes for improving production in both major cereals and related under-utilized crops. More specifically, to collectively develop, characterise and data-base mutant collections of key crops for application in breeding programmes and to molecularly characterize new or existing mutated genes affecting key agronomic traits in major crops using comparative approaches in under-utilized crops with a view to their eventual isolation. This meeting will give all participating groups the opportunity to report their achievements made during the past five years, and discuss future directions in this field. Since it is the final Research Coordination Meeting (RCM), all the results obtained during the CRP will be published as a TECDOC.

First Research Coordination Meeting on the "Pyramiding of Mutated Genes Contributing to Crop Quality and Resistance to Stress Affecting Quality", Vienna, Austria, 13–17 September 2004

Technical Officer: Q.Y. Shu

The improvement of quality traits in food and industrial crops is among the most important goals in plant breeding, and is gaining more and more attention. Improved crop quality is of great economical and social value for both developed and developing countries, and has the capacity to bring about greatly enhanced quality of life. Major constraints to improve quality in agricultural crops include a lack of understanding of the genetic basis of quality traits and limited diverse and desirable germplasm, and the difficulty in efficiently combining favourable alleles into an optimal genotype. This CRP will address the problems associated with pyramiding mutated genes contributing to crop quality and will use marker assisted selection (MAS) to accelerate plant quality improvement. In the first RCM, around 18 contract/agreement holders will be invited to present the background and working plan of their project. Working groups will be established to coordinate different research activities and individual working plans of research contracts will be reformulated as appropriate.

Fourth Interregional Training Course on "Mutant Germplasm Characterization using Molecular Markers", Seibersdorf, Austria, 27 September–22 October 2004

Technical Officers: S. Nielen & C. Mba

The course will entail lectures and practical laboratory exercises covering the theory and use of DNA markers with particular emphasis on their applications in plant breeding and in utilisation of crop plant mutants. The course will include substantial hands-on training and the topics covered will include radioactive labelling and detection, commonly-used DNA marker techniques (AFLP, SSR, ISSR, and retrotransposon based marker techniques), TILLING, chromosomal analysis using fluorescence *in situ* hybridisation, applications of DNA markers (marker-assisted selection, DNA fingerprinting, linkage analysis and genetic mapping principles) to enhance the utilisation of plant mutants. A special focus of this year's course will be one-week computer based training on mapping and phylogenetic analyses. A short introduction to sequencing and advanced bioinformatics will be given.

The training course is open to 20 participants from developing Member States of FAO and IAEA. From the 20 available places five will be awarded to participants working within the PRO*MUSA* programme and being nomi-

nated through IPGRI - INIBAP/PRO*MUSA*. Applications must be submitted through the official channels. For more information on the application procedure and to download the nomination form, please check: http://www.iaea.org/programmes/nafa/dx/index.html

Deadline for nominations: 30 June 2004

Third Research Coordination Meeting on the "Improvement of Tropical and Subtropical Fruit Trees through Induced Mutations and Biotechnology", Nelspruit, South Africa, 4–8 October 2004

Technical Officer: S.M. Jain

Tropical and subtropical fruits are quite important in developing countries for socio-economic, food security and nutrition. Value added fruit crops would certainly benefit growers economically. It takes a long time to genetically improve tropical and subtropical fruit trees due to their long life cycle. So far, this CRP has made excellent progress in utilizing various strategies to recover different type of mutants. The third and final RCM will be held in October. Since it is the final RCM, all the results obtained during the CRP will be published as a TECDOC.

Third Research Coordination Meeting on the "Mutational Analysis of Root Characters in Annual Food Plant Performance", Antalya, Turkey, 11–15 October 2004

Technical Officer: Q.Y. Shu

This will be the final RCM of this CRP. Currently there are 21 participating institutes in this project. This meeting enables all participating groups to report their achievements made during the past five years, and discuss future directions in this field (e.g. "Roots Consortium"). The material presented at the meeting will be published as a TECDOC.

National Training Course on "Application of *In Vitro* Culture, Mutations and Molecular Markers in Horticultural Crop Improvement" PHI/5/029, Manila, Philippines, 25–29 October 2004

Technical Officer: S.M. Jain

The main purpose of the training course is to impart training to plant breeders/biotechnologists in developing somatic embryogenic cultures and applications, large-scale plant production and multiplication, molecular markers for mutant characterization. The training will be comprised of theory lectures on bioreactor technology and their applications in plant multiplication, micropropagation, somatic embryogenesis, and applications in mutation induction and clonal propagation, cryopreservation, different molecular markers such as AFLP, SSRs, and others, microarray and TILLING, applications of molecular markers; a field trip to a molecular biology lab in IRRI; and practical demonstrations in molecular markers. Local course director and project counterpart of the project PHI/5/029 will do the selection of the participants for the training course.

Consultants Meeting on "Vegetatively Propagated Crops", Vienna, Austria, 8–11 November 2004

Technical Officers: P.J.L. Lagoda & C. Mba

Among vegetatively propagated crops, root and tuber crops, including banana and cassava, have myriad and complex roles to play in feeding the world in the coming decades. These crops are faced with major problems of post harvest storage, poor quality and nutrition, and low tolerance to biological stress. As a result, high quality products for food, feed and industry are unavailable to the consumers and industry. The end results are national economic problems and uncertainty of food security and nutrition. Previous CRPs on improvement of vegetatively propagated crops did not address some of these problems, especially quality and nutrition, as they were mainly devoted to the development of *in vitro* methodologies.

This CRP is expected to address micropropagation and molecular characterization of mutants, identify trait specific molecular markers, which could be used for marker-assisted breeding, control of homogeneity in micropropagated populations and for mutant clone protection. It will contribute to a better understanding of induced mutation aspects in vegetatively propagated crops and is bound to open up leads to possible applications of molecular tools for speeding up the breeding process of asexually propagated plants.

Regional Training Course on "Cost Effective Up Scale *In Vitro* Plant Production and Long-Term Storage of Mutant Plant Material" RAF/5/049, Sfax, Tunisia, 29 November–3 December 2004

Technical Officer: S.M. Jain

The basic purpose of this course is to provide training to plant breeders/biotechnologists in large-scale plant production and multiplication, long-term storage of mutant lines, hardening of *in vitro* plants, low cost of plant production, and greenhouse technology. The training will be comprised of theory lectures on bioreactor technology and their applications in plant multiplication, cryopreservation; low temperature storage, hardening of *in vitro* plants, greenhouse types and maintenance; cost reduction of plant production; practical demonstration in bioreactor and cryopreservation: A trip will be made to a date palm experimental station in Toezeur. This training course is open to 15 qualified participants from local institutes, which are engaged in mutation assisted breeding of date palm. All participants must be engaged in mutation-assisted breeding and biotechnology dealing with genetic improvement of date palm. Participants must

improvement of date palm. Participants must have university training in plant breeding and a working knowledge of mutagenesis, biotechnology, and horticultural science.

First Research Coordination Meeting on the "Identification and Combining of Mutated Genes: Novel Approaches for Improving Crop Tolerance to Salinity and Drought", Vienna, Austria, 29 November–3 December 2004

Technical Officers: S. Nielen & S.M. Jain

As drought and salinity are major constraints in crop production and food security, and have particular economic and social impact on poor people in developing countries, the development of crops with tolerance has high priority. A major constraint to improved tolerance is a lack of understanding of its complex genetic basis and the difficulty in efficiently combining favorable alleles into an optimal genotype. This led to the limited success of previous efforts at improvement using conventional techniques. This CRP will address the problems associated with screening natural and mutated germplasm, and identifying and pyramiding genes contributing to abiotic stress tolerance, and will use marker-assisted methods and induced mutations to accelerate improvement. The first RCM will be held in Vienna, Austria, 29 November-3 December 2004. In this CRP, we expect 10-12 research contract holders from the developing countries, and five research agreement holders from developed countries.

Past Events

First Research Coordination Meeting on the "Effects of Mutagenic Agents on the DNA Sequence in Plants", Vienna, Austria, 1–5 March 2004

Technical Officer: P.J.L. Lagoda

The first RCM was held in Vienna, Austria, 1–5 March 2004, joining 13 participants from Bulgaria, China, Colombia, India, Korea, the Philippines, Poland, South Africa, United Kingdom and USA. The Plant Breeding Unit at Seibersdorf contributed a project bound to deliver data from their programme on banana and rice.

This CRP is atypical as compared to previous ones, because of its molecular focus and upstream orientation. The reason for the choice of this particular research subject is that the use of induced mutants in breeding has had a profound impact on world agriculture, measured in billions of dollars and millions of planted hectares: more than 2300 new crop varieties, all carrying novel induced variation, have up until now been officially registered (IAEA Mutant Varieties Database). But this has all been achieved largely in the absence of knowledge of the precise changes induced at the DNA level. Indeed there still is very little understanding of the nature of the mutations induced by different mutagens. Today, with the range of technologies available to the scientific community to assay variation in DNA sequence and the availability of a vast amount of crop plant DNA sequence, including the complete sequences of both *Arabidopsis* and rice, this question can now be approached. On the other hand, with the advent of molecular genetics and genomics, induced mutations are finding new applications in modern plant breeding. Reverse genetics and deletion library methodologies capable of discovering new genes and their modes of action are often underpinned by variation induced by both physical and chemical mutagens. However, the efficiency of these new methods will be enhanced only when the type, frequency and distribution of mutations in a range of crop species can be predicted, and ideally directed.

This Coordinated Research Project sets out to define the type, frequency, rate and patterns of molecular changes induced by the range of physical and chemical mutagens in a range of crops, including seed and vegetatively propagated, annual and perennial as well as diploid and polyploid species. The CRP will focus on physical mutagens such as gamma radiation, fast neutron and X-rays. Selected chemical mutagens will be used to compare the relative efficiency of both types of mutagenic agents.

Consultants Meeting on "Identification and Combining of Mutated Genes: Novel Approaches for Improving Crop Tolerance to Salinity and Drought", Vienna, Austria, 15–19 March 2004

Technical Officers: S. Nielen & S.M. Jain

Drought and salinity stress are complex phenomena involving several climatic, edaphic and agronomic factors, often aggravated by high temperatures, high levels of solar radiation, and poor soil characteristics in the target environments. Yield losses due to drought and salinity can reach 80%, depending on the timing, intensity, and duration of the stress coupled with other location-specific environmental factors. The constant challenge in world agriculture is therefore to reduce the gaps between the potential and the average yields obtained on farmers' fields under stress conditions to assure sustained food security for the benefit of resource-poor farmers.

1. Salt stress: Plant salt tolerance is generally defined as the inherent ability to withstand the effects of high salts

in the root zone or on the leaves without significant adverse effects on productivity. It is a complex trait involving responses to cellular ionic and osmotic stresses, their consequent secondary stresses, (*i.e.* oxidative stress), and their integration in the whole plant. The relationship between the cellular, metabolic and molecular processes associated with tolerance to salt-stress needs further detailed investigation if improvements in tolerance are to be made. Most crop species are sensitive to salt stress at all stages of development, although tolerance at one stage is often not correlated with tolerance at others. Thus, specific growth stages should be evaluated separately to assess tolerance and identify, characterise and utilise useful genetic components. Each stage (which may be considered as a separate trait) may require a different screening procedure, and simultaneous or sequential screening may be impractical or impossible. Partitioning traits in this way may facilitate a better understanding of the genetic basis of stress tolerance and development of stress tolerant plants.

2. Drought stress: Drought resistance is the plant's ability to adapt to and survive water deficit conditions, resulting in minimal yield losses. It is a complex trait, but can be simplified if one considers specific developmental stages and morphological and physiological components affecting plant water status and yield. Based on this, we can identify three general strategies of plant adaptation to drought. Drought escape is basically early flowering and completion of the life cycle, while drought avoidance involves developing leaf properties to prevent water loss or establishing deep roots to access additional water. Drought tolerance is where the plant builds up cellular capacity to survive tissue water deficits. The development of drought tolerant crop varieties will require the understanding and integration of these mechanisms to contribute to the relevant strategies for particular crops and target environments. As with salinity, this will require a better understanding of the relationship between the cellular, metabolic and molecular processes involved in drought tolerance.

Overall Objectives

To identify and develop germplasm of cereals and grain legumes with superior resource use efficiency and adapted to stress environments, in order to increase its availability and exchange between Member States.

Specific Objectives

1. To pyramid identified genes and genotypes for effective improvement of stress tolerance in locally important cereals and grain legumes which contribute to food security using marker-assisted and other biotechnologies as well as farmer-participatory selection.
2. To develop refined nuclear and molecular techniques for screening large germplasm populations for improved yield and water use efficiency under saline and drought conditions.
3. To generate genetic variability and to use existing mutated and naturally tolerant germplasm of crop plant genetic resources to identify genes controlling various traits contributing to tolerance to drought and salinity in defined environments and so gain a better understanding of the physiological and molecular basis of plant tolerance to drought and salinity.
4. To foster relationships, transfer knowledge, technology, and genetic and molecular resources between all participating research groups for their mutual benefit.

Project Outputs

- Target environments and genetic resources identified and categorized using participatory processes (Objective 1).
- Efficient methodologies for the induction of mutants and screening of crop germplasm with desirable tolerance characters developed (Objectives 1, 2).
- Molecular markers linked to farmer-preferred traits, components of water use efficiency, yield and enhanced tolerance to stresses in induced mutants and other germplasm identified (Objectives 1, 2).
- Mechanisms for tolerance to abiotic stress characterised and genes identified and pyramided into breeding lines (Objective 1, 3).
- Newly characterized lines, including mutated germplasm, with genetically tagged loci produced through marker-assisted pyramiding evaluated by farmers and ready to be entered into national or regional breeding programmes for tolerance to abiotic stresses (Objective 3).
- Cutting-edge molecular genetic techniques for crop tolerance improvement transferred and improved genotypes exchanged (Objective 4, Subprogramme objective).
- Sustainable research network that outlives the CRP as a platform for continuing application of molecular breeding and mutation technologies to crop improvement in stress environments established (Objective 4, Subprogramme objective).

- Guidelines and approaches, accessible through the Internet and publications, for the application of molecular markers in crop improvement programmes in stress environments (Objective 4, Subprogramme objective).

The consultants of this meeting were: Dr. S.K. Sopory, International Centre for Genetic Engineering and Biotechnology, New Delhi, India; Dr. H. Nguyen, University of Missouri, Columbia, USA; and Dr. P. Hollington, University of Wales, Bangor, UK.

First Interregional Training Course on "Mutation, Biotechnology and Screening Techniques for Tolerance to Salinity" INT/5/147, Faisalabad, Pakistan, 26–30 April 2004

Technical Officer: S.M. Jain

The basic purpose of this training course was to introduce molecular marker technology for the detection of salt and drought tolerant genes and develop molecular marker assisted breeding; and screening techniques for salt tolerance. The course was held at the National Institute for Agriculture and Biology (NIAB), Faisalabad, Pakistan from 26–30 April 2004. Ten participants attended; five from Pakistan and one participant each from China, Costa Rica, Cuba, Guatemala and Thailand. They differed in their academic background with similar goals of saline agriculture. Dr. R. Yadav, UK, gave eight lectures on molecular markers in saline agriculture, which included a computer demonstration on mutated gene mapping. Dr. P. Hollington, UK delivered six lectures on screening techniques for salinity and drought. A full day field trip was organized in Pukka Anna and Shorkot to visit farmer's fields, practical demonstration of digging holes with a tractor in high saline soil, see irrigation system, saline water ponds for aquaculture and crops growing in saline soil**.** At the end of the course, all participants were provided with a CD disk containing all lectures delivered during the course. Overall, participants were satisfied with the quality of teaching and arrangements. Participants suggested the inclusion of practical demonstrations and the reduction of theory lectures. The second training course will be held in Beijing, China, 2–6 August 2004.

Status of Existing Coordinated Research Projects

Mutational Analysis of Root Characters in Annual Food Plants Related to Plant Performance

Technical Officer: Q.Y. Shu

This CRP was initiated in 2000, with the overall objective of assisting Member States to apply mutation techniques and related biotechnology to generate and utilize mutants for the identification of root properties and genes for improvement of crop plants. At the present time there are 21 participating institutes in this project. Reports were obtained from all and evaluated. The second RCM was organized by the Department of Genetics, University of Silesia and held in Krakow, Poland, 10–14 June 2002. The third and final RCM will be held in Antalya, Turkey, 11–15 October 2004.

(For details, please refer to B. FORTHCOMING EVENTS)

Molecular Characterization of Mutated Genes Controlling Important Traits for Seed Crop Improvement

Technical Officer: P.J.L. Lagoda

This CRP was initiated in 1999 with the aim of assisting Member States to apply molecular genetics of mutated genes for improving production in both major cereals and related underutilized crops. More specifically to collectively develop, characterize and data-base mutant collections of key crops for application in breeding programmes and to molecularly characterize new or existing mutated genes affecting key agronomic traits in major crops using comparative approaches in under-utilized crops with a view to their eventual isolation. The third RCM was organized by the Department of Genetics, University of Silesia and held in Krakow, Poland, 10–14 June 2002. The fourth and final RCM will be held in Faro, Portugal, 6–10 September 2004.

(For details, please refer to B. FORTHCOMING EVENTS)

Improvement of Tropical and Subtropical Fruit Trees through Induced Mutations and Biotechnology

Technical Officer: S.M. Jain

This CRP was initiated in 2000 to address the objectives related to the improvement of tropical and subtropical fruits through induced mutations and biotechnology. More specific objectives were to overcome major constraints in plant regeneration by tissue culture for large-scale multiplication of desirable induced mutants in order to sustain natural and induced fruit tree biodiversity leading to improved economic viability of growers and nutrition component; to assess the impact of induced mutants on fruit yield and quality components, depending on the fruit tree life cycle, under field conditions; and to assess the root stocks of induced mutants, especially tolerant to abiotic and biotic stresses, for grafting and their impact on yield. The success of this project will also be of great help in enhancing the use of nuclear techniques for inducing mutations in fruit crops. The third and final RCM will be held in Nelspruit, South Africa, 4–8 October 2004.

(For details, please refer to B. FORTHCOMING EVENTS)

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

Technical Officer: S. Nielen

This CRP was initiated in 2002 with the objective to accelerate crop-breeding programmes through the application of physical mapping and complementary genomic approaches and the characterization and utilization of induced mutants for improvement of crop quality. The first RCM was held in Vienna, Austria, 31 March–4 April 2003, followed by a three day Workshop on fluorescence *in situ* hybridization (FISH) at the Plant Breeding Unit, Seibersdorf, Austria. Among the traits assessed for improved quality within the CRP is bread making (wheat/*Leymus*), fruit colour and carotinoide (tomato and pepper), aroma and waxes (rice), fibers (cotton), oils and fatty acids (*Brassica*), and secondary metabolites, in particular medicinal alkaloids (poppy). The Working Material containing abstracts and work plans of the individual projects is available upon request from the Plant Breeding & Genetics Section.

Effect of Mutagenic Agents on 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.

(For details, please refer to C. PAST EVENTS)

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

Technical Officer: Q.Y. Shu

This CRP was initiated in 2003. The first RCM will be held in Vienna, Austria, 13–17 September 2004.

(For details, please refer to B. FORTHCOMING EVENTS)

Technical Cooperation Projects

Currently Active Projects

Project Number	Title	Technical Officer
CPR/5/013	Induced Mutations to Improve Rice Quality	Q.Y. Shu
GHA/5/030	Improved Cocoa Productivity through Control of Cocoa Swollen Shoot Virus Disease	S. Nielen
GHA/5/031	Enhancing Cassava Production through Supplementary Nutrient Application	S.M. Jain
INS/5/030	Sustainable Agriculture Development in Yogyakarta	S.M. Jain
INS/5/031	Mutation Breeding of Horticultural Crops	S.M. Jain
INT/5/147	Developing Salt-Tolerant Crops for Sustainable Food and Feed Production in Saline Lands	S.M. Jain
IRQ/5/015	Induction of Mutations in Crops through *In Vitro* Culture	S.M. Jain
JOR/5/008	Establishment of *In Vitro* Mutagenesis Laboratory	P.J.L. Lagoda
KEN/5/024	Crop Improvement and Management through Application of Nuclear and Bio-technology Techniques	Q.Y. Shu
MAL/5/024	*In Vitro* Mutagenesis for Horticultural Crop Plants, Phase I	S.M. Jain
MYA/5/010	Development of Improved Rice with Tolerance to Drought and Soil Salinity	Q.Y. Shu
NIR/5/031	Radiation-Induced Mutations for the Development of Cowpea Varieties	P.J.L. Lagoda
PAK/5/040	Improvement of Heat-Tolerant Semi-Dwarf Bread Wheat through Radiation-Induced Mutations	S. Nielen
PAK/5/042	Induced Mutations to Improve Salt-Tolerance in Non-Aromatic Rice Varieties	S. Nielen
PER/5/024	Introduction of Barley and other Native Crop Mutant Cultivars	S. Nielen
PHI/5/029	Enhancing Agricultural Productivity through Radiation Technology in Mindanao	S.M. Jain
RAF/5/049	Field Evaluation of Bayoud-Resistant Date Palm Mutants	S.M. Jain
RAF/5/050	Increasing Production of Nutritious Food through Mutation Breeding and Bio-technology (AFRA III-3)	S. Nielen
RAS/5/040	Enhancement of Genetic Diversity in Food, Pulses and Oil Crops and Establishment of Mutant Germplasm Network (RCA)	Q.Y. Shu
RAS/7/014	Monitoring of Food Fortification Programmes Using Nuclear Techniques	P.J.L. Lagoda
ROK/5/033	Quality Improvement of Major Crops and Integrated Plant Nutrition Management in the Low-Input Agricultural System	P.J.L. Lagoda
SRL/5/034	Radiation-Induced Mutations for Black Pepper Improvement	S.M. Jain
SRL/5/036	Virus Screening of Improved Banana Mutants for Large-Scale Dissemination	S. Nielen
SUD/5/026	Improvement of the Productivity and Sustainability of Industrial Crops	S. Nielen
VIE/5/014	Rice Mutant Varieties for Saline Land, Phase II	Q.Y. Shu
YEM/5/003	Applying Nuclear Techniques for Improvement of Crop Yield	S.M. Jain
ZAI/6/009	Mutation Techniques for Improving Medicinal Plants with a Curative Effect on Human Diseases	S.M. Jain
ZAM/5/022	Crop Improvement through *In Vitro* Mutation Techniques	S. Nielen

Demonstration plot for rice in Vietnam – TC project VIE/5/014
Rice farmer (left) is happy with rice breeder (right) at the Institute of Agriculture in Southern Vietnam: a short duration mutant variety means an extra crop harvest of rice a year!

Ongoing Activities at the Plant Breeding Unit, Seibersdorf

Multiplication of *Musa* Putative Mutant Germplasm for Field-Testing

Considerable efforts in the Plant Breeding and Genetics component of the Sustainable Intensification of Crops Production Systems (SICPS) has gone into the development of banana mutants that are tolerant to the banana black leaf streak disease (BLSD or black sigatoka), caused by the fungus *Mycosphaerella fijiensis*. Several mutants of the banana variety Grand Naine, treated at different irradiation doses of gamma rays and fast neutron have shown tolerance to juglone, a synthetic toxin that mimics the effects of black sigatoka under controlled conditions. The next logical step is to have these mutants challenged under field conditions in endemic countries and collaborations have been secured with national partners on this. The *in vitro* multiplication of hundreds of these mutants is at different stages of progress.

Fingerprinting of *Musa* Bacterial Artificial Chromosome (BAC) Clones

The *Musa* Genomics Consortium is committed to a long-term goal of developing robust genomics recourse for bananas, the final outcomes of which would include the sequencing of the genome, development of a physical map and gene discovery. The Genomics Resource Centre for the Consortium at the Institute of Experimental Botany of the Academy of Sciences of the Czech Republic, Olomouc, Czech Republic is the repository of a series of BAC libraries constructed by them over the years. As part of this consortium, the Plant Breeding Unit has committed to carrying out BAC-end sequencing of some of the clones from these libraries, fingerprinting them and generating libraries of sub-clones of these BACs. The BAC-end sequencing of the first batch of 106 BAC clones received from the Genomics Resource Centre has been concluded. Ongoing is the fingerprinting of these BAC clones. The fingerprint profiles of these BACs will be used to establish the preliminary alignments, a prerequisite for the eventual sequencing of the genome. Cytogenetic and molecular genetic markers from the banana map and the BAC-end sequences will also be used in clarifying such alignments and for anchoring the contigs to chromosomes.

Induced Mutations in Cassava

Cassava, *Manihot esculenta* Crantz, is the most important staple and food security crop for most of the population of sub-Saharan Africa. In addition, it is fast becoming a major cash crop in Asia and South America with potential to assume the same role in Africa. Due to its robust nature, cassava yields fairly well even under marginal

soil and climatic conditions, most of the time with nil or minimal input. It is for this second reason that it has been the favoured crop in staving off famine in countries of Eastern and Southern Africa after spells of man made and natural disasters. Cassava is subject to several important production constraints that must be overcome before its full potential can be realized in these regions: virus and bacterial diseases reduce yield, as do insects, nematodes and weeds. Also, post-harvest deterioration of the roots decreases shelf life of the crop, significantly impacting its marketability, especially in sub-Saharan Africa. In addition, it is projected that cassava starch has the potential of replacing most of the modified starch used in the food industry if cassava varieties with waxy starch (or amylose-free) variants can be produced to replace the traditionally cultivated varieties.

A new initiative for using induced mutagenesis to broaden the genetic base of the cassava germplasm available to the NARS breeders has been commenced in collaboration with the International Centre for Tropical Agriculture (CIAT), Cali, Colombia. Since information is lacking on the dosimetry for induced mutagenesis in cassava, we have recently commenced the generation of data on the responses of 37 cassava varieties to irradiation. Protocols on several aspects of their *in vitro* propagation are also being optimally developed. Such baseline data will guide future work on the integration of *in vitro* techniques in induced mutagenesis in cassava. An efficient regeneration system is imperative for dissociation of chimeras while somatic embryogenesis will be used for massively regenerating putative mutants after irradiation of callus.

Field Evaluation and Fingerprinting of Salt Tolerant Mutants

In collaboration with the International Rice Research Institute, Manila, Philippines, data collection is continuing at several location in Asia on several agronomic traits on salt tolerant mutants induced from the rice variety, IR29. The molecular genetic fingerprinting of these mutants and their parents is also ongoing.

Irradiation Services

The 14 batches of irradiation services provided during the period December 2003 to May 2004 are broken down thus:

Number of requests	14
Number of species	20
Number of varieties	58
Number of treatments	156
Number of countries	10

Fellowship Training

The following Fellows were interned in the Unit during the period under review:

Name	Country	Subject Area	Period
Musa İlhan Çağirgan*	Turkey	Sesame molecular biology	2003-11-10 to 2004-05-10
Jeannot Ramelison	Madagascar	Induced mutations in cassava, molecular genetics and *in vitro* techniques	2004-03-01 to 2004-08-31
Henry Otieno Okwaro	Kenya	Induced mutations in cassava, molecular genetics and *in vitro* techniques	2004-04-01 to 2004-09-31
Noronirina Victorine Raktoarisoa	Madagascar	Induced mutations in rice, molecular genetics and *in vitro* techniques	2004-04-01 to 2004-11-30

*Fellowship ended during period under review

Publications

1. Escalant, J.V. and S.M. Jain, 2004. Banana improvement with cellular and molecular biology, and induced mutations: future and perspectives. In: Banana improvement: cellular, molecular and mutagenesis approaches, Jain, S.M. and R. Swennen (eds.), Science Publishers, New Hampshire, USA, pp 359–367.

2. Jain, S.M. and R. Swennen (eds.), 2004 Banana improvement: cellular, molecular and mutagenesis approaches. Science Publishers, New Hampshire, USA. ISBN 1–57808–340–0.

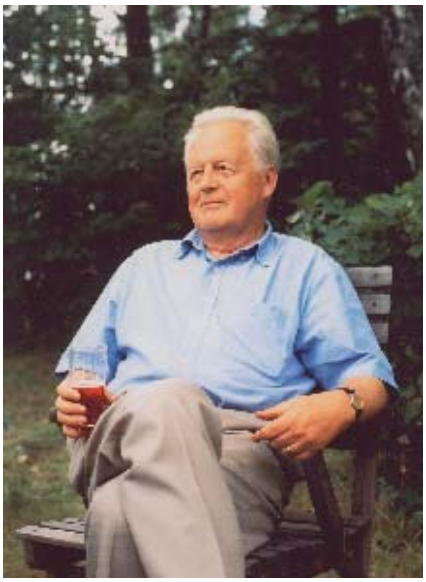
3. Jain, S.M. 2004. Banana improvement with cellular and molecular biology, and induced mutations: Introduction. *In:* Banana improvement: cellular, molecular and mutagenesis approaches, Jain, S.M. and R. Swennen (eds.), Science Publishers, New Hampshire, USA, pp 1–2.

4. Low cost options for tissue culture technology in developing countries. IAEA–TECDOC–1384.

5. Manuel Ruiz, Mathieu Rouard, Louis Marie Raboin, Marc Lartaud, Pierre Lagoda and Brigitte Courtois (2004) TropGENE-DB, a multi-tropical crop information system. *Nucleic Acids Research,* **32**: Database issue D364–D367.

In Memoriam

Thorsten Hermelin (1929–2004)



Thorsten Hermelin joined the Agency in 1975 as a mutation breeding specialist from the Department of Genetics and Plant Breeding at the Swedish University of Agricultural Sciences in Uppsala. He served first as Head of the Plant Breeding Unit at the Seibersdorf Laboratories. There he played a key role in planning and setting up laboratories within his Unit and in implementing mutation breeding programmes of the Joint FAO/IAEA Division in Agriculture. Some years later he became Head of the Agencies Agricultural Laboratories at Seibersdorf, a position he kept until his retirement in 1989.

Thorsten had a calm nature and an unwavering sense of humour. He was a faithful friend and "family" man. Through his correctness and charisma he established a good working relationship with colleagues and gained the respect and affection of all who knew him.

Many of his friends met him during his 'obligatory' yearly visits in Vienna. It was a must for Thorsten and his wife Ingrid to attend operetta performances and consume culture in Vienna during these visits.

During a visit to Vienna some years ago, Ingrid suddenly passed away. This was for Thorsten the shock of his life and he never fully recovered.

Now they are together forever.

Thorsten passed away unexpectedly shortly before his 75th birthday as a result of a stroke. A daughter and two sons survive him. Not only they will miss him, but also many of us, who had the privilege of sharing his friendship.

Helmut Brunner

Please complete this Registration Form and send it to the Plant Breeding and Genetics Section at the following address:

Wagramer Strasse 5, P.O. Box 100, A-1400 Vienna, Austria, Fax: +43-1-26007, Telephone: +43-1-2600

New Crop Variety Developed through Mutation Induction or by Crossing with Induced Mutants

A. Latin name of species:

English name:

B. Name of new variety (cultivar):

C. Year of release from breeder:

D. Place and Date of official approval: _____

E. Parent variety(ies) - if new variety results from a cross with mutant, indicate which is the mutant:

		mutant
1.		yes / no
2.		yes / no
3.		yes / no

F. Main improved characters of variety (indicate if character is derived from mutation or not):

		mutation derived
1.		yes / no
2.		yes / no
3.		yes / no

G. Kind(s) of mutagenic treatment:

H. Doses(s) and/or concentration(s):

I. Year of mutagenic treatment:

J. How was the variety bred: _____

K. Name(s) of breeder(s) and institute(s):

Address:

L. Extent of acceptance by growers:

- **Commercial value:** _____
- **Hectares of cultivation:** _____
- **Other:** _____

M. References (published articles, official documents, etc.):

Name of person contributing this information: _____

THANK YOU FOR YOUR COLLABORATION!

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