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Survey of nitrogen fixation in soybean farmers' fields, Paraña State, Brazil

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To Our Readers

Significant staff changes have taken place this year, both in the Section Headquarters in Vienna and in the Soil Science Unit at the Agency's Laboratories at Seibersdorf. Mr. Phillip M. Chalk, Section Head, left the IAEA in August 2004 after 7 years service and returned to his home in Australia, for a well-deserved rest. Phil will continue his involvement with agricultural research in Brazil, his adopted country, in 2005. We all wish Phil and his family good health, happiness and every success for the future.

Phil has successfully led the Section into new research and technical projects involving the use of nuclear-based techniques to investigate soil-plant-water management practices that improve soil fertility and plant productivity within the context of sustainable production systems. Under Phil's leadership, a number of projects dealing with soil degradation (i.e. salinization, desertification, soil erosion and acidification), crop water use efficiency, conservation agriculture and organic residue management were formulated and successfully implemented in many Member States of the IAEA and FAO.

I was privileged to take over Phil's position as Section Head in mid-October and I look forward to being part of a dynamic and innovative team with Mr. Claude Bernard, who joined the Section in May and Mr. Rachid Serraj, who arrived in



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August. The Section is now almost fully staffed again. An appointment has been made to replace the position left vacant by Ms. Rebecca Hood-Nowotny at the Soil Science Unit. This post will be filled early next year. Ms. Lee Heng, a member of the team at this Unit, will leave in May 2005 after 7 years of sterling service with the Agency. Necessary measures will be put in place to ensure that our continuing effort and future research activities relating to water management, a major worldwide issue, will not be compromised by Lee's forthcoming departure.

With full deployment of staff resources and the collective skills and research experience both in the Section in Vienna and at Seibersdorf, we are committed to successfully accomplishing the existing programme: <http://www.iaea.org/programmes/nafa/d1>

We also need to build on our existing capabilities and address the increasing pressure of a worldwide demand for food security on the sustainability of land and water resources. Our challenges are to apply existing nuclear techniques and new applications to address soil and water conservation issues at the watershed and agricultural landscape level rather than simply on a field plot scale. This will enable us to identify unsustainable farming practices and to develop integrated management tools for enhancing the optimal use of scarce natural resources and sustaining plant productivity and profitability in agricultural systems. At the same time, we will continue to strengthen the existing integration across a range of science disciplines within the Agency and FAO in our pursuit of a better understanding of soil-plant-water relationships so as to: (i) optimize water and fertilizer use efficiency in a range of cropping and irrigation systems; (ii) identify crops that are efficient at utilizing water and soil nutrient resources and adapted to harsh environments (e.g. drought, salinity or nutritional stress); and (iii) promote the efficient re-use of agricultural wastewaters as a source of water and nutrients for crop productivity. A current Coordinated Research Project (CRP) jointly conducted by the Soils Section and the Plant Breeding and Genetics Section on "Selection for greater agronomic water use efficiency in wheat and rice using the ^{13}C isotope discrimination technique" is a good example of combining isotopic and radiation technologies together with tissue culture and molecular-based techniques to find out how plants respond to water stress and to identify genes or genetic regions that contribute to stress tolerance for subsequent development of better adapted crop

varieties. Further information about this CRP can be viewed in this newsletter (see p. 16, Status of CRPs).

Besides the new challenges that I have outlined above, I also wish to share with you the following good news. In July, Lee Heng received a merit promotion for her excellent performance and contribution to the sub Programme. In November, another significant event took place with the birth of a baby boy to proud parents Rachid and Nadia Serraj. Our warmest congratulations to Lee and to both Rachid and Nadia.

Finally, I wish to thank Felipe Zapata, a former staff member of the Section, who has ably assisted us during the transitional four-month period of staff departures and new appointments. We will miss Felipe for his friendliness, openness, dedication and thorough knowledge of the operation and function of the Section and the Soil Science Unit. Felipe will end his assignment on 15 December 2004. I wish him well in his retirement and hope to be able to enlist his services again in the near future. Felipe's almost 25-year working experience with the FAO/IAEA Programme has been a tremendous asset and during my short time in the Section I have been extremely impressed by his energy and dedication. The successful Research Coordination Meeting (RCM) on Acid Soils recently held at the Agency in Vienna (further details in this Newsletter) is a testament to Felipe's professional commitment and it has been both a privilege and a pleasure to work with him.

Christmas is approaching. My wife Sharon and our two sons, James and Thomas, will join me in Vienna in mid-December for our first traditional 'white' Christmas, which will be very different from the summer Christmas season we celebrate in New Zealand. We are looking forward to the special festivities for which Vienna is deservedly famous and I would like to extend to you all, Season's Greetings and my best wishes to you and your families for the coming year. I look forward to your continuing support and active participation in our research and technical cooperation programmes.

Long Nguyen

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Staff changes

Mr. Rachid Serraj joined the Section on 8 August as Crop Scientist/Nutritionist, to fill the post vacated by Gamini Keerthisinghe. Rachid has a Ph.D. in Agronomy & Crop Physiology from the University of Montpellier, France. His expertise is in plant nutrition, soil fertility and nitrogen fixation, ecophysiology and plant-environment interactions, with major focus on tolerance to abiotic stress factors for increased crop productivity in low input agriculture. Before joining the IAEA, Rachid worked as Professor at the University of Marrakech (Morocco), Associate Scientist at USDA-University of Florida (USA), held several post-doctoral positions (Germany, Japan, Canada, France, etc.) and more recently worked as Principal Scientist at ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) in India, leading the Crop Physiology Laboratory and coordinating the regional research programme on drought and abiotic stress, contributing to ICRISAT's new vision to 2010 of improved well-being of the poor of the semi-arid tropics through agricultural research for impact. We welcome Rachid to the Section and wish him a successful tenure in the Joint FAO/IAEA Programme.



Mr. Long-Minh Nguyen, a Vietnamese-born New Zealander, recently joined the Soil and Water Management and Crop Nutrition Section (SWMCN) as Section Head. His Ph.D. thesis was completed at Lincoln University, Canterbury and entitled "Sulphur cycling in grazed and its implication on pasture sulphur requirements", using ^{35}S radioactive tracer. Prior to joining the IAEA, he has been working with the New Zealand National Institute of Water & Atmospheric Research (NIWA) as a senior research scientist acting as project leader and project manager for a range of research and commercial projects over the past 10 years. His main areas of research expertise include soil fertility, soil chemistry, crop nutrition, nutrient cycling in soil-plant and soil-plant-animal systems and in riparian and wetland ecosystems, diffuse pollution control, water quality assessment, and the sustainable management of natural resources. Both the NAFA Soils Section and NAAL Soil Unit Groups welcome Long to the Joint FAO/IAEA Programme and look forward to working with him in developing and implementing new challenging project areas.



Forthcoming Events

Research Coordination Meetings (RCMs) of FAO/IAEA Coordinated Research Projects (CRPs)

Fourth RCM of CRP on “Use of Nuclear Techniques for Developing Integrated Nutrient and Water Management Practices for Agroforestry Systems” 18–22 April 2005, Vienna, Austria

Eight research contractors from Benin, Chile, Costa Rica, Kenya, Malaysia, Sri Lanka, Uganda, Zambia and five agreement holders from Australia (2), Belgium, France and Kenya (TSBFI-CIAT) will participate in the fourth and final RCM. The specific objectives of the project are: (i) To understand how trees contribute to N, C and P cycling and the availability of nutrients and water to crops; (ii) To identify how tree-crop systems can be manipulated for improved nutrient and water use; and (iii) To identify relationships between N and C fractions of soil organic matter and capacity for long-term productivity. The results obtained throughout the implementation of the project (1999–2007) will be reviewed and discussed and the main achievements will be evaluated in accordance with the project objectives. Mr. Rachid Serraj is the Project Officer and will serve as the Scientific Secretary.

First RCM of CRP on “Integrated Soil, Water and Nutrient Management in Conservation Agriculture” 13–17 June 2005, Vienna and Seibersdorf, Austria

Eleven participants, namely eight research contractors, one technical contractor and two agreement holders are expected to attend the first RCM of this CRP, in Vienna and Seibersdorf. The main purpose of this first coordination meeting will be to review the experimental plans of the participants and establish work plans, methodologies and protocols in accordance with the objectives of the CRP. All participants will be requested to present a report on their on-going work and the activities planned for the CRP. A workshop session in the Agency’s laboratories of Seibersdorf, will be organized as part of the meeting. Mr. Claude Bernard is the Project Officer and will serve as the Scientific Secretary.

Third RCM of CRP on “Integrated Soil-Water and Nutrient Management for Sustainable Rice-Wheat Cropping Systems in Asia” 11–15 July 2005, Dhaka, Bangladesh

Seven contract holders from Bangladesh, China (2), India (2), Nepal, Pakistan, two technical contractors from Australia and the Philippines (IRRI) and two Agreement

holders from Australia (CSIRO) and India (CIMMYT), are expected to participate in the meeting. The meeting has been postponed from February to July 2005. The RCM will be held from 11 to 15 July in Dhaka, Bangladesh. Dr. Murshedul Alam from the Bangladesh Rice Research Institute will act as local organizer. Progress reports on the work carried out under this project will be presented and overall progress in implementation will be assessed to elaborate final plans for project completion in 2006. Mr. Long Nguyen is the Project Officer and will serve as the Scientific Secretary.

Non-FAO/IAEA Meetings

- January 30–February 4, 2005. 9th International Symposium on Soil and Plant Analysis (ISSPA), Cancun, Mexico. Fax: +49 6307 401104; palmmail@convservices.de
- February 13–17, 2005. Innovative Management Practices for Nitrogen Use Efficiency in Rice Systems, Dhaka, Bangladesh. Contact: IFDC Director, Training and Workshop Coordination Department. Email to: hrd@ifdc.org or hdu@ifdc.org <http://www.ifdc.org>
- February 23–25, 2005. Int’l Conference on Integrated Assessment of Water Resources and Global Change: A North-South Analysis, Bonn, Germany. Contact: Eric Craswell, Global Water System Project (GWSP), Walter-Flex-Str. 3, D-53113 Bonn, Germany, eric.craswell@uni-bonn.de; waterconference@uni-bonn.de ; <http://www.giwa.net>
- April 11–15, 2005. Integrated Soil Fertility Management. Accra, Ghana. Contact: IFDC Director, Training and Workshop Coordination Department. Email to: hrd@ifdc.org or hdu@ifdc.org; <http://www.ifdc.org>
- April 25–27, 2005. Int’l Study Forum on Managing Saline Soils and Water: Science, Technology and Social Issues, Riverside, CA, USA. Contact: Donald Suarez, Phone: +1-909-3694815, dsuarez@ussl.ars.usda.gov
- May 16–22, 2005. International Symposium on Land Degradation and Desertification (Simpósio de Degradação de Terras e desertificação), Uberlândia, Brazil. Contact: Sílvio Carlos Rodrigues, Instituto de Geografia, Universidade Federal de Uberlândia,

Brazil, silgel@ufu.br; comland2005@ig.ufu.br; <http://www.ig.ufu.br/comland/index.htm>

- June 13–17, 2005. Nitrogen Fertilizer Production Technology Workshop (on behalf of IFA), Maastricht, Netherlands. Contact: IFDC Director, Training and Workshop Coordination Department. Email to: hrd@ifdc.org or hrdu@ifdc.org; <http://www.ifdc.org>
- June 20–25, 2005. International Symposium on “Sustainability of Paddy Farming Systems”, Manila, Philippines. Contact: Jose Rondal at joserondal@yahoo.com
- July 18–23, 2005. XVII International Botanical Congress, Austria Centre Vienna, Austria (Europe), Nomenclature Section: UNI-CAMPUS Hörsaalgebtrynm 12-16 July. <http://www.ibt2005.ac.at>
- July 17–22, 2005. XII International Congress on Molecular Plant-Microbe Interactions, Cancun, México. Contact the Congress Chair: Federico Sanchez at federico@ibt.unam.mx; <http://www.ibt.unam.mx/cancun2005>
- July 30–August 4, 2005. Soil and Water Conservation Annual and International Conference. Rochester, New York, USA. Contact: Nancy Herselius, Phone: +1-515-2892331, nancy.herselius@swcs.org <http://www.swcs.org>
- September 10–18, 2005. 19th International Congress on Irrigation and Drainage (ICID), Beijing, China. Contact the Chinese National Committee on Irrigation and Drainage, Phone: +86-10-68415522/68416506, cncid@iwhr.com; http://www.icid.org/index_e.html
- September 17–20, 2005. 8th International Conference on Dry Lands Development, Beijing, China. <http://www.8iccd.org>
- September 26–30, 2005. InterDrought-II. The 2nd International Conference on Integrated Approaches to Sustain and Improve Plant Production under Drought Stress, Rome, Italy. <http://www.plantstress.com/id2>
- September 14–19, 2005. 14th International Plant Nutrition Colloquium (IPNC). Beijing, China. Fax: +86 10 62891016; ipnc2005@cau.edu.cn; <http://www.ipnc15.com>
- September 26–30, 2005. Phosphate Fertilizer Production Technology Workshop (on behalf of IFA).

Brussels, Belgium. Contact: IFDC Director, Training and Workshop Coordination Department. Email to: hrd@ifdc.org or hrdu@ifdc.org; <http://www.ifdc.org>

- 3–7 October 2005. III World Congress on Conservation Agriculture, Nairobi, Kenya. The congress theme is “Linking production, livelihoods and conservation”. More information can be obtained at <http://www.act.org.zw/Congress/congress.htm>
- March, 2006. 4th World Water Forum: Local Actions for a Global Challenge, Mexico City, Mexico. See http://www.cna.gob.mx/publica/doctos/eventos/Cuarto_Foro_Mundial/Paginas/Inicio_ingles.htm
- July 9–15, 2006. 18th World Congress of Soil Science. Frontiers of Soil Science: Technology and the Information Age, Philadelphia, Pennsylvania, USA. Contact: The Organizing Executive Committee at 18wcss@soils.org; www.18wcss.org
See First Announcement at http://www7.nationalacademies.org/usncss/WCSS_First_Announcement.html

Technical Cooperation Projects (TCPs)

FAO/IAEA Regional TCP for East Asia and the Pacific (RCA). Combined meeting for Project Conclusion on “Restoration of Soil Fertility and Sustenance of Agricultural Productivity” (RAS/5/039) Part II – Measuring Soil Erosion/Sedimentation and Associated Pesticide Contamination” and Planning Meeting on “Sustainable Land Use and Management Strategies for Controlling Soil Erosion and Improving Soil and Water Quality” RAS/5/043, 14–19 March 2005, Manila, the Philippines

This meeting will have a double objective:

- 1) To hold the final meeting on “Restoration of Soil Fertility and Sustenance of Agricultural Productivity” (RAS/5/039) Part II – “Measuring Soil Erosion/Sedimentation and Associated Pesticide Contamination”. Final reports will be presented by participating counterparts. These reports will include the latest results on ¹³⁷Cs measurements and erosion/sedimentation assessments, conclusions on the nature and extent of soil erosion/sediment problems in the study area and indications on how the knowledge acquired in the project will be transferred to end-users and will help reduce the severity of erosion/sedimentation problems. They will also include complete references of all published papers and presentations of the results of the project. These reports will constitute the basic documents for the production of a special issue of a scientific journal.

2) To initiate the work on “Sustainable Land Use and Management Strategies for Controlling Soil Erosion and Improving Soil and Water Quality” (RAS/5/043). This new regional project is in continuation with the previous one. The skills developed in RAS/5/039 Part II will be used to investigate the relationship between soil redistribution, as assessed from radionuclide measurements, and

soil and water quality. The emphasis will be on the interactions between soil erosion and soil quality, and on the positive effects of soil conservation practices in terms of soil and water quality.

Technical Cooperation Projects

Operational during the Biennium 2005–2006 and Technical Officers Responsible for implementation

Project Number	Title	Technical Officer
ALG/5/020	Combating Desertification	R. Serraj
ALG/5/021	Optimising Irrigation Systems and Surface Water Management	L. Nguyen
CMR/5/013	Use of Nuclear Techniques in Soil Nutrient and Water Studies	L. Heng
CPR/5/015	Assessment of Soil Erosion and Effectiveness of Soil Conservation Measures	C. Bernard
CHI/5/048	Integrated Watershed Management for the Sustainability of Agricultural Lands	C. Bernard
ECU/5/022	Efficient Use of Nitrogen Fertilizers I Flower Production	R. Serraj
GHA/5/032	Enhancing Production and Use of Cassava	R. Serraj
HAI/5/003	Enhancing Crop Productivity through the Application of Isotope Nuclear Techniques	R. Serraj
IVC/5/029	Improvement in Yield of Plantain and Cassava through the Use of Legume Cover Crops	R. Serraj
JAM/5/009	Developing Soil Fertility Management	R. Serraj
KEN/5/023	Combating Desertification Using Nuclear Technology	R. Serraj
LIB/5/010	Establishing a Drip Irrigation-fertigation System Using Nuclear Techniques	L. Heng
MON/5/014	Application of Isotopes in Soil and Plant Studies	G. Hardarson
NAM/5/008	Increasing Crop Productivity and Resource Use Efficiency in the Northern Communal Areas	R. Serraj
PHI/5/031	Assessment of Erosion and Sedimentation Processes for Effective Formulation of Soil Conservation and Water Quality Production Measures	C. Bernard
RAF/5/048	Combating Desertification in the Sahel	C. Bernard
RAS/5/043	Sustainable Land Use and Management Strategies for Controlling Soil Erosion and Improving Soil and Water Quality (RCA)	C. Bernard
SIL/5/008	Contribution of Nitrogen Fixing Legumes to Soil Fertility in Rice-based Cropping Systems	G. Hardarson
SRL/5/038	Application of Isotope Techniques for Soil Erosion Studies	C. Bernard
TAD/5/002	Assessment of Soil Erosion and Sedimentation for land Use	C. Bernard
TUR/5/024	Improving Crop Productivity through Nuclear and Related Techniques	L. Nguyen
ZIM/5/011	Combating Desertification in Agricultural Drylands	R. Serraj

Past Events

Research Coordination Meetings (RCMs) of FAO/IAEA Coordinated Research Projects (CRPs)

First RCM of CRP on “Selection for Greater Agronomic Water-Use Efficiency in Wheat and Rice Using Carbon Isotope Discrimination”, 27 September–1 October 2004, Vienna, Austria

Six contract holders from Algeria, China, India, Morocco, Pakistan, Yemen, two contract holders from Australia (CSIRO) and Mexico (CIMMYT), two agreement holders from Philippines (IRRI) and USA, and a consultant (Syria) attended this first RCM, in addition to the SWMCN section staff. The Project Officer, Mr. R. Serraj, served as the Scientific Secretary of the RCM. The overall objective of this project is to contribute to increasing the agronomic water-use efficiency of wheat and rice production where agronomic water-use efficiency is defined as grain yield/total water use including both transpiration and evaporation (see Status of CRPs).

The participants presented the major results and conclusions of their research covering the first year of the project (2003-2004). The presentations of the participants were followed by Sessions to review the work plan of the CRP and to discuss the future activities. A detailed work plan was also established for future research activities in each participating country and in line with the project objectives. A visit was organized to the Agency's Agriculture Laboratories (Soils Unit) at Seibersdorf, where participants were introduced to the various technical aspects and processes associated with ^{13}C isotope sample preparation and analysis as well as soil moisture measurements. A report of the first RCM will be shortly available from the Scientific Secretary upon request or at <http://www.iaea.org/programmes/nafa/d1>

Second RCM of CRP on “Assess the Effectiveness of Soil Conservation Measures for Sustainable Watershed Management Using Fallout Radionuclides”, 4–8 October 2004, Istanbul, Turkey

The Second RCM of this CRP was held at the Istanbul Technical University (ITU), in Istanbul, Turkey. The local organizer was Dr. Sevilay Hacıyakupoglu, from the Institute of Energy of ITU. Twelve research contractors from Argentina, Brazil, Chile, China (2), Morocco, Poland, Romania, Russia, Turkey, Viet Nam and Pakistan, one technical contractor from UK and six agreement holders from Australia, Austria, Canada, Japan, Switzerland and USA attended the meeting, along with thirteen

observers. The objective of this meeting was to review and assess the work done since the first RCM. All participants reported on their work, the progress accomplished, the difficulties encountered and the implemented solutions to overcome these difficulties. These presentations provided an opportunity to discuss research hypothesis, experimental protocols and results and share experience. A field day was scheduled and included a visit to the Cekmece Nuclear Research Centre of the Turkish Atomic Energy Agency and a tour of the Buyukcekmece Dam Lake Erosion Study Site. This reservoir provides the city of Istanbul a part of its water supply. Studies are underway on the magnitude of soil erosion and sedimentation problems in the catchment of this reservoir. Finally, a presentation was done on recent developments of new models and of new software for the use



Land Use in the Catchment of the Buyukcekmece Dam Lake, Turkey (Courtesy of Claude Bernard)

of $^{210}\text{Pb}_{\text{ex}}$ and ^7Be in erosion/sedimentation studies. The report of the meeting is available from the web site of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, at: www.iaea.org/programmes/nafa/d1/crp/fallout-crp-second.pdf. The third RCM will be held in Rabat, Morocco, in May 2006.

Fourth RCM of CRP on “Development of Management Practices for Sustainable Crop Production Systems on Tropical Acid Soils Through the Use of Nuclear and Related Techniques”, 15–19 November 2004, Vienna, Austria

Eight research contractors from Brazil (2), Burkina Faso, Cuba, Mexico, Nigeria, Venezuela, one technical contractor from Germany and three agreement holders from Kenya (TSBF), Nigeria (IITA) and USA (IFDC) participated in the fourth and final RCM. The results obtained throughout the implementation of the project (1999-2004) were reviewed and discussed and the main

achievements were evaluated in accordance with the project objectives.

Technical Cooperation Projects (TCPs)

FAO/IAEA Regional TCP for East Asia and the Pacific (RCA) on "Restoration of Soil Fertility and Sustainability of Agricultural Productivity" (RAS/5/039)

In East Asia and the Pacific region, extensive land degradation and the conversion of agricultural land into other uses (urbanization, infrastructure and industrial development) are factors contributing to reduced agricultural productivity. The principal land degradation processes are nutrient depletion, acidification, salinization, pollution, and soil erosion. Inappropriate land use, soil and water mis-management and inadequate farming practices exacerbate the effects of human-induced degradation. For instance, excessive and continued use of agrochemicals in some areas may greatly affect both water and soil quality over the long term. Enhancing sustainable food production will require the combined use of the following strategies: a) agricultural intensification on the best arable land, b) rational utilization of marginal lands, and c) prevention and restoration of soil degradation.

The overall objective of this project is to develop improved soil, water, nutrient and crop management practices while counteracting predominant soil degradation processes in order to increase and sustain crop productivity. Two complementary approaches are utilized to achieve this main objective. Part I of this project deals with the restoration of soil fertility, and implementation commenced during the 2001-2002 cycle. The specific objective of Part II of this project is to measure soil erosion/sedimentation and associated pesticide contamination. For this purpose, the fallout radionuclide ^{137}Cs related techniques are utilised to measure erosion/sedimentation rates and to define soil redistribution patterns in the landscape. Pesticides are being extensively used to maintain agricultural production over the long term. It is often found that eroded soil particles are a carrier for pesticides that may become toxic to aquatic plants and animals. Conventional and radiotracer techniques are applied to assess potential pesticide contamination levels in soil, water and crops. This part of the project started with the project formulation meeting held in February 2002, Beijing, China and will be implemented through 2004. The regional meeting was recently held in Jakarta, Indonesia, 17-23 October 2003.

=> Regional meeting on "Exchanging of Experience using the Cs-137 Technique for Measuring Erosion/Sedimentation and Associated Pesticide Contamination" (RAS/5/039) Part II, 5-9 July 2004, Kuala Lumpur, Malaysia

The meeting was held under the auspices of the Malaysian Institute for Nuclear Technology Research (MINT). All national counterparts participating to this project (CPR, INS, MAL, PAK, PHI, SRL and VIE), four local staff members, Dr. Robert Loughran (AUL), as invited IAEA expert, and IAEA's technical officer attended the meeting. The local organizer was Dr. Zainudin Othman, the national counterpart from Malaysia. The national counterparts presented their respective progress report, in which they explained the progress achieved since the Jakarta meeting, particularly on the aspects of adequate reference site, ^{137}Cs data conversion to soil movement data and interpretation of the data in relation to land use and the agri-environmental conditions prevailing at the experimental sites. Each presentation was followed by a question period. A discussion period had also been planned at the end of each session. Dr. Loughran provided a lecture entitled "Soils, Sediments and Caesium-137 in Maluna Creek Catchment". He also made two technical presentations on the use of different conversion



Intensive vegetable production in the Cameron Highlands Malaysia (Courtesy of C. Bernard)

models to translate ^{137}Cs data into soil movement data and on the comparison of erosion rates predicted by models to estimates obtained from ^{137}Cs measurements. A field visit was done at Cameron Highlands, an area intensively cropped for vegetables and flowers where erosion risks are high, given the climate and the accentuated topography. Finally, work plans for the remaining 9 months of the project were updated, discussed and adopted.

⇒ **Final Review Meeting of the IAEA/RCA Technical Co-operation Project on Restoration of Soil Fertility and Sustenance of Agricultural Productivity (RAS/5/039) Part I: Integrated Nutrient, Crop and Water Management Practices for Increased Crop Production, 6–10 September 2004, Bangkok, Thailand**

The meeting was organized in collaboration with the Applied Radiation and Isotopes Department, Faculty of Science, Kasetsart University, Bangkok, and attended by the project coordinators from the eleven participating countries (Bangladesh, China, India, Indonesia, Korea, Malay-



Participants of the RAS/5/039 Final Review Meeting Part I Bangkok, Thailand (Courtesy of R. Serraj)

sia, Pakistan, Philippines, Sri Lanka, Thailand and Viet Nam). Dr. Jariya Prasatsrisupab (Dept. Agriculture, Kasetsart University) was the local host country organizer and Dr. Roland Buresh from the International Rice Research Institute (IRRI) served as consultant and assisted in the review and evaluation of the project reports and activities. During the opening session, Dr. Somchid Disthaporn (Head of Dept. Agriculture, Kasetsart University) deliv-



Close view of rice experimental field (Courtesy of P. Jiarong, CAAS, Beijing, China)

ered a welcome address and highlighted the main research activities related to the project. Dr. G. Keerthisinghe (FAO-RAP, Thailand) and previous TO in charge of the

project presented the background and previous steps in project implementation. The current project TO and scientific secretary of the meeting (R. Serraj) presented the programme of the meeting and an overview of the project objectives and expected outputs.

This Regional RCA/IAEA TC project involved eleven countries of the region (Bangladesh, Indonesia, Malaysia, Myanmar, Mongolia, Pakistan, People's Republic of China, Philippines, Sri Lanka, Thailand, Viet Nam) focused on the restoration of soil fertility in the rice-based cropping systems in the region with the objectives to: a) improve fertilizer management practices to increase the efficiency of chemical and bio-fertilizers to optimize the cost-effectiveness of fertilizer inputs (mainly nitrogen), and, b) identify crop residue management practices to enhance the nutrient availability to crops and improve soil fertility.

At the completion of the project three major research achievements emerged as most significant in terms of their potential for application, namely:

1. Introduction of N-fixing short-duration legumes in rice–wheat-cropping systems, which was tested in Bangladesh and Pakistan with the use of labelled Nitrogen-15,



Close view of mungbean crop in rice field (Courtesy of Q. Haque, BINA, Bangladesh)

and resulted in the demonstration of successful introduction of short-duration mungbean in wheat–legume–rice rotation, and its potential economic benefit.

2. Integrated use of organic-inorganic sources for soil fertility management, which was carried out in several participating countries and demonstrated the benefit of this management practice for sustenance of soil productivity in rice-based cropping systems.

3. Management of crop residues in rice systems, carried out in China, India, and Viet Nam, for which the benefits of recycling of rice residues using various techniques

(no-till, mulching, incorporation) were documented and quantified with help of isotopic techniques.

Overall, the project has resulted in a significant progress for the development and application of innovative and promising management practices for rice cropping systems in Asia. These research achievements are to be further evaluated and promoted for wider dissemination and better adoption in the region. A detailed socio-economic analysis should also provide quantitative data on the economic benefits of the improved rice management practices developed in this project.

FAO/IAEA Regional TC Project for Europe “Fertigation for Improved Crop Production and Environmental Protection” (RER/5/011)



*Fertigation trial in Cyprus
(Courtesy of G. Elliades, ARI, Cyprus)*

Limited water resources available for agriculture and their poor quality are becoming serious problems to agricultural productivity and ecosystem safeguard in several



*Soil water measurement using neutron
probe
(Courtesy of M. Oncsik, HAKI, Hungary)*

countries of Europe with Mediterranean climate. Good agricultural practices that promote both efficient and sustainable use of water and nutrients to improve crop pro-

ductivity while reducing environmental damage are therefore, essential.

Fertigation, which is the application of soluble fertilizer through drip irrigation, was introduced and improved management practices were successfully developed through the implementation of a Regional Technical Cooperation Project in nine countries of Europe. The use of nuclear techniques was instrumental for evaluating irrigation and fertilizer management strategies and their positive impacts under local conditions.

These improved fertigation practices resulted in higher crop yields and a considerable increase in the efficiency of water and fertilizer use compared with conventional practices, while the risk of nitrate leaching to groundwater was minimized. The project also established the scientific basis for fertigation and drip-irrigation scheduling for a range of soils, crops and environments in the participating countries. Further socio-economic studies are needed to enable policy and decision makers to formulate policies to assist farmers to adopt best management practices in their countries.

FAO/IAEA TC Project: “Improvement of Soil/Water/Nutrient Management to Control Soil Degradation” (CHI/5/021)

At request of the government of Chile, this project was approved for implementation through the biennium 2001-2002 and further extended to the next biennium 2003-2004 due to the sustainability issues being studied and the need to better evaluate the impact of the activities. This project assisted in the development and promotion of an integrated approach for soil, water, and nutrients management (SWNM) in the central-southern area (regions VIII, IX and X) of Chile to provide solutions for controlling/mitigating specific soil degradation problems such soil fertility decline, soil erosion losses, scarcity of irrigation water and deforestation using nuclear and related techniques. This project underpins the activities of national programmes aiming at conserving natural resources and monitoring impacts from agriculture on the environment such as the Degraded Soils Recovery Programme (PRSD) implemented by the Ministry of Agriculture through the Agricultural and Livestock Service.

The various activities of the project were grouped into the following **three main sub-projects** focusing on the studies to be conducted in selected agro-ecosystems (and localities).

1. Development of improved wheat-based cropping systems (rotation with legumes; improved NP fertilization regimes, no burning and recycling of crop residues) under conservative soil management (no tillage). These included studies on the dynamics and

quality of organic matter, soil erosion assessment and nutrient and water balance and cycling. Location: Temuco, Carillanca (region IX).

2. Introduction and development of fertigation techniques in berries production. Studies on the efficiency of water and nutrient use under improved irrigation systems using nuclear and related techniques. Location: Chillan, Concepcion (region VIII).
3. Development of agroforestry and agro-silvopastoral systems in the internal coastal rainfed region of the country. Nutrient (carbon and nitrogen) and water cycling studies in these systems. Location: Quilamapu, Concepcion (region VIII).

As the development of the integrated SWNM approach requires the formation of multi-disciplinary (and often inter-institutional) teams, the following institutions and working teams participated actively in the implementation of the project:

Chilean Nuclear Energy Commission (CCHEN)

Inés Pino, Adriana Nario, Ana María Parada, Ximena Videla, Marco Acuña. Agricultural Section, Nuclear Cen-



*Final Coordination Meeting, Chillán INIA, Quilamapu
(Courtesy of I. Pino, CCHEN, Chile)*

ter La Reina, Santiago.

National Institute for Investigations in Agriculture and Livestock (INIA)

Juan Luis Rouanet, Adolfo Montenegro, Nelba Gaete, José María Peralta, Héctor Pauchard. Natural Resources Department, INIA Carillanca.

Carlos Ovalle, Julia Avendaño, José Cares, Teresa Aravena. INIA Quilamapu.

National Universities

Iván Vidal, Erick Zagal, Héctor Troncoso, Alejandro Fraga. Soils Department, Universidad de Concepción.

Paulina Schuller, Alejandra Castillo, Alejandra Sepúlveda, Rosa Eugenia Trumper. Institute of Physics, Universidad Austral de Chile.

At the start of the project a detailed work plan including allocation of resources was established in a general meeting of all participating groups and the assistance of the FAO/IAEA Technical Officer. The logical project framework was also developed. Local scientists worked in multi-disciplinary teams and in close collaboration to implement the various activities of the project. Overall the main counterpart from CCHEN efficiently carried out coordination. Annual coordination workshops were held to assess progress and modify/adjust work plan as necessary. Further coordination was made by email and other communication ways. The picture below shows some participants of the teams during the final coordination meeting held at Chillan, INIA Quilamapu.

The experts also provided advice for the selection of study sites; visited experimental fields; and evaluated and interpreted results obtained from fertigation experiments, and from studies on soil redistribution rates, nutrient cycling and water balance, and soil organic matter quality and nitrogen dynamics. The Agency's assistance focused in providing expert services and training in the fields mentioned and on procuring specialized equipment and isotopic ^{15}N labelled products. International experts assisted national counterparts in planning experimental protocols for studies using nuclear and related techniques on soil organic matter dynamics and C and N cycling, soil erosion, and on nitrogen/nutrient cycling and water balance in wheat-based cropping and agro-silvopastoral & agroforestry systems; fertigation and water balance in orchard plantations. Expert services included provision of



View of the experimental field on minimum tillage and burning of crop residues, including erosion runoff plots at Pumalal (IX region). (Courtesy of I. Pino, CCHEN, Chile)

guidelines, reporting on progress and local training activities.

Local staff was trained on application of the ^{137}Cs technique for soil redistribution studies, on the use of C isotopes for carbon dynamics and modelling; and on the use of nuclear techniques for developing improved fertigation

practices and water balance studies. Additionally, four fellows received training on the application of the ^{137}Cs technique for soil erosion studies, on models to estimate soil erosion using ^{137}Cs measurements; on the effect of organic residues in soil carbon and nitrogen cycling processes using ^{13}C and ^{15}N isotopes; and in interactions between the components of agro-forestry systems. Furthermore, seven scientific visits provided training in the management of soil & fertilizer nitrogen; analytical aspects of ^{137}Cs & ^{210}Pb ; use of fertigation systems; water nutrient cycling, organic matter dynamics in agroforestry systems; stable isotope methodologies; and on the use of stable isotopes in agro-ecosystems. As a result of these activities, an increased number of local scientists from the participating institutions are applying the appropriate nuclear techniques and equipment for developing an integrated approach to the management of soil, water, and nutrients needed for controlling soil degradation in the major farming systems of the target region.

The work done generated a variety of process-level data on soil, water and nutrients in the studied farming systems and a database was established to collect relevant



*Close view of a young berry plantation under fertigation system
(Courtesy of I. Pino, CCHEN, Chile)*

information on the quality of soils, plants, and climate in accordance with the experiments.

This project developed and promoted the adoption of the conservative management of wheat-based cropping systems to improve soil fertility, increase sustainable crop production, conserve natural resource base and protect the environment and neighbouring ecosystems. Novel technologies include crop rotation with legume, use of fallow and incorporation (no burning) of crop residues, minimum tillage, control of soil erosion and improved NP fertilization practices. Moreover, a technique based on the ^{137}Cs measurements was devised to make a comparative assessment of soil erosion between traditional and minimum soil tillage management.

Fertigation was successfully introduced and quickly adopted by farmers growing blueberries and raspberries

and other orchard plantation trees (of great economic importance to the country as export crops) on volcanic acid soils located in sloping areas, because both irrigation water-saving and efficient fertilization methods were needed to incorporate these marginal areas into sustainable agricultural production. The adoption process was facilitated by the development and application of the OPTIFER software in CD-ROM and related instruction manual, which assisted farmers, professionals, enterprises and technicians, in the design of their fertigation programmes, including amount/types of fertilizers, preparation of solutions and injection rates into irrigation systems.

Significant increases in native prairie production to sustain higher animal carrying capacity were obtained by developing improved agro-silvopastoral systems through the inclusion of nitrogen-fixing herbaceous and woody leguminous species into Espinal (*Acacia caven*) formations.

The experimental work was conducted with progressive farmers and other agricultural organizations thus facilitating the adoption of the novel technologies. Moreover, to raise awareness across relevant stakeholders of the region and country, the techniques used, the results obtained from the undertaken experiments and technologies developed were widely disseminated through several means such as publications in newspapers, magazines, manuals, and books, and via conferences, courses, field days with extension specialists and farmer's associations, annual workshops, presentations in scientific and technical meetings, etc.

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*Field visit of the participating staff and the expert Prof. Mark Smith, Australia to the improved agro-silvopastoral system
(Courtesy of I. Pino, CCHEN, Chile)*

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and books, and via conferences, courses, field days with extension specialists and farmer's associations, annual workshops, presentations in scientific and technical meetings, etc.

An increased number of extension specialists and progressive farmers are applying proper technologies for sustainable intensification of agricultural production while controlling soil degradation in the region. It is expected that a bulletin containing the main relevant results and findings of the project will be produced in 2005.

These outcomes will contribute to the establishment of a decision support system to assist national and regional decision makers to formulate appropriate policies to control & prevent further soil damage and to rehabilitate degraded soils.

In continuation a brief analysis of the socio-economic impact of some of these outcomes is presented:

- In the improved wheat-based production systems, the crop residue recycling (no burning) in the studied area will lead to estimated savings of between 7000 and 10 000 tons of N (equivalent to 15 000 to 23 000 tons of urea). This does not include additional benefits from the increases in soil organic matter content and the efficiency of the applied nitrogen and phosphate fertilizers. The no-burning practice also entails other environmental and socio-economic benefits.
- A methodology using fallout radionuclides to measure soil erosion at the field scale and to evaluate farmer's practices was designed and applied for the first time in Chile. This will contribute to the introduction of cost-effective soil conservation practices (actual estimated reduction from 47 ton/hectare of soil loss to 5 ton/hectare). There is also great scope for further transfer of the technique to other countries in the Latin American region.
- Technologies on the conservative management of wheat-based cropping systems are available for the recovery of about 40% of the degraded soils considering an area of 2 427 475 hectares (IX and X Regions). These results have a strong socio-economic impact helping to alleviate poverty, ensure food security and minimize conflicts with the native Mapuche communities.
- The introduction of fertigation technologies into some 50 000 hectares of orchard tree plantations will generate an estimated annual income of \$8 million as a result of the increase of both yield and quality of the berries. An additional environmental benefit is the reduction of the ground water contamination through improved water and fertilizer use efficiencies obtained through fertigation.

- An estimated extra income of US\$1 million annually for the incorporation of 1000 hectares under improved agro-silvo-pastoral system with trees and leguminous shrubs without considering additional environmental benefits and soil and water conservation.

For additional information on this project visit the websites at: www.cchen.cl/Agriculture_eng (English) and www.cchen.cl/Agricultura (Spanish).

Arab Fertilizer Association (AFA) 2004 Award

We are pleased to announce that Dr. Munir Mohammad Rusan from the Faculty of Agriculture, Jordan University of Science and Technology, won this year the very prestigious publication award by the Arab Fertilizer Association (AFA) for his research paper on "*Utilization of applied fertilizer nitrogen and irrigation water by drip-fertigated squash as determined by nuclear and traditional techniques*" published in the Journal Nutrient Cycling in Agroecosystems, Vol. 68, 111. The research work was done under the IAEA TC regional projects for West Asia (RAW/5/002 and RAW/5/007). Two IAEA Regional TC projects on Fertigation were implemented from 1995 to 2000 in eight countries from the West Asia region (Iran, Jordan, Lebanon, Saudi Arabia, Syria, Turkey, United Arab Emirates, and Yemen) to improve productivity of annual crops and enhance resource use efficiency in arid and semiarid environments. The results have been published in an IAEA TECDOC 1266 "Water balance and fertigation for crop improvement in West Asia", January 2002

Dr. M.M. Rusan will receive the Award during the AFA International Annual Conference to be held on Feb 2-3, 2005, in Cairo, Egypt. Our congratulations on receiving this award go foremost to Dr. Rusan for his excellent input into this project. However, it also goes to the **whole IAEA Team** that facilitated this TC Project and ensured that it was performed in the style and manner that enabled this publication.

From the above accomplishments, it is gratifying and highly motivating to see that the Agency continues to be the driving force in the generation and application of state-of-the-art nuclear science and in the implementation of such to the benefit of our Member States.

Non-FAO/IAEA Meetings

3rd Phaseomics Conference on Common Beans (*Phaseolus* spp.), 13-15 June 2004, Geneva, Switzerland

The Conference was held in Geneva and was organized by the University of Geneva. Approximately 50 participants from all regions attended the meeting as well as local scientists. The Conference included 35 presentations. Most of the papers were on Plant Molecular Biology and the main aim of the Phaseomics project is to sequence the bean genome and to develop/utilize tools/methodologies for improving (crossing and breeding) domesticated *Phaseolus* species in order to assure sustainable production of this highly nutritious high protein crops for human consumption.

Mr. Gudni Hardarson attended and gave an oral presentation entitled “Below-ground nitrogen in grain legumes”.

The meeting was very well organized and the Phaseomics project is of high relevance to sustainable agricultural development in developing Member States.

VIII European Society for Agronomy Congress, 11-15 July 2004, Copenhagen, Denmark

The theme of the VIII European Society for Agronomy Conference was “European agriculture in a global context”, with special emphasis on sustainable farming and the quality of agricultural products. The conference was held at Royal Veterinary & Agricultural University (KVL) in Copenhagen.

The conference was opened in plenary with keynote presentations given by Per Pinstrup Andersen on Europe's Role in Global Food Production, and Jacob Weiner on Agriculture and Ecology. There were some 600 scientists from Europe, Africa, USA, Australia and New Zealand attending the conference, including the new countries of the EU. The programme was organized in eight sessions, ranging from crop physiology; agro-

climatology and modelling; plant and soil; crop quality; cropping and farming systems; agriculture and environment; seed science and developing country agriculture.

Ms. Lee Heng gave an oral presentation on “Optimizing Wheat Productivity Under Extreme Dry Rainfed Environments of West Asia-North Africa (WANA) Using APSIM”.

Joint European Stable Isotope Users Group Meeting (JESIUM), 30 August-3 September 2004, Vienna, Austria

The Joint European Stable Isotope Users Group Meeting (JESIUM) was organised by Roland Bol, Rebecca Hood-Nowotny, Christof Oberwalder, Andreas Richter, Wolfgang Wanek, Susanna Wiener and Maria Heiling. About 200 participants attended the meeting in the Vienna International Centre. The main aim of the meeting was to promote the exchange and transfer of stable isotope knowledge, ideas and techniques across the disciplinary and national boundaries.

Mr. Erik-Busch Petersen and Ms. Marianne Popp opened the meeting. The sessions varied from Health and Nutrition to Isotope Ecology, Isotope Physiology, Stable Isotopes in the Atmosphere and Biospheric Exchange, Methodology, Hydrology and Earth Science to a Stable Future. On the final day of the meeting, about 30 scientists had the opportunity to visit laboratories of the Austrian University in Vienna, the IAEA Hydrology, the Austrian Research Centre in Seibersdorf and the Agency's Laboratories in Seibersdorf.

Status of Coordinated Research Projects

Development of Management Practices for Sustainable Crop Production Systems on Tropical Acid Soils through the Use of Nuclear and Related Techniques (D1-50.06)

Project Officer: F. Zapata

At the final RCM the participants presented their final reports containing research results obtained during the implementation of the project (2000–2004) and formulated conclusions and recommendations focusing on the main research areas of the project, i.e. crop genotypes adapted to tropical acid soils, i.e. tolerant to Al toxicity and efficient in N and P acquisition, and improved management practices for nutrients such as nitrogen (chemi-

cal fertilizer, biological nitrogen fixation, crop residues recycling, green manuring), phosphate (use of local reactive phosphate rocks) and soil (liming, tillage) to achieve sustainable crop production in the tropics.

The information provided will be utilized to create a database with field experimental data from the maize-, sorghum- and millet- based cropping systems (including grain legumes) grown in tropical savannah acid soils of Latin America and Africa. The participants have accumulated a wealth of information on the topics above. Some results have been utilized to prepare manuscripts for the final publication of the project as an IAEA TECDOC in 2005. Moreover, their results will be published as papers in scientific journals.

Other related activities such as the Decision Support System for Phosphate Rock (PRDSS) Use in Agriculture, which will be continued through the biennium 2004-2005, are reported separately under Research Networks.

Integrated Soil, Water and Nutrient Management for Sustainable Rice-Wheat Cropping Systems in Asia (D1-50.07)

Project Officer: L. Nguyen

The project has a full complement of participants, comprising seven contract holders from Bangladesh, China (2), India (2), Nepal, Pakistan, two technical contractors from Australia and the Philippines (IRRI) and two Agreement holders from Australia (CSIRO) and India (CIMMYT). The 2nd RCM was held from 8-12 September 2003 in Nanjing, People's Republic of China.

The contractors have so far conducted three rice-wheat cropping cycles and a wealth of information is being generated. A technical contract has been awarded to create a database set for the DSSAT (Decision Support System for Agrotechnology Transfer) rice and wheat models, specifically to simulate water and nitrogen interactions in the rice-wheat cropping systems.

The 3rd RCM is scheduled from 11-15 July 2005 in Dhaka, Bangladesh, where the participants will report on progress made and prepare final plans for completion of the experimental work. The final RCM will be held towards the end of 2006 in Australia.

Use of Nuclear Techniques for Developing Integrated Nutrient and Water Management Practices for Agroforestry Systems (D1-20.07)

Project Officer: R. Serraj

Participating in this CRP are nine contract holders: K. Aihou (Benin), B. Zhang (People's Republic of China), C. Ovalle-Molina (Chile), C. Cervantes (Costa Rica), J.M. Ndufa (Kenya), Z. Rahman (Malaysia), S. Nissanka (Sri Lanka), P. Ebanyat (Uganda) and R. Chintu (Zambia); and five agreement holders: M. Adams (Australia), S. Recous (France), L. Verchot (ICRAF-Kenya), N. Sanginga (TSBF-CIAT, Kenya) and M. Smith (UK). Participants have established links with CGIAR centres (IITA, ICRAF), international funding institutes (IFS, DFID, USAID) and a range of national institutes for ef-

fective implementation of the project activities. Through these linkages they have been able to obtain considerable financial and human resources in addition to the inputs from the Agency. The experimental work is progressing well in line with the main objectives and the project is well positioned for significant contributions in understanding the role of trees in agricultural systems and in contributing to the development of improved agroforestry systems. It is encouraging to note that the contract holders are actively involved in dissemination of information emanating from this project to end-users through presentations at national and international meetings and publications in scientific journals. The third RCM was held in Colombo, Sri Lanka in June 2003 and the fourth and final RCM will be held on 18-22 April 2005 in Vienna, Austria.

Assess the Effectiveness of Soil Conservation Measures for Sustainable Watershed Management Using Fallout Radionuclides (D1-50.08)

Project Officer: C. Bernard

This CRP was approved in March 2002. The overall aim of these projects is to develop diagnostic tools for assessing soil erosion and sedimentation processes and effective soil conservation measures for sustainable watershed management. The specific research objectives are: i) to further develop fallout radionuclide (FRN) methodologies, with particular emphasis on the combined use of ¹³⁷Cs, ²¹⁰Pb_{ex} and ⁷Be for measuring soil erosion over several spatial and time scales, ii) to establish standardized protocols for the combined application of the above techniques, and iii) to utilize these techniques to assess the impact of short-term changes in land use practices and the effectiveness of specific soil conservation measures.

Twelve research contract holders: A. Bujan (Argentina), O. Bacchi (Brazil), M.E. Trumper/P. Schuller (Chile), Y. Li (China PR), X. Zhang (China PR), M. Benmansour (Morocco), M. Rafiq Sheikh (Pakistan), W. Froehlich (Poland), N. Popa (Romania), V. Golosov (Russia), S. Hacıyakupoglu (Turkey), and H. Son Phan (Viet Nam); one technical contractor: D.E. Walling (UK) and six agreement holders: P. Wallbrink (Australia), A. Klik (Austria), D. Lobb (Canada), J. Onda (Japan), H. Liniger (WOCAT-Switzerland), J. Ritchie (USA), are currently participating in the project. The participants are representing multi-disciplinary and inter-institutional teams involved in soil erosion/sedimentation research. The individual studies cover a wide range of conditions (land use, environment, spatial scales) that should allow a robust testing of the potential of the FRNs to assess the ef-

efficiency of soil conservation practices. The first RCM was held in Vienna and Seibersdorf, Austria, 18–22 May 2003. The second RCM was in Istanbul, Turkey, on 4–8 October 2004. The third one will be held in Morocco, in May 2006. Reports from the RCMs are available from the Soil and Water Management and Crop Nutrition Section website, at the following address:

<http://www.iaea.org/programmes/nafa/d1/crp/d1-crp.html>

Integrated Soil, Water and Nutrient Management in Conservation Agriculture (D1-50.09)

Project Officer: C. Bernard

The overall objective of this new CRP is to enhance the productivity and sustainability of farming systems through a better understanding of the principles and practice of conservation agriculture. More specifically, the individual and interactive effects of conservation tillage practices, residue management, crop rotations, nutrient and water inputs on soil organic matter stocks, resource use efficiency, agricultural productivity and environmental quality will be investigated.

From the proposals received by the IAEA, eight research contracts were awarded to Argentina, Brazil, India, Morocco, Pakistan, Turkey, Uganda and Uzbekistan. One technical contract was awarded to Chile and two research agreements to Australia and Kenya.

Selection for Greater Agronomic Water-Use Efficiency in Wheat and Rice using Carbon Isotope Discrimination (D1-20.08)

Project Officer: R. Serraj

This CRP was approved by the IAEA in 2003 and implementation started in 2003 with an anticipated duration of 5 years (2003–2007). Overall objective of this project is to contribute to increasing the agronomic water-use efficiency of wheat and rice production, where agronomic water-use efficiency is defined as grain yield/total water use including both transpiration and evaporation. The specific objectives are (i) to evaluate different strategies for using carbon isotope discrimination as a selection tool for identifying higher yielding genotypes of wheat and rice in various target zones and cropping systems, (ii) to develop sets of elite isomorphic lines varying in carbon isotope discrimination, and (iii) using sets of these isomorphic breeding lines evaluated in contrasting cropping environments, national program scientists to determine

the most effective breeding strategies for application of carbon isotope discrimination in their environments.

Six contract holders: M. Hafsi (Algeria), X. Xu (PR China), S.C. Misra (India), M. Jlibene (Morocco), J. Akhter (Pakistan), A. Al-Hakimi (Yemen); two technical contractors: A. Condon (CSIRO-Australia) and P. Monneveux (CIMMYT-Mexico), and two agreement holders: A. Ismail (IRRI-Philippines) and A. Hall (USA), are currently participating in the project and attended the first Research Coordination Meeting held recently in Vienna (see Past Events). The group has a variety of expertise and advanced skills related to crop improvement of water use efficiency under a wide range of environmental conditions. However, most of these participants are focusing mainly on wheat. In order to cover all project objectives and strengthen the research aspects on rice and salinity, in addition to drought effects on wheat, it was recommended by the first RCM and after consultation with Director NAFA to invite more research contracts to work on these aspects. Given the amount of research work needed on rice and the direct involvement of the team at IRRI, previously involved as agreement holder, it was suggested to award a technical contract to IRRI in addition to NARS partners from Bangladesh and PR China to work on the application of carbon isotope discrimination in the improvement of salinity tolerance in rice. An additional contract was awarded to A. Wahbi (Aleppo, Syria) to work on experimental sites characterization, wheat simulation modelling and field evaluations in relation to the CRP objectives.

During the first RCM (see Past Events) progress reports were presented, and project objectives and outputs were revisited and a detailed work plan was also established for future research activities in each participating country and in line with the project objectives. The report of the first RCM will be shortly available from the Scientific Secretary upon request or at

<http://www.iaea.org/programmes/nafa/d1>. The second RCM will be held in November 2005, in Morocco.

Research Networks

In addition to the Coordinated Research Projects (CRPs) that bring together research institutes in both developing and developed Member States to collaborate on a common research topic of interest, the Agency has other modalities to support research activities. A small portion of available funds can be used to finance projects, which deal with tasks included in the IAEA Programme of Work and Budget. This is done by awarding individual contracts and creating research networks such as the ones described below.

1. Decision Support System for Phosphate Rock Use (PRDSS) in Agriculture

Phosphorus (P) deficiency is one of the main constraints for crop and livestock productivity in soils of many developing countries. Locally available phosphate rocks (PRs) can be potentially used as P fertilizer sources in agricultural production systems of the tropics and subtropics. Under certain conditions, PRs can be applied to supply P to crops at a lower cost than using imported water-soluble P fertilizer. However, before PR application a farmer most likely will pose several questions. In fact, many factors determine whether or not a given PR will be an effective P fertilizer in a farmer's field. These include the PR reactivity, the soil properties, climatic conditions, plant species and variety and farmer own management practices such as crop residue management and PR application method. The way these factors interact to influence PR performance is complex for any specific condition. Thus, it is difficult to make general technical recommendations. Under these conditions, Decision Support Systems (DSS) are simple tools that can be readily used by research and extension personnel to provide technical recommendations and decision support to farmers. A DSS for PR use (PR-DSS) is constructed utilising available information on the main influencing factors mentioned above to predict whether a given PR will be effective in a given crop and environment. During the past three years the Joint FAO/IAEA Division and the International Center for Soil Fertility and Agricultural Development, formerly International Institute for Fertilizer Development (IFDC) have been working in close collaboration to develop a suitable and practical PRDSS. Currently, a PRDSS is available but needs to be validated. Moreover, experimental guidelines were also jointly developed for the field PRDSS validation.

This PRDSS validation work will be carried out in a network of field trials in selected benchmark sites of Latin America, Africa and Asia during the biennium 2004-2005. Six collaborators, namely R. Melgar (Argentina), L. Prochnow (Brazil), Moussa Bonzi (Burkina Faso), J. Semoka (Tanzania), M.H. Musa (Malaysia) and Phan Thi Cong (Viet Nam) have been selected and IAEA research contracts will be awarded this year to conduct the field experiments and collect the relevant information required for the PRDSS validation. At the end of this validation study, it is expected to release the validated expert system in a CD-ROM version and also posted in FAO/IAEA website. In this connection, the SWNM subprogramme is also developing a website on "direct application of phosphate rock" (DAPR) including all relevant PR information and other materials such as "e-learning programme" to promote the use of PRs as P fertilizers in developing countries. A status report of the progress made and an outline of the future development work to be completed

in 2005 are available in the report of the Consultants' Meeting held in August 2003 (see website at <http://www.iaea.org/programmes/nafa/d1>).

2. The Comparison of Soil Water Measuring Techniques

A Consultants' Meeting (CM) on the "Comparative assessment of neutron probe, time domain reflectometry and capacitance probe for the measurement of soil water content" was held in November 1998 to review the advances in the various soil water measuring techniques, and to consult on the procedures for adopting soil water measurement techniques in the Agency's future research and training programmes. An IAEA-TECDOC-1137 "Comparison of soil water measurement using the neutron scattering, time-domain reflectometry and capacitance methods" was published in February 2000.

Subsequently, four research contracts were awarded in 2000, to compare various soil moisture sensors, in particular the neutron probe, with other profiling measuring systems under different environmental, soil and cropping systems. The second CM was held at IAEA Headquarters from 21–23 March 2001, the report of that meeting is available online at

<http://www.iaea.org/programmes/nafa/d1>. The third and final CM was held from 24–28 March 2003. The main recommendation was the production of practical guidelines entitled "Measuring Soil Water Content in the Field: A Beginners Guide for Methods, Instrumentation and Technique". This publication is in preparation and will be published in 2005 in the IAEA Training Course series.

It was also planned that scientific articles on the experimental work undertaken in the project would be published in 2005 as a special issue in *The Vadose Zone Journal*. For this publication, an agreement would be pursued with the publisher to allow the IAEA to reproduce the special issue.

The panel also recommended that a CM be convened in 2005 to plan a new CRP on "Effective Measurement of Crop Water Use at the Field and Farm Level". The objective of this project will be to further refine soil water balance measurements within the context of accurate determination of crop water use at several levels.

3. Crop Water Productivity (CWP)

Collaboration was established in 2001 between the Joint FAO/IAEA Division (AGE) and FAO-AGLW on their CWP programme. The initial motivation of that programme was to update procedures to assess CWP including updating the FAO Publication Irrigation and Drainage Bulletin No. 33 on "Yield Response to Water", which

was published in 1979. Accurate knowledge of CWP is a key to improving efficiency in agricultural water use; this is dependent on accurate measurements of crop yield and water use. Mr. van Halsema was employed as consultant on two Special Service Agreements (SSA) to review and process suitable data sets within IAEA, FAO and other potential partners, and to establish relevant relationships and parameters on the yield response functions, in particular with regard to the establishment of crop-yield-responses to different water regimes, both under rainfed and deficit irrigation conditions.

During an expert consultation held in March 2003 in FAO, Rome, twenty partner institutions working on water in agriculture decided to submit a joint proposal to the CGIAR Challenge Program for a three-year project (2004–2006) to develop practical tools and guidelines for the enhancement of water productivity under various management and climatic conditions. The submission was unfortunately unsuccessful; however, the FAO/IAEA Division has decided to support research under this initiative. So far, four individual research contracts have been awarded to scientists of China, Kenya, Turkey and Uzbekistan, to accurately quantify the crop water use and yield under both rainfed and irrigated conditions; and under different cropping and tillage systems.

4. Hydraulic lift

In the IAEA 2002–2003 PWB, a laboratory task was included on identifying the sources of water for trees growing in dry environments using isotopic techniques. The original idea was to study hydraulic lift (HL) phenomenon with *Eucalyptus* trees grown in the large columns in the glasshouse at Seibersdorf. This was found unsuitable because the environment in the glasshouse is far from that exists in the dry savannah in African or other parts of the world where HL mechanism occurs. It was therefore, agreed to grant two research contracts for this study to be conducted in the West African Sahel. Hydraulic lift is a process of water movement from relatively wet to dry soil layers through plant roots, with transport taking place mostly during the night when leaf stomata are closed. The process is supposed to be passively driven by differences in water potential, with the major water potential gradient between the deep wet roots and the drier surface roots in the topsoil. Both trees and the under storey can benefit from HL in several ways. Water releases to the topsoil through HL during the night can be replaced and

taken up by the tree the next day, thereby increasing their daily water and nutrient uptake. Higher soil moisture in the topsoil can also increase mineralization rates of the soil organic matter and may help to maintain mycorrhizae, which in turn can enhance soil nutrient availability in the areas under the influence of trees.

In many dry savannah regions of the world, HL has been demonstrated; and over 30 tree species have been identified. In the dry West African Sahel there are traditional systems where crops are grown in association with tree formations such as parklands. One of the reasons trees and vegetation can co-exist in isolation could be due to the HL mechanism.

The objective of this study is to investigate the role of HL in tree-grass or tree-crops interactions, in two locations of the dry savannah of the West African Sahel, i.e. Burkina Faso (Mr. Jules Bayala) and Niger (Mr. Mahamane Larwanou). Soil water potential will be continuously monitored using soil thermocouple psychrometers at several distances from trees for a few months during the dry season. Soil, plant, rain and groundwater samples will be collected periodically, their water extracted locally (soil and plant) and their isotopic signatures (^{18}O and ^2H) analysed in the Agency's laboratories at Seibersdorf. The existence of HL can be confirmed and its contribution to the total water uptake can then be calculated. The understanding of this process is important to develop improved agro-forestry systems for dry savannah conditions, thus contributing to ensure sustainable food production in the rain-fed agriculture of the countries while combating desertification in the Sahel. The projects started in 2003 and are expected to complete by 2005.

5. Endophytic nitrogen fixation

At present there are two technical contracts in Uruguay (Survey of indigenous diazotrophic bacteria associated to maize in Uruguay, Dr. Adriana Montanez Massa, D1.URU/12845) and Brazil (BNF contribution to sugar cane crop by endophytic diazotrophic bacteria, Dr. Bruno Alves, D1.BRA/12969) being implemented to study endophytic nitrogen fixation. The objective is to obtain initial measurements on endophytic nitrogen fixation in maize (Uruguay) and sugar cane (Brazil) using ^{15}N isotope tracer technology. This work will be implemented during the biennium 2004-2005.

Laboratory Activities

Research

Optimizing wheat productivity under rainfed environments of West Asia and North Africa using simulation modelling

L.K. Heng

Yields of cereal crops in the arid and semi-arid rainfed areas are generally low. While applying N and P fertilizer and other management practices can lead to increased grain yield, these practices could have opposite effects when water is limiting. The unpredictability of the rainfall also makes it difficult to determine the level and timing of fertilizer needed to obtain optimum yield. In order to develop suitable and appropriate crop production strategies to increase yields, and to understand the links between climate variability, water availability and management options, a crop simulation model APSIM (Agricultural Production Systems Simulator Model APSIM-N wheat) was tested using data obtained from two locations in the arid and semi-arid rainfed environments of West Asia and North Africa, Morocco and Jordan. The experiments were to investigate the role of crop residues and levels of nitrogen fertilizer on wheat crop in various crop rotations.

The experimental results showed that yield was extremely low in most seasons; it was limited mainly by rainfall. The APSIM model was able to simulate wheat grain yield and grain N content reasonably well except for one season in Morocco (Fig. 1). Long-term (20-year) simulation using historical weather record from Morocco to examine the effect of crop genotype (early versus late variety) and management practices (amount and timing of N fertilizer, initial stored soil water, sowing date, sowing density, soil types and supplemental irrigation) on the probability of grain yield potential, indicate that application of nitrogen fertilizer up to 40 kg N/ha could improve grain yield under arid and semi-arid rainfed environment. Higher N rates did not result in further yield improvement; in fact, the effect could be detrimental depending on the timing and distribution of rainfall.

The simulations showed that late planting by one month compared to early November planting reduced yield substantially (Fig. 2), especially in well-distributed high rainfall, or in high early seasonal rainfall, however, yield could be equal or even higher in a dry season or when rain comes later in the season. Having initial stored soil moisture was beneficial in the dryer years; on average it increased yield between 10 to 40 % compared to dry sub-soil (results not shown). It also reduced yield variability between seasons. It is therefore important to incorporate crop management practices, such as fallowing which could enhance stored soil moisture.

The model also compared the effect of different sowing densities; the typical sowing density at 150 seeds/m² was compared with two different rates at 100 and 300 seeds/m². The simulations showed that reducing the sowing density from 150 seeds/m² to 100 seeds/m² only reduces the maximum yield slightly (Fig. 3) at the 40-00-00 N treatment; similarly increasing the sowing density to 300 seeds/m² (the current sowing density in the WANA region) did not significantly improve yield. The analysis implies that under most circumstances a high sowing density is not warranted, this would be a significant saving of seeds to the farmers.

Many studies have shown that yield and water productivity could be greatly enhanced by applying a relatively small quantity of supplementary irrigation (SI). The effect of five times 60 mm irrigation given at the beginning of each month starting from December on grain yield combined with N rate under different management options was studied. Simulated yield was observed to increase tremendously with N application under SI and early sowing. There was however little yield increase above the 40-80-40 N treatment (Fig. 4a). Similarly, there was minimal yield penalty with a lower sowing density (100 seeds/m²) compared to the current practice of 150 seeds/m² (Fig. 4b). The above results showed that simulation model such as APSIM can be a useful tool in identifying better nutrient and water management practices to increase crop production in rainfed arid and semi-arid areas.

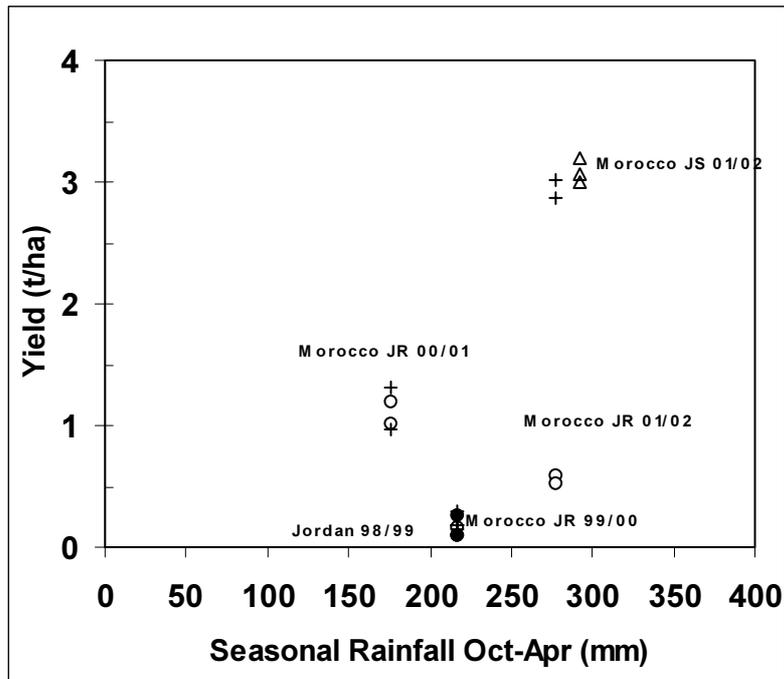


Fig. 1. Measured (round symbols) and simulated (+) wheat grain yields versus cumulative seasonal October to April rainfall for Moroccan and Jordan.

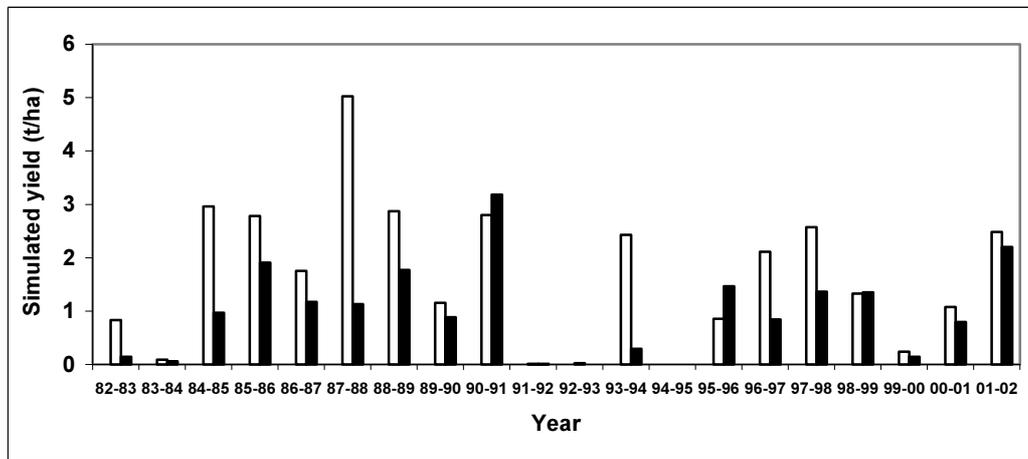


Fig. 2. Effect of different planting dates (early, and ■ late) at 40-80-00 N rate on the Moroccan simulated wheat grain yield.

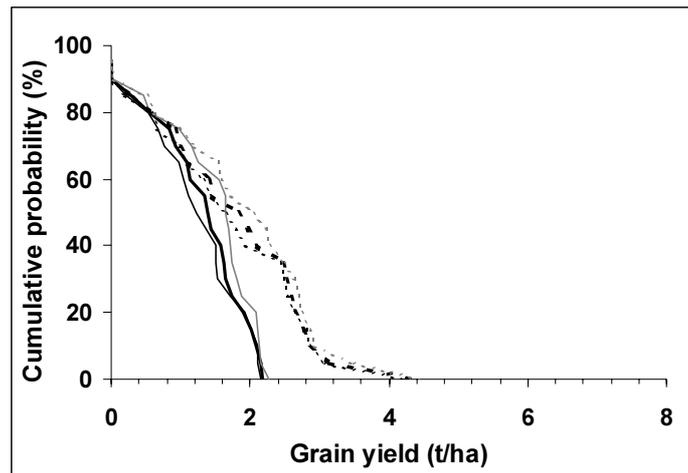


Fig. 3. The effect of different sowing densities (-100 , -150 and -300 seeds/m², respectively), with N fertilizer (dashed lines) and without N (solid lines) on simulated wheat grain yield.

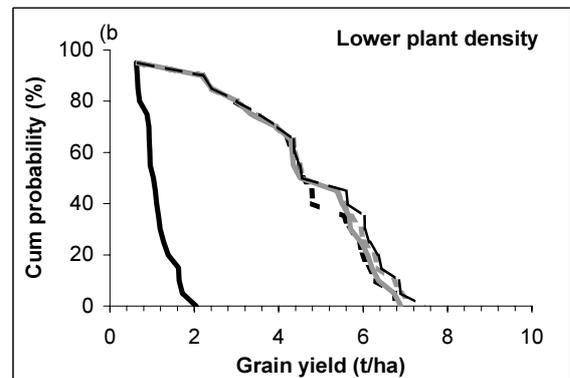
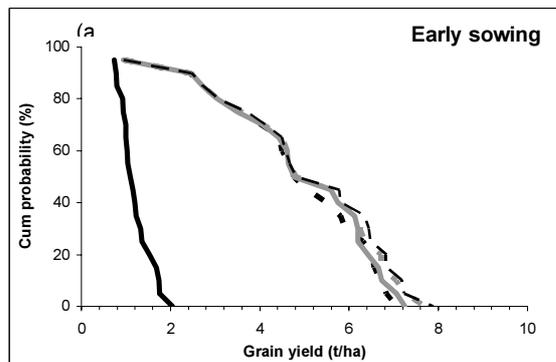


Fig. 4. Effect of supplemental irrigation (5×60 mm) on grain yield at different N fertilizer rates ($-00-00-00$, $--40-80-40$, $-80-80-00$, $--80-80-40$ and $--120-120-00$, respectively, under (a) early sowing and (b) using a lower sowing density (100 seeds/m² compared with 150 seeds/m² originally).

Training

Fellowships

Mr. C.K. Kaizzi (UGA/03019P) received training on the use of nuclear techniques to quantify nutrient availability from organic sources and to measure below ground nitrogen in soybean under the supervision of Ms Rebecca Hood-Nowotny.

Mr. R.P. Nallahandy (SRL/03019P) received three months training on the use of ¹⁵N isotopic dilution methodology to quantify biological nitrogen fixation. He conducted experiments on the effect of early nodulation on biological nitrogen fixation under supervision of Mr. Gudni Hardarson.

Ms. A. Ahmed (SUD/02007P) received four months training on the use of ¹⁵N methodology to quantify biological nitrogen fixation. She conducted greenhouse experiments with soybean and common bean, studying the effect of rhizobial strains on early nodulation and fixation under the supervision of Mr. Gudni Hardarson.

Mr. D. Zhang (CPR/0408) received one month training on the use of emission spectrometer for the ¹⁵N analyses of under the supervision of Mr. Jose Luis Arrillaga.

Training Workshop

Mr. Jose Luis Arrillaga conducted group training on the use of Sentek-Diviner 2000 soil moisture probe to a group of scientists and technicians from Agricultural Research and Extension Unit (AREU); from 12 to 16 July 2004 at

AREU-Wooton Research Station, Mauritius. The activities were carried out in support of the TC project MAR/5/014 entitled "Management Practices for Increased Efficiency of Fertilizers and Improved Productivity of Saline Soils". A group of six scientists from AREU participated actively in all sessions of the training which included installation of access tubes, creation of profiles, measurement and data logging as well as downloading and processing of the soil moisture data on a PC. The scientists are now able to use, without difficulties, the Diviner 2000 probe to assess soil moisture content in the various experiments that they are planning to undertake in the future.

Supportive Services

Isotope Analytical Services

The Soil Science Unit performed approximately 10 400 measurements on 4600 samples during the year 2003. Of

these approximately 1/3 was at natural abundance (^{15}N , ^{13}C and ^{18}O) and 2/3 enriched samples (mostly ^{15}N). A detailed report was made in the June 2004 Newsletter showing the trend in the isotope analyses during the past five years. During this period isotope analyses of enriched ^{15}N samples have decreased as most of these analyses are being done in Member States using emission spectrometers and more recently mass spectrometers in some laboratories with quality assurance provided by the Soil Science Unit. At the same time numbers of natural abundance analyses have increased as these types of analyses have to be done by mass spectrometers. Detailed report of the analytical work during the whole of 2004 will be reported in the next Newsletter.

External Quality Assurance

A detailed report of the Proficiency Testing Exercise for the year 2003 was made in the June 2004 Newsletter. Detailed report of the Proficiency Testing Exercise for the year 2004 will be made in the next Newsletter.

Publications

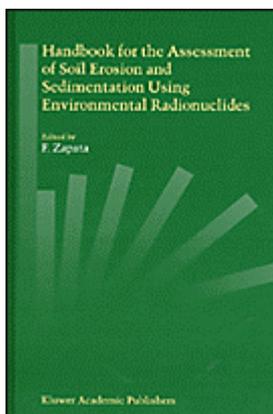
Recent Publications of the Sub-programme

A list of articles from Soils Section and Unit staff published in Scientific journals and Conference Proceedings are available on our SWMN Section website at the URL http://www.iaea.org/programmes/nafa/d1/public/d1_pbl_1.html

Recent titles

Handbook for the Assessment of Soil Erosion and Sedimentation Using Environmental Radionuclides.

F. Zapata, editor. Kluwer Academic Publishers, Dordrecht, Boston, 2002, xii + 219 p. ISBN 1-4020-1041-9. Hardcover.



This handbook deals with soil erosion and sedimentation. Soil erosion and associated sediment deposition are natural landscape-forming processes that can be greatly accelerated by human intervention through deforestation, overgrazing, and non-sustainable farming practices. Soil ero-

sion and sedimentation may not only cause on-site degradation of the natural resource base, but also off-site problems, e.g. downstream sediment deposition in fields, floodplains and water bodies, water pollution, eutrophication, and reservoir siltation. There is an urgent need for accurate information to quantify the problem and to underpin the selection of effective soil-conservation technologies and sedimentation-remediation strategies, including assessment of environmental and economic impacts. Existing classical techniques to document soil erosion are capable of meeting some of the needs, but they all possess important limitations. The quest for alternative techniques for assessing soil erosion, to complement existing methods, directed attention to the use of environmental radionuclides, in particular fallout ^{137}Cs , as tracer to quantify rates and establish patterns of soil redistribution within the landscape.

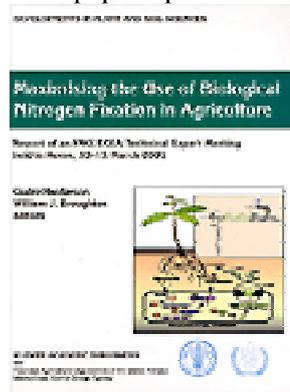
This handbook contains the developments made in the refinement and standardization of the technique, developed by 25 research groups worldwide, and featuring the contributions of a team of leading experts in the field. It provides a comprehensive coverage of the methodologies for using radionuclides, primarily ^{137}Cs and ^{210}Pb to establish rates and spatial patterns of soil redistribution and determine the geochronology of sediment deposits. The book is illustrated with many figures and photographs. The book also aims to give advice on matters relating to the selection of suitable coring sites, the sampling strat-

egy, and on methods for retrieving cores and subsampling. It is stated that these first steps should be well planned and executed with careful attention to detail.

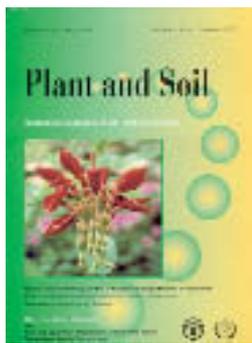
Maximizing the Use of Biological Nitrogen Fixation in Agriculture. Report of an FAO/IAEA Technical Expert Meeting held in Rome, 13-15 March 2001.

G. Hardarson and W.J. Broughton, editors. Food and Agriculture Organization of the United Nations, Rome (ISBN 92-5-104898-3) and Kluwer Academic Publishers, Dordrecht (ISBN 1-4020-1237-3), 2003, vii + 226 pages. This publication was published as a hard cover book in the series "Developments in Plant and Soil Sciences" and as a Special Issue of Plant and Soil, International Journal on Plant - Soil Relationships.

This publication contains invited papers presented at a joint meeting FAO/IAEA Technical Expert Meeting on Increasing the Use of Biological Nitrogen Fixation (BNF) in Agriculture held in Rome in 2001. The objectives of the meeting were to take use of the stock of current knowledge and identify opportunities where BNF technologies could offer the greatest environmental and economic benefits for specific agroecosystems in developing countries.



Incorporating contributions from microbiologists, molecular biologists, plant breeders and soil scientists this volume reports the results and recommendations of the experts participating in the meeting above. There is a real opportunity for achieving major benefits from BNF research and development in developing countries through targeted interventions.



This book is unique in that it reviews the latest thinking on various aspects of nitrogen fixation technology and applications; reviews the possibilities in enhancing nitrogen fixation in various cropping systems; shows ways how biological nitrogen fixation can be used to enhance crop production and considers the applicability of these technologies to small farmers in developing countries.

Use of phosphate rocks for sustainable agriculture. FAO Fertilizer and Plant Nutrition Bulletin No. 13.

F. Zapata and R.N. Roy, editors. Food and Agriculture Organization of the United Nations (FAO). Rome, 2004, xvii + 148 pages. ISBN 92-5-105030-9. Soft cover. A joint publication of the FAO Land and Water Development Division and the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture.



This bulletin deals with the direct application of phosphate rock (PR) sources to agriculture. Phosphorus (P) is an essential plant nutrient and its deficiency severely restricts crop yields. Tropical and sub-tropical soils are predominantly acidic, and often extremely P-deficient with high P-sorption (fixation) capacities. Therefore, substantial P inputs are required for optimum plant growth and adequate food and fiber production. Manufactured water-soluble P fertilizers such as superphosphates are commonly recommended to correct P deficiencies, but most developing countries import these fertilizers, which are often in limited supply and represent a major outlay for resource-poor farmers. In addition, sustainable intensification of agricultural production in these regions necessitates the addition of P not only to increase crop production but also to improve soil P status to avoid further soil degradation. Therefore, it is imperative to explore alternative P sources. In this context, under certain soil and climatic conditions the direct application of PR is an agronomically and economically sound alternative to the more expensive superphosphates. PR deposits occur world wide, but few are mined for use mainly as raw materials to manufacture water-soluble P fertilizers.

Extensive research on utilization of indigenous PR deposits has been done by several organizations in tropical soils of Latin America, Africa, Asia and elsewhere. Over the past ten years considerable progress has been made in the utilization of PR sources for direct application in agricultural cropping systems worldwide, and a wealth of information is available but scattered in several publications of meetings. Recognizing the need for the wide dissemination of this information, the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture together with the Land and Water Development Division, convened a Consultants' Meeting in November 2001 in Vienna to review advances in this field of research and development, and to elaborate a proposal for the production of this technical bulletin. Mr. F. Zapata (IAEA, Vienna) and Mr. R. Roy (FAO, Rome) implemented this task. Well-known specialists working in this sector were invited to contribute to the chapters of the publication. The aim of this publication is to provide up-to-date information on direct application of PR in agriculture in a

technically focused document leading to practical guidelines to assist middle level decision makers, the scientific community, higher-level extension workers, NGOs and other stakeholders involved in agricultural development. The ultimate goal will be to reach the maximum number of people particularly policy makers at local, regional and central levels of government who need to be guided on the adoption of PRs as a capital investment to trigger sustainable agricultural intensification in the acid soils of the tropics and sub-tropics.

Papers in Scientific Journals and Conference Proceedings

- Heng, L.K., Asseng, S., Mejahed, K. EL., Rusan, M.M. and Keerthisinghe, G. 2004. Optimizing wheat productivity under extreme dry rainfed environments of West-Asia-North Africa (WANA) using APSIM. In: S-E. Jacobsen, C.R. Jensen, and J.R. Porter (eds). Book of Proceedings of VIII European Society for Agronomy Congress. 11–15 July 2004, Copenhagen, Denmark. p. 923-924.
- Kútúk, C., Çayci, G. and Heng, L.K. 2004. Effects of increasing salinity and ¹⁵N-labelled urea levels on growth, N uptake, and water use efficiency of young tomato plants. *Australian J. Soil Research* 42: 345-351.
- Roy, R.N. and Zapata F. 2004. Chapter 12. Epilogue. In: F. Zapata and R.N. Roy (eds.). *Use of Phosphate Rocks for Sustainable Agriculture*. FAO Fertilizer and Plant Nutrition Bulletin 13. FAO, Rome, Italy, p. 125-126.
- Sale, P.W.G. and Heng, L.K. 2004. Chapter 7. Decision-support systems for the use of phosphate rocks. In: F. Zapata and R.N. Roy (eds.). *Use of Phosphate Rocks for Sustainable Agriculture*. FAO Fertilizer and Plant Nutrition Bulletin 13. FAO, Rome, Italy, p. 69-75.
- Zapata F. and Roy, R.N. 2004. Chapter 1. Introduction. In: F. Zapata and R.N. Roy (eds.). *Use of Phosphate Rocks for Sustainable Agriculture*. FAO Fertilizer and Plant Nutrition Bulletin 13. FAO, Rome, Italy, p. 1-9.
- Zapata F. 2004. Soil erosion and sedimentation studies using fallout radionuclides: Recent developments and future applications. In: R. Francaviglia (ed) "Agricultural impacts on soil erosion and soil biodiversity: Developing indicators for policy analysis", pp. 415-

426. Proc. from an OECD Expert Meeting. Rome, Italy, March 2003, 654 pp. Also the individual paper is available as pdf download at URL: [http://webdomino1.oecd.comnet/agr/soil_ero_bio.nsf/viewHtml/index/\\$file/Publ](http://webdomino1.oecd.comnet/agr/soil_ero_bio.nsf/viewHtml/index/$file/Publ).

CD-ROMs

Use of Isotope and Radiation Methods in Soil and Water Management and Crop Nutrition. An Interactive CD-ROM. The aim of the product is to provide an electronic version of the manual (pdf format) including ready made power-point presentations, which could be used as learning tools and teaching aids by scientists in Member States. Also, to provide short video presentations of techniques, which are difficult to convey using other media, in general, to provide an interesting and stimulating learning environment.

Websites

The Soil and Water Management and Crop Nutrition Section is updated on a regular basis.

Please visit the website and make comments.

<http://www.iaea.org/programmes/nafa/d1/index.html>

FAO/IAEA Technical Meeting "Combating soil degradation to enhance food security in Africa: The Role of Nuclear Techniques in Developing Improved Soil, Water and Nutrient Management Practices, 16–20 May 2005, ICRAF Headquarters, Nairobi, Kenya.

For detailed information on this visit the sites: <http://www.iaea.org/prgrammes/nafa/d1/index.html>

(under news of the sub-programme) and

<http://www-pub.iaea.org/MTCD/Meetings/Meetings2005.asp> (under IAEA meetings 2005).

Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture:

<http://www.iaea.org/programmes/nafa>

FAO website: <http://www.fao.org>

FAO/AGL (Land and Water Development Division)

<http://www.fao.org/AGL/portals.stm>

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