

SOILS

A Publication of the Soil and
Water Management &
Crop Nutrition Sub-Programme
of the Joint FAO/IAEA Division
of Nuclear Techniques in Food and
Agriculture and FAO/IAEA
Agriculture and Biotechnology
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NEWS LETTER

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A. TO OUR READERS

Water is a scarce and finite resource, and the FAO Committee on Agriculture (COAG) recently identified the sustainable use of natural resources as a priority area within the agriculture programme. COAG made specific reference to the need for better water management and the improvement of land, soil and water quality. The sub-programme is currently engaged in several projects on water, and will endeavour to expand these activities in the future through both the regular and technical co-operation programmes of the Agency.

The final Consultants' Meeting of a 3-year study on "The comparison of the soil moisture neutron probe with time-domain reflectometry and capacitance methods" was held at IAEA HQ, Vienna, in March 2003. Experts from Australia, Austria, France and the United States of America, and the SSU Seibersdorf, conducted the comparative assessment under various soil and climatic conditions and cropping systems. Two sets of guidelines will be issued from this project. One will be a technical guide to the use of various soil water monitoring instruments and the other will provide guidelines for choosing a soil water measurement sensor. In addition, it is planned to publish a special issue of *The Vadose Zone Journal* containing scientific articles on the experimental work undertaken in the project.

An FAO/IAEA Interregional Training Course on "the Use of Nuclear and Related Techniques to Increase Water Use Efficiency in Rainfed and Irrigated Agriculture" will be held at the SSU, Seibersdorf, from 1 – 25 July 2003. Fifteen candidates from FAO and IAEA Member States in all regions have been selected to participate. The objective of the course is to transfer knowledge and practical experience to developing countries on the use of nuclear and related techniques to measure and monitor soil water status, including technologies, strategies and approaches to conserve water, reduce wastage and increase water use efficiency in irrigated and rainfed cropping systems, especially in arid and semi-arid areas.

The sub-programme and other international institutions are co-operating with the Land and Water Development Division of FAO on a project to review and develop simulation methodologies to assess crop water productivity (CWP) relationships. Two expert consultations have been held since the project began in December 2001. Considerable progress has been made towards developing a new dynamic crop growth and water stress model, adapted to assess and evaluate different environmental and management conditions affecting CWP, from optimum to severely water stressed. The collaborating institutions have jointly submitted a proposal to the CGIAR Challenge Programme to further broaden the expertise and knowledge base. Additional data collection and model testing will be carried out through the award of individual contracts under the IAEA Research Contracts Programme.

The sub-programme is implementing a Co-ordinated Research Project on "Integrated Soil, Water and Nutrient Management for Sustainable Rice-Wheat Cropping Systems in Asia". The overall objective is to improve the productivity and sustainability of rice-wheat cropping systems through increased efficiency of water and nutrient use. The specific objective is to modify existing water and nutrient management systems, and improve soil management in both traditional and emerging tillage systems, for sustainable intensification of cereal production. Considerable savings of water have been demonstrated for both wheat and paddy rice grown on permanent raised beds with minimum tillage and furrow irrigation compared with flood irrigation in conventionally tilled systems.

The sub-programme has awarded two research contracts on hydraulic lift (HL) in the dry Sub-Saharan, West Sahel region of Africa. It is hypothesized that water can move from relatively wet to dry soil layers through tree roots during the night when leaf stomata are closed. The process is driven by differences in water potential, with the major water potential gradient between the deeper and wetter roots and the drier roots in the topsoil. Several beneficial effects are hypothesised: During the next day the tree and under storey can take up water transported by HL during the previous night, thereby increasing daily water and nutrient uptake. Higher topsoil moisture can also increase mineralization rates and may help to maintain mycorrhizae, which can increase soil nutrient availability. The contribution of such water is thought to be important to the sustainability of traditional rainfed farming systems of the region. A better understanding of this process will help in formulating reforestation programmes and tree management strategies in agro-forestry parkland systems. HL has been demonstrated in native trees in arid savannah regions of North America and Australia. The research being undertaken in Burkina Faso and Niger will involve measurement of soil water potential and analysis of the isotopic composition (^2H , ^{18}O) of water from various sources to quantify the amount and flux of water in the system.

Both water and fertilizer use efficiency can be markedly increased by delivery through drip irrigation systems compared with conventional surface application methods. Such systems are particularly attractive for perennial orchards and other high value ornamental or vegetable crops in areas of meagre water supply. A regional technical co-operation project (TCP) in Europe involving nine countries, and national projects in Yemen and Libya are extending the fertigation technology to the end-users. In addition, the sub-programme is presently undertaking up-stream planning and pre-project missions for the 2005-06 TC cycle that will focus on the conservation and more efficient utilization of scarce water resources in arid and semi-arid regions.

With my very best wishes.

Phillip Chalk
Head, Soil and Water Management
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B. STAFF

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3. Staff Changes

Mr. Iban Mateos Peña left the Section at the end of 2002 to take up a new assignment with the International Criminal Tribunal for the Former Yugoslavia in The Hague, The Netherlands. Iban was with us as a temporary Secretary for a period of 8 months. We wish him all the best in his new employment.

Ms. Judith Carrillo de Fischer joined the Section as a temporary Secretary on 12 January 2003. Judith is fluent in several official languages, including English, French and Spanish.

Mr. Steve Evett, Soil and Water Management Research Unit, USDA-ARS, Bushland, Texas, USA, began a 4-month assignment at the Soil Science Unit on April 1, 2003 to (i) write guidelines on the use of neutron, TDR and capacitance probes (ii) participate in collaborative work on crop water productivity with FAO (iii) present lectures and demonstrations at the Interregional Training Course on Soil Water (iv) explore opportunities for increased TCP activities in the water sector.

Ms. Muriel Weinreich, retired from the Soil Science Unit on March 31, 2003. Ms. Weinreich started work as Secretary of the Soil Science Unit on 1st July 1994. We thank her for her long service and wish her well in retirement.

C. FUTURE EVENTS

RESEARCH CO-ORDINATION MEETINGS (RCMs) OF FAO/IAEA CO-ORDINATED RESEARCH PROJECTS (CRPs)

- ⇒ **Third 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” (D1-50.06), 18 – 22 August 2003, Ouagadougou, Burkina Faso**

Eight research contractors from Brazil (2), Benin, Burkina Faso, Cuba, Mexico, Nigeria, Venezuela; one technical contractor from Australia and four agreement holders from Germany, Kenya (TSBF), Nigeria (IITA) and USA (IFDC) will participate in the third RCM. The purpose of the meeting is to: a) review research results obtained during the reporting period 2002-2003 in accordance with the work plan of the project, and b) assess overall progress in the implementation of the project and draw an activity plan for completion of the project. Dr. Vincent Boubié Bado, from the “Institut de l’Environnement et des Recherches Agricoles” (INERA) is the local organizer.

One hour will be allotted for each presentation including 15 minutes for discussion. The abstract should be sent to the Project Officer by 14 July 2003. The progress report (abstract, introduction, materials and methods, results and discussion, conclusions and references) will be submitted on a 3.5” diskette at the meeting. As the project will be completed in October 2004, overall progress made in implementation of the work plan of the project will be reviewed in accordance with the project objectives and plans for completion will be made. Mr. F. Zapata is the Project Officer and will serve as the Scientific Secretary.

- ⇒ **Second RCM of CRP on “Integrated Soil, Water and Nutrient Management for Sustainable Rice-Wheat Cropping Systems in Asia” (D1-50.07), 08 – 12 September 2003, Nanjing, China**

Nine contract holders and 2 agreement holders are expected to participate. Prof. Qirong Shen, Nanjing Agricultural University, is the local organiser. The participants will present the major results and conclusions of their research since commencement of the project on 1st October 2001. The data presented will be fully discussed in line with the objectives of the project, and adjustments made where necessary to the agreed work plan and experimental protocols. The role of crop simulation models in the project will also be thoroughly assessed. Mr. P.M. Chalk is the Project Officer and will be Scientific Secretary of the RCM. A report of the meeting will be prepared by the Project Officer, which will serve as the basis for the mid-term review of the CRP.

CONSULTANTS' MEETINGS

- ⇒ **FAO/IAEA Consultants' Meeting on "Integrated Soil, Water and Nutrient Management under Conservation Agriculture Practices", 16 – 18 August 2003, Iguazu Falls, Parana, Brazil**

This Meeting will be held immediately after the 2nd **World Congress on Conservation Agriculture**, which is co-sponsored by several Divisions within the Agriculture Department of FAO. The objective of the meeting will be to prepare the project document for a new CRP on Conservation Agriculture as included in the programme of work and budget for the 2004-2005 biennium. It is expected that five Consultants from Australia, Brazil, India, Kenya, and the United States of America will participate in the meeting in addition to IAEA and FAO professional staff. Mr. P.M. Chalk will be the convenor and Scientific Secretary of the Meeting.

- ⇒ **FAO/IAEA Consultants' Meeting on "Decision Support Systems for Utilization of Phosphate Rocks and Organic Nutrient Sources", 25 – 27 August 2003, Vienna, Austria**

Since its creation, the Joint FAO/IAEA Programme has conducted research and implemented field projects to increase crop yields and the efficiency of applied fertilizers utilizing isotopes, mainly ¹⁵N and ³²P as tracers, to pilot test innovative management practices. The Programme has also been involved in the development of ¹⁵N isotopic techniques to measure biological nitrogen fixation, and the implementation of projects aimed at increasing nitrogen fixation in grain, forage and tree legumes. More recently, by adopting the integrated approach to soil, water and nutrient management in cropping systems, research and development focused on the cost-effective utilization of locally available nutrient sources, as supplements to expensive and mostly imported manufactured fertilizers. In this respect, ¹⁵N and ³²P techniques were developed and used to measure the nutrient supply from these sources in a wide range of environments. Two CRPs on phosphate rocks and crop residues have been completed (refer to the Section on Status of CRPs). Moreover, national and regional Technical Co-operation Projects have generated data on the best use of local nutrient sources. The results from all of these projects have been published in books, the IAEA-TECDOC series and special issues of peer-reviewed scientific journals, targeting mainly the scientific community. Thus, a large body of information is available in many publications and reports from ours as well as other international projects, but it needs to be collated, consolidated and synthesised into practical recommendations and guidelines for all stakeholders involved in sustainable resource management, including policy and decision makers, land use managers and ultimately the end-users, i.e. the farmers.

A series of follow-up activities of the Phosphate CRP were initiated in 2001 and continued during the IAEA PWB 2002-2003. These activities include **the development of a Decision Support System for Phosphate Rock use (PR-DSS) and the construction of a website for Direct Application of Phosphate Rocks (DAPR)**. Furthermore, it is also planned during the next biennium 2004-2005 to start similar activities with **organic nutrient sources**. To streamline the implementation of the activities related to the use of phosphate rocks and to plan the activities on the use of organic nutrient sources (ONS), a Consultants'

Meeting will be convened with the following objectives: a) to review the overall development and technical aspects of the PR tasks (**PR-DSS and DAPR website**), b) to assess progress made and plan the way ahead including requirements for resources, c) to develop a work plan for the development of the activities related to the use of **organic nutrient sources**, and d) to discuss other programmatic issues of common interest.

The meeting will be held at the IAEA Headquarters with the participation of five invited scientists as consultants: Drs. Larry Hammond and Upendra Singh from the International Fertilizer Development Center (IFDC), USA; Dr. Nteranya Sanginga, Director of the Tropical Soil Biology Institute of the International Center for Tropical Agriculture (CIAT), Kenya; Dr. Georg Cadisch from Wye College, University of London, UK and Dr. Roberto Giaccio, a web developer from Italy. In addition, FAO and IMPHOS have been invited to participate. The consultants, together with the IAEA staff involved in this development work (Ian Ferris, Lee Heng and Felipe Zapata), will review the work done so far on the development of the PR-DSS and the interactive web-based DAPR resource. Based on the progress made and experiences gathered, the consultants will elaborate a detailed work plan for further development of the PR-DSS including distance learning tools and for initiating the development of the ONS-DSS. This will include the definition of activities in a logical sequence, a provisional schedule of activities, and more importantly, an assessment of the resources required. The overall aim of this work would be to enhance outreach activities and to disseminate the results obtained from research conducted by the Joint FAO/IAEA Programme by providing practical recommendations and guidelines to a wide audience comprising policy and decision makers, the scientific community, higher level extension workers, NGOs and other stakeholders involved in sustainable agricultural development at the local, national, regional and international levels. Mr. F. Zapata, assisted by Ms. L. Heng and Mr. I. Ferris, will serve as the Scientific Secretary.

FAO CO-SPONSORED MEETINGS

- ⇒ **2nd World Congress on Conservation Agriculture, 11 – 15 August 2003, Iguaçu Falls, Parana, Brazil**

The Brazilian Federation of No Tillage in Crop Residues (FEBRAPDP) is organizing this Congress under the theme of “Producing in Harmony with Nature”. More information can be obtained at <http://www.febrapdp.org.br/inscriptions.htm>

TRAINING COURSE

- ⇒ **FAO/IAEA Interregional Training Course on “The Use of Nuclear and Related Techniques to Increase Water Use Efficiency in Rainfed and Irrigated Agriculture”, 1 – 25 July 2003, Seibersdorf, Austria**

Fifteen participants from developing countries in all regions were selected for training. The curriculum of the course is available at <http://www.iaea.org/programmes/nafa/d1/index.html>

The following guest lecturers will be involved in the training activities:

1. Dr. Steve Evett (Chief Course Instructor), Soil and Water Management Research Unit, USDA-ARS, Bushland, Texas, USA.
2. Dr. Roger Hartmann, Dept. of Soil Management and Soil Care, Faculty of Agricultural and Applied Biological Sciences, Ghent University, Belgium.
3. Dr. Munir Rusan, Dept. of Natural Resources and the Environment, Faculty of Agriculture, Jordan University of Science and Technology (JUST), Irbid, Jordan.
4. Dr. Peter Cepuder, Institute of Hydraulics and Rural Water-Management, University of Agricultural Sciences, Vienna, Austria.

NON-FAO/IAEA MEETINGS

- ⇒ **2nd International Symposium on Phosphorus Dynamics in the Soil-Plant Continuum, 21 – 26 September 2003, Perth, Australia**

Information about this Symposium, which will be held at the University of Western Australia, can be found at http://www.agric.uwa.edu.au/soils/P_Symposium/index.html

- ⇒ **XIV International Congress on Nitrogen Fixation, 1 – 6 November 2003, Beijing, China**

Information about this Congress to be held at Peking University under the theme “Towards Sustainable Agriculture and Protection of the Environment” can be found at <http://n2fix.pku.edu.cn>

- ⇒ **Symposium on Stable Isotopes in Agriculturally Impacted Watersheds, ASA-CSSA-SSSA Annual Meetings, 2 – 6 November 2003, Denver, Colorado, USA**

For more information, contact Roger A. Burke (burke.roger@epa.gov)

- ⇒ **5th Austrian Workshop on Stable Isotopes in Ecological and Earth Sciences, 7 – 8 November 2003, Innsbruck, Austria**

For more information, contacts Christoph Spötl (christoph.spoetl@uibk.ac.at) or Leopold Füreder (leopold.fuereder@uibk.ac.at).

- ⇒ **International Conference on Water in Agricultural Production in Asia for the 21st Century, 25 – 28 November 2003, Phnom Penh, Cambodia**

The Cambodian Agricultural Research and Development Institute (CARDI) will host this conference. For more information, contact the Conference Secretary, Mr. Chea Marong at CARDIconference@bigpond.com.kh

⇒ **Workshop, SCOPE Nitrogen Fertilizer Rapid Assessment Project (NFRAP), 13 – 16 January 2004, Kampala, Uganda**

The Scientific Committee on Problems in the Environment (SCOPE) <http://www.icsu-scope.org/> has recently approved a Nitrogen Fertilizer Rapid Assessment Project (NFRAP) as a contribution to the International Nitrogen Initiative (INI) <http://gaim.unh.edu/Structure/Future/fasttrack/nitrogen.htm> The purpose of NFRAP is to assess the current scientific understanding on the fate of mineral fertilizer N in the context of the overall N inputs to agricultural systems. The long-term objective of the project is to help enhance the efficiency of mineral N use and reduce negative impacts on the environment.

The workshop will focus on four cross-cutting issues with a regional focus. Working groups will be established to consider:

1. Efficiency of fertilizer N use as determined by product, method and time of application, soil, crop and their interaction.
2. Role of emerging technologies (e.g. genetic enhancement, fertilizer manipulation, and remote sensing and other site-specific precision technologies) on the efficiency of N fertilizer use.
3. Pathways of N loss and their impact on human health and the environment (including soil degradation).
4. Societal responses to meeting N input needs in different regions (including national policies on fertilizer use and promotion of organic agriculture).

Thirteen review Chapters will be prepared by invited authors and peer reviewed before the meeting. . Mr. P. Chalk as been invited to review two Chapters and will participate in the meeting. A book will be published, including the 13 review Chapters and a synthesis Chapter arising from the discussions/deliberations of the working groups. It is planned to have this publication ready for the 3rd International Nitrogen Conference, 12 – 16 October 2004, Nanjing, China.

TECHNICAL CO-OPERATION PROJECTS (TCPs)

⇒ **FAO/IAEA Regional TCP for Europe on “Fertigation for Improved Crop Production and Environmental Protection” (RER/5/011)**

The objectives of the project are to increase water-use efficiency, improve crop production and reduce environmental damage through fertigation, using nuclear techniques to monitor fertilizer and water dynamics. Nine countries are participating in the project: Bulgaria, Cyprus, Former Yugoslav Republic of Macedonia, Greece, Hungary, Romania, Slovenia, Turkey, Serbia and Montenegro. Ms. Lee Heng is the Technical Officer of the TCP.

• **Final Co-ordination Meeting, 22 – 25 September 2003, Busteni, Romania**

The project counterparts in the participating countries will attend the meeting. The objective is to review progress during 2002-2003 and to formulate conclusions and

recommendations for future work in this area. Mr. Mihail Dumitru, Research Institute for Soil Science and Agrochemistry, Bucharest, Romania, is the local organizer.

⇒ **FAO/IAEA Regional TCP for East Asia and the Pacific (RCA) on “Restoration of Soil Fertility and Sustenance 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 (urbanisation, infrastructure and industrial development) are factors contributing to reduced agricultural productivity. The principal land degradation processes are nutrient depletion, acidification, salinisation, pollution, and soil erosion. The effects of human-induced degradation are exacerbated by inappropriate land use, soil and water mismanagement and inadequate farming practices. 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 utilisation 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 1 of this project deals with the restoration of soil fertility, and implementation commenced during the 2001-2002 cycle. The specific objective of Part 2 of this project is to measure soil erosion/sedimentation and associated pesticide contamination. For this purpose, the fallout radionuclide ^{137}Cs and related techniques will be utilized 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 better carrier for pesticides that may become toxic to aquatic plants and animals. Conventional and radiotracer techniques will be applied to explore potential pesticide contamination levels in soil, water and crops. This part of the project started in 2002 and will be implemented through 2004.

- **Mid-Term Review of Part 2: “Measuring soil erosion and sedimentation and associated pesticide contamination”, 13 – 17 October 2003, Jakarta, Indonesia**

The local organizer of the meeting will be Mr. Zainal Abidin from BATAN, Jakarta. National project co-ordinators from China, Malaysia, Indonesia, Pakistan, Philippines, Sri Lanka and Viet Nam will participate in the meeting. In addition, scientists from Australia, Japan and the Republic of Korea will be invited as experts. The main purpose of this activity will be to review progress made in the implementation and to plan further the completion of the project. All participants will be presenting major achievements and these will be critically examined in accordance with the objectives of the project. Specific issues to be discussed include: (a) analysis of problems and limitations in implementation and assessment of resources required for further implementation, b) impact assessment; and c) identification of future directions for the formulation of a new project proposal. Mr. Felipe Zapata is the Technical Officer.

- **Regional Training Workshop on “Promising Fertilizer and Crop Residue Management Practices for Sustainable Crop Production in Rice-based Cropping Systems ”, 20 – 24 October 2003, Hanoi, Viet Nam**

The training workshop, which belongs to Part 1 of the project, will be organized through the National Institute for Soils and Fertilizers, Dong Ngac, Tu Liem, Hanoi. The local director of the workshop is Dr. Quang Ha Pham and the Technical Officer for the Project is Mr. Gamini Keerthisinghe. It is anticipated that representatives from ten countries in the project (Bangladesh, China, India, Indonesia, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand and Viet Nam) will attend this training workshop. The main purpose of this workshop will be to discuss and refine various fertilizer and residue management practices that are being investigated in the project for identifying promising technologies for sustaining crop production in rice-based cropping systems.

D. PAST EVENTS

RESEARCH CO-ORDINATION MEETINGS (RCMs) OF FAO/IAEA CO-ORDINATED RESEARCH PROJECTS (CRPs)

- ⇒ **First RCM of CRP on “Assess the effectiveness of soil conservation measures for sustainable watershed management using fallout radionuclides” (D1-50.08), 19 – 23 May 2003, Vienna and Seibersdorf, Austria**

The Co-ordinated Research Project (CRP) on “Assess the effectiveness of soil conservation measures for sustainable watershed management using fallout radionuclides” from the Joint FAO/IAEA Programme will be implemented together with another small CRP from the Isotope Hydrology Section entitled “Isotope techniques for sediment sources characterization” over a period of 5 years (2003-2007). 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.

Twenty scientists from the research network, namely twelve contract holders from institutes in Argentina, Brazil, China (2), Chile, Morocco, Pakistan, Poland, Romania, Russia, Turkey, and Viet Nam; one technical contractor from the UK, seven agreement holders from advanced research organizations in Australia, Austria, Canada (2), Japan, Switzerland (WOCAT) and the USA participated in the meeting. In addition, one FAO representative and seven observers attended the meeting. The objective of this meeting was to review the experimental plans of the participants in the context of the work plan and objectives of the project and to establish experimental plans for the next 18 months. During the presentations and group discussions, research objectives, approaches, and methodologies were thoroughly examined.

A technical workshop to review generic topics on both the application of fallout radionuclides in soil erosion research and the use of databases and methodologies on soil and water conservation of the World Overview of Conservation Technologies and Approaches (WOCAT) consortium was held at the IAEA Laboratories in Seibersdorf, near Vienna. The SWC technologies will be described in a standardized manner using the WOCAT

questionnaires for further approval and inputting into the databases. The participants, divided in two working groups, developed guidelines for the use of standardised protocols for describing the soil conservation technologies to be studied by the network and approaches for utilising fallout radionuclides to assess the effectiveness of soil conservation measures and fingerprinting techniques to discriminate sources in sedimentation studies. Detailed recommendations were given for consideration by the IAEA to facilitate and further support research and training in the use of fallout radionuclides in soil erosion and sedimentation research and related activities. Mr. F. Zapata, the Project Officer, served as Scientific Secretary of the meeting. A full report of the meeting is available upon request or at <http://www.iaea.org/programmes/nafa/d1>

⇒ **Third RCM of CRP on “The Use of Nuclear Techniques for Developing Integrated Nutrient and Water Management Practices for Agroforestry Systems” (D1-20.07), 2 – 6 June 2003, Colombo, Sri Lanka**

Seven contract holders, four agreement holders and the Scientific Secretary, Mr. Gamini Keerthisinghe, attended this RCM. Dr. Sarath Nissanka, Faculty of Agriculture, University of Peradeniya, Sri Lanka, was the local organiser. The Chairperson of the Atomic Energy Authority of Sri Lanka, Prof. R. Hewamanna and the FAO representative in Sri Lanka, Mr. Mazlan Jusoh, attended the opening session of the meeting. The participants presented the major results and conclusions of their research covering the period from 1999-2003. The presentations of the participants were followed by a Session to review the progress of the CRP in line with its objectives and to discuss the future activities. A field trip was organized to the Coconut Research Institute of Sri Lanka, where different agroforestry systems are practiced. A report of the RCM is available from the Scientific Secretary upon request or at <http://www.iaea.org/programmes/nafa/d1>

CONSULTANTS' MEETINGS

⇒ **FAO Expert Consultation on “Crop Water Productivity”. 26 – 28 February 2003, Rome, Italy**

Lee Heng attended the Second Expert Consultation on Crop Water Productivity together with approximately 20 experts from all regions. Consensus was reached on the conceptual approach of a new methodology to assess yield response to water under irrigated and rain-fed conditions, and the framework of a new dynamic model was outlined. Work plans to further implement the project were defined, tasks and data requirements for calculating yield response to water identified and assigned, including updating FAO Irrigation and Drainage Paper No. 33 on *Yield Response to Water*. The meeting helped to broaden the network of collaborating scientists, and a joint proposal was submitted to the CGIAR Challenge Program from all participating institutions to further integrate the global initiatives on water for food.

⇒ **FAO/IAEA Final Consultants' Meeting on "The Comparison of the Soil Moisture Neutron Probe with Time-Domain Reflectometry and Capacitance Methods", 24 – 28 March 2003, Vienna, Austria**

Four individual contract holders, Mr. Cliff Hignett (Australia), Mr. Peter Cepuder (Austria), Mr. Jean-Paul Laurent (France) and Mr. Steve Evett (USA) gave final presentation of research conducted during the 3-year project. Ms. Lee Heng (SSU, Seibersdorf), Mr. Gerardo Van Halsema (Land and Water Development Division, FAO, Rome), Mr. Pierre Moutonnet (retired IAEA colleague, France) and Mr. Pierre Ruelle (Institute of Agricultural and Environmental Engineering Research, Montpellier, France) also gave presentations. An excursion to the experimental station of Boku University, Groß-Enzersdorf, the Marchfeld Canal project and a nitrate groundwater removal plant was organized. The Marchfeld project aims to divert water from the Danube to artificially recharge the groundwater removed by irrigation pumping.

Major recommendations from the Meeting were to publish (i) technical guidelines on the use of several soil water monitoring instruments (ii) guidelines for choosing a soil water measurement sensor (iii) a special issue of The Vadose Zone Journal containing scientific papers from the project.

A report of the meeting can be obtained upon request from the Scientific Secretary, Ms. Lee Heng, or at <http://www.iaea.org/programmes/nafa/d1>

FAO CO-SPONSORED MEETINGS

⇒ **IFA/FAO Agriculture Conference on "Global Food Security and the Role of Sustainable Fertilization", 26 – 28 March 2003, Rome, Italy**

The conference, jointly sponsored by the International Fertilizer Association (IFA) <http://www.fertilizer.org/ifa/> and FAO addressed the role of fertilizers in sustainable food security with inputs from key stakeholders in plant nutrition, food production, farm management systems and emerging technologies. Mr. Gamini Keerthisinghe made a presentation on "Plant Nutrition: Challenges and Tasks Ahead". This paper and the other presentations given at the conference including panel discussions and poster abstracts can be found at http://www.fertilizer.org/ifa/news/2003_9.asp

NON-FAO/IAEA MEETINGS

⇒ **OECD Expert Meeting on "Soil Erosion and Soil Biodiversity Indicators", 25 – 28 March 2003, Rome, Italy**

The OECD (Organisation for Economic Co-operation and Development) www.oecd.org/ is actively engaged in the assessment of the performance of agriculture not only in terms of productivity (and profitability) but mainly its environmental impacts in the OECD Member States. The following quotation embodies this philosophy:

“The condition of our soils ultimately determines human health by serving as a major medium for food and fibre production and a primary interface with the environment, influencing the quality of the air we breathe and the water we drink. Thus, there is clear linkage between soil quality and human and environmental health. As such, the health of our soil resources is a primary indicator of the sustainability of our land management practices” (Ref. Acton, D.F. and Gregorich, L.J. (eds.), 1995, The health of our soils. Towards sustainable agriculture in Canada. Agriculture and Agri-Food Canada, Ottawa, Canada).

In this context, indicators are established to define the state and trends (in particular risk) of environmental conditions in agriculture, and are used as tools for monitoring, evaluation and projections. OECD Member countries and other stakeholders undertake this work with a focus on national scale issues (including regional variation) for policy makers and other land use/management stakeholders. These indicators are aimed at protecting natural resources, reducing environmental pollution, and improving agri-environmental management practices and resource use efficiency. It is self evident that this work has great policy and economic relevance at both national and international levels.

Background information on this activity is provided in the Executive Summary of the OECD report (2001) “Environmental Indicators for Agriculture, Volume 3: Methods and Results” (copy available at <http://www.oecd.org/agr/env/indicators.html>). A series of OECD Agri-Environmental Indicator Expert Meetings have been scheduled during the period 2001-2004 to provide an opportunity to bring together the scientific research community with those concerned with policy-decision making, monitoring and evaluation.

Mr. F. Zapata participated in the OECD Expert Meeting, with approximately 120 participants from 24 OECD Member countries and the EU Commission, and 12 International Organizations. There were also posters and many documents on display. The objectives of the meeting were to: a) review the current set of OECD soil erosion indicators based on recent research, b) consider a methodological framework for identification of soil biodiversity indicators, c) make recommendations to the Joint Working Party (to be convened in June 2003) for indicators to help address policy concerns related to soil erosion and soil biodiversity, d) provide input to the next OECD report on Environmental Indicators for Agriculture (scheduled for mid-2004) and national efforts on soil quality monitoring, and e) to communicate the results of the meeting internationally.

There were 5 Plenary Sessions, a field trip and 5 Parallel sessions for each working group (Working group 1: soil erosion and working group 2: soil biodiversity). Mr. F. Zapata submitted a paper and made an oral presentation on “Soil erosion and sedimentation studies using fallout radionuclides: recent developments and future applications”. Although the potential of using fallout radionuclides as a method for direct measurement of soil erosion and sedimentation at the landscape level was recognized, it has some limitations such as the need for dedicated, specialized analytical equipment and the lack of an economic assessment (cost/benefit analysis). In the same session, Mr. P. Koohafkan, Chief, AGLL, FAO, delivered a presentation on “Land degradation assessment in drylands (LADA project)”. Also, representing FAO, Ms. Sally Bunning, AGLL, made a presentation on “Indicators and assessment of soil biodiversity/soil ecosystem functioning for farmers and governments” in the Plenary Session 4. The final plenary session was devoted to the discussion of summary reports provided by rapporteurs of each working group. As recent reports of worldwide land degradation are alarming, the need to establish appropriate linkages between national and regional programmes according to the three major UN environmental conventions was

highlighted: “Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, particularly in Africa” (UNCCD); “United Nations Framework Convention on Climate Change” (UNFCCC) and the “United Nations Convention on Biological Diversity” (UNCBD). It should be also noted that the Global Environment Facility (GEF) has recently designated land degradation as a focal area by creating a new operational programme on Sustainable Land Management. FAO can take the lead in driving this operational programme.

The meeting provided a good forum to publicize the activities of the Joint FAO/IAEA Division in the field of soil erosion. Orders were taken for IAEA publications. Relevant feedback was obtained to direct on-going and future FAO/IAEA projects in soil erosion and related environmental areas. From the presentations and discussions it was clear that good progress has been made in soil erosion studies while much remains to be done in the field of soil biodiversity indicators. The meeting clearly highlighted the high priority given to soil erosion and its environmental impacts by the OECD Member countries. A comprehensive approach to land use and management should be taken in addressing soil quality and its environmental impacts. In this context, the need to establish linkage to the three UN conventions was also highlighted. An ecosystem risk-based approach should be adopted for assessment, monitoring and management. Due consideration should be given to socio-economic issues. In this context, the use of expert systems (decision support systems) is a powerful tool to integrate a host of factors and their interactions, including socio-economic issues.

The following issues related to FAO/IAEA projects can be listed:

- To promote the strategic use of the nuclear techniques through a better integration of conventional and radionuclide tracer techniques in soil erosion/sedimentation studies for creating high quality databases for model validation and developing and implementing soil erosion indicators.
- To foster further development of environmental radionuclide techniques to improve both temporal and spatial data sets used to develop and implement soil quality indicators that are useful for policy and economic analysis.
- To create a small research network to develop criteria and guidelines at different scales in selected agro-ecosystems as a framework for guiding the identification of soil biodiversity indicators, including the assessment of soil biodiversity resilience. The report of the International Technical Workshop on Biological Management of Soil Ecosystems for Sustainable Agriculture, organized by FAO and EMBRAPA-Soybean, Londrina, Brazil, 24 – 27 June 2002 would be a valuable background document for this initiative to be developed further under Conservation Agriculture and/or Carbon sequestration future CRPs of the sub-programme.
- To support further the development and implementation of the tasks on the decision support systems for phosphate rocks and organic sources (sub-programme E1) as well the joint initiative on “Pesticides in agricultural landscapes” (sub-programmes E1 and E5).
- To establish mechanisms to enhance communication/collaboration with other groups (IGOs/NGOs), land managers, researchers developing environmental indicators in agri-ecosystems, and farmers, in particular in the frame of the IAEA Technical Co-operation Programme.

NON-AGENCY INTERNATIONAL COURSE

- ⇒ **United Nations University International Course on “Environment and Sustainable Development”, 19 May – 27 June 2003, Tokyo, Japan**

Mr. P. Chalk presented two lectures in week 5 of this 6-week course, which focused on issues related to both renewable and non-renewable natural resource use, and the special challenges associated with addressing these problems in developing countries. The course objective was to provide insight into the social, political, economic and technical aspects of a range of issues including land degradation, deforestation, desertification, air and water pollution, human disease, biodiversity and coastal zone management. The 90-minute powerpoint lectures presented by Mr. Chalk were (i) The role of legumes in sustainable farming systems (June 17) and (ii) Integrated management of soil, water and nutrients in cropping systems to conserve natural resources and optimise external inputs (June 19). All professional staff from the sub-programme contributed material for the lectures.

TECHNICAL CO-OPERATION PROJECTS (TCPs)

- ⇒ **FAO/IAEA Regional TCP for East Asia and the Pacific (RCA) on “Restoration of Soil Fertility and Sustenance of Agricultural Productivity” (RAS/5/039)**

- **IAEA/RCA Regional training workshop on “Use of conventional and radiotracer techniques in pesticide contamination studies in the landscape”, 3 – 7 March 2003, Hangzhou, China**

In support of Part 2 of the regional project, this training workshop was held at the Institute for Nuclear Agricultural Sciences (INAS) of the Zhejiang University, Hangzhou, China. The local Director of the workshop was Prof. Xu Bujin. Eight participants from five countries in the region, namely China (3), Malaysia, Pakistan, Sri Lanka (2) and Thailand plus five local observers attended the workshop. In addition to INAS staff, Mr. Rai Kookana, CSIRO, Australia and Mr. F. Zapata, IAEA Technical Officer of the project participated as lecturers. The main purpose of this activity was to provide training on all aspects of the application of conventional and selected radiotracer techniques and approaches and strategies for Pesticide Risk Management studies at the landscape and watershed levels.

The workshop included theoretical lectures, laboratory practical sessions, a one-day field excursion and discussion sessions. INAS had excellent scientific and technical staff and laboratories/conference room and other facilities to conduct the workshop. Mr. Rai Kookana supported the activities on the environmental impacts of pesticides. He introduced the expert system “Pesticide Impact Rank Assessment” (PIRI), illustrated his application with selected case studies from IAEA TC projects and ran a practical demonstration session on its use with the participants divided into two groups. Mr. Zapata delivered lectures on the regional TC project RAS/5/039-Part II: “Measuring soil erosion and sedimentation and associated pesticide contamination”; the application of the Cs-137 technique to study soil redistribution patterns and rates in the landscape; and presented a concept paper on “Fate of herbicides in agricultural landscapes: Between Scylla and Charybdis” co-authored by Ian Ferris, Lee Heng and F. Zapata. At the end of the workshop, Messieurs R. Kookana and F. Zapata moderated and facilitated the discussion sessions on the concept paper. This provided the opportunity to

share ideas and experiences among the participants of the workshop. The main conclusion was to adopt, develop further and implement the initiative on “Pesticide studies in agricultural landscapes”. In this context, the following points are to be considered in the frame of an integrated approach to agricultural development:

- In the context of sustainable development, there is a need for integrating efficiency and economic profitability of agricultural production systems with sustainability issues of natural resource use (Land and Water).
- Scale issues should be addressed in conducting pesticide studies in the environment: plot/field versus landscape scale. Monitoring/mechanistic studies (process understanding) are normally done at the laboratory/plot/field scale whereas policy- and decision-making require information at landscape/regional scales.
- Sampling design considerations are of particular importance in the studies at the landscape scale. Among these, the following should be included: a) Sampling modality (transect/grid) and density, b) Sampling statistics (geostatistics), c) Geo-referencing, d) Use of Digital Elevation Models (DEM).
- Geographical Information Systems (GIS) should be utilized for integration of layers possibly linked to modelling. There must be a possibility of inclusion of other relevant layers with the use of appropriate databases (e.g., land use, soil types, topography, drainage, etc.).
- Impact of relevant soil/water management such as agrochemical inputs, conservation tillage and irrigation management should be studied in relation to predominant “Cropping Systems”.
- Ecosystem risk-based approach should be adopted for assessment, monitoring and management. This includes: use of adequate risk assessment tools and definition/identification of relevant indicators.
- Models for process understanding and/or Decision Support Systems (DSS) should be strategically utilized. PIRI-GIS version should be included as a niche in the framework.
- Integration of conventional and radiotracer techniques in pesticide studies - both are complementary.
- Strategic use of radiotracer studies – value-adding advantages. Safety standards and radiation protection procedures must be complied with.
- Pesticide studies in agricultural landscapes call for a proper utilization of analytical techniques in different matrices. This includes: quality control/quality assurance; reliability of analytical results; precision versus accuracy; use of reference materials and internal standards; inter-laboratory comparisons, etc.
- A multi-disciplinary approach and skill needs are required in these studies. This involves: identification of specialised fellowship training needs in strategic areas; multi-institutional collaboration and co-ordination, and good management skills of the team leaders conducting basic research and monitoring studies.
- Similarly, the whole problem should be divided into compartments. Utilise a phased approach (in space and time) and start from simple (processes/units) and build-up progressively.
- Networking (nationally and internationally) of these studies would promote the sharing of knowledge/experience among participating groups, the development of standardised protocols for comparison purposes and trouble shooting assistance.
- Communication/co-ordination between and among all stakeholders involved should be effective. This calls for due consideration of socio-cultural and economic issues.

The participants filled in the evaluation questionnaire of the workshop and Prof. Xu Bujin distributed the certificates to the participants. The final evaluation indicated that the participants were satisfied with the content and quality of the lectures. Some of them requested more coverage on specific topics reflecting the need for more training. It is hoped that the new knowledge and skills will be put into good use for implementing the project activities. The objectives of the workshop were successfully achieved.

⇒ **FAO/IAEA Regional TC Project for Africa “Combating Desertification in the Sahel” (RAF/5/048)**

Implementation of this regional TC project commenced in 2001. The overall objective is to sustainably intensify food production in the rainfed agriculture of Sahelian countries, in order to enhance food security while combating desertification. The specific objective is to develop, pilot-test and promote the adoption of improved and integrated soil, water and nutrient management technologies in cropping systems through the use of nuclear and related techniques. The short-term goal is to improve the productivity of the agricultural systems, while the long-term goal is to restore and maintain soil fertility to effectively combat dry-land degradation. The target area is the West African Sahel and includes Burkina Faso, Mali, Niger and Senegal.

The first project co-ordination meeting was held in Ouagadougou, Burkina Faso from 18 – 21 February 2001. The specific focus of the initial phase (2001-2002) of the project activities has been to strengthen the national capacities and to establish a network of field trials to generate specific technologies for improved and integrated crop, soil, water and nutrient management in millet-based cropping systems. The second phase (2003-2004) of the project has been approved for implementation and the focus will be on the continuation of the field trials and the pilot-testing of promising technologies in farmers’ fields to promote their adoption.

- **Second Co-ordination Meeting of project co-ordinators, 07 – 09 April 2003, Niamey, Niger**

The meeting was hosted in the seminar room of the Training and Visitors Center of the International Crops Research Institute for the Semi-arid Crops (ICRISAT) in Niamey, Niger. The project counterparts and high-level agriculture/environment policy makers involved in combating desertification in the Sahel from Burkina Faso, Mali, Niger and Senegal were invited to participate. Twenty-five participants in total attended the meeting including twenty-one from Burkina Faso, Mali and Niger, two co-ordinators of regional projects (DMP and TSBF) and two IAEA representatives, Mr. Vincent Nkong-Njock, Project Officer, TCPA, Africa Section and Mr. F. Zapata, Technical Officer, NAFA.

Mr. Nkong-Njock welcomed the participants on behalf of the IAEA and made introductory remarks on TC strategies. The meeting was formally opened by Dr. Issaka Mahamane, Director General of the “Institut National de Recherche Agronomique du Niger” (INRAN). Presentations were made by Mr. Zapata, and Mr. V. Nkong-Njock on project technical and managerial issues, respectively, followed by country presentations by all project counterparts (PCs) describing the progress and results obtained so far, the country work plans and arrangements for the continuation of the project activities. Presentations of the regional programmes African Network for Soil Biology and Fertility (AFNET) of TSBF/CIAT and

Desert Margins Programme (DMP) of ICRISAT were also delivered. A field visit was made to the new installations of “Institut des Radio-Isotopes” (IRI) at the University of Niamey and selected laboratories of INRAN. The participants, divided in groups, elaborated national Action Plans for the biennium 2003-2004.

During the meeting the following results were achieved:

a) An assessment of the overall progress made based on the presentation and discussion of the country reports during the first phase of the project.

b) Following the presentations of the desertification-related regional projects, e.g. AFNET and DMP, discussions focused on the co-ordination with the National Action Plan on Desertification of each country and partnerships with regional projects on desertification. It was recommended to strengthen networking and improve communication and exchange of information at both national and regional levels and establish strategic partnerships for collaborative work among participating countries.

c) The identification of national and regional TC project proposals for the next biennium 2005-2006.

d) Technical issues on sustainable intensification of agricultural production in rainfed semi-arid areas to ensure food security and combat desertification were discussed in depth, and in this connection it was recommended to associate end-users as early as possible in the implementation of the project, and the development of larger scale pilot plots during the final phase through on-farm participatory trials.

e) The Action Plans of the participating countries for the next biennium 2003-2004, including allocation of Government and IAEA inputs were finalized.

f) Guidelines on the integrated approach to soil, water and nutrient management in millet-based cropping systems and other studies were formulated.

g) The report of the meeting was adopted and conclusions and recommendations were formulated. A socio-economic assessment for developed technologies should be made within the final phase of the project, and the need to take into account the environmental and conservation of natural resources for the developed technologies was recognised.

The meeting completed all tasks that were envisaged, including review and updating of the regional priority needs, project activities and work-plans for the remaining two years. All participants stressed the need for another review and co-ordination meeting before the final evaluation meeting. Specific issues to be discussed include: (a) cost-recovery, cost-benefit analysis and impact assessment; and (b) identification of future directions for the formulation of a new project proposal. The participants acknowledged the administrative support and technical direction provided by IAEA. A full report of the meeting is available upon request from Mr. F. Zapata, Technical Officer.

⇒ **Programming FAO/IAEA TC Activities in Africa**

The IAEA Technical Co-operation (TC) Programme develops Country Programme Frameworks (CPFs) in close consultation with Member States to ensure that IAEA TC is fully tuned to national development objectives and priorities. The CPF is a planning tool and a frame of reference for programming in the medium term. The objective is to reach an agreement that focuses the limited resources of the IAEA’s TC Programme on a few areas of development, which are of high priority to the Government, and where nuclear-based technologies can make a significant contribution. Identification of these selected areas provides opportunities for developing TC projects with national counterpart institutions.

- **CPF Mission, 23 – 27 June 2003, Harare, Zimbabwe**

The mission team consisted of Mr. F. Zapata, representing the Food and Agriculture Programme and Mr. M. Abdul-Malik from the Africa Section, TCPA. Consultations were held with potential counterparts and national authorities of the Ministries of Land, Agriculture and Rural Resettlement, and Environment and Tourism, among others, in connection with the development of the CPF for the period 2005-2010. In addition, Mr. F. Zapata met with counterparts of the Chemistry and Soil Research Institute and assisted them in the formulation of a TC project proposal on “Combating desertification in the agricultural drylands of Zimbabwe” for submission to the IAEA TC Programme, cycle 2005-2006.

E. STATUS OF CO-ORDINATED RESEARCH PROJECTS

⇒ Assess the Effectiveness of Soil Conservation Measures for Sustainable Watershed Management using Fallout Radionuclides

Project Officer: F. Zapata

This CRP was approved by the IAEA in March 2002 and implementation commenced this year with an anticipated duration of 5 years (2003-2007). This project will be implemented in close co-ordination with another CRP from the Isotope Hydrology Section entitled “Isotope techniques for sediment sources characterization”. 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 ^{137}Cs , ^{210}Pb 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 utilise these techniques to assess the impact of short-term changes in land use practices and the effectiveness of specific soil conservation measures.

Thirteen research contract holders: A. Bujan (Argentina), O. Bacchi (Brazil), M.E. Trumper/P. Schuller (Chile), Yong Li (China PR), Xinbao Zhang (China PR), K. Manjaiah (India), M. Benmansour (Morocco), M. Rafiq Sheikh (Pakistan), W. Froehlich (Poland), Nelu Popa (Romania), V. Golosov (Russia), S. Hacıyakupoglu (Turkey), and Hai Son Phan (Viet Nam); one technical contractor: D.E. Walling (UK) and eight agreement holders: P. Wallbrink (Australia), A. Klik (Austria), C. Bernard (Canada), D. Lobb (Canada), J. Onda (Japan), H. Liniger (WOCAT-Switzerland), J. Ritchie (USA), Ted Yang (USA), are currently participating in the project. The participants are representing multi-disciplinary and inter-institutional teams involved in soil erosion/sedimentation research in their countries. The first Research Co-ordination Meeting plus technical workshop was held in Vienna and Seibersdorf, Austria, 18 – 22 May 2003 (see past events). The next RCM will be held in October 2004, in Istanbul, Turkey.

The group has a variety of well-developed skills, expertise and experience. The individual studies cover a wide range of conditions (land use, agro-environmental conditions,

scales) that should allow a robust testing of the potential of the FRNs to assess the efficiency of soil conservation practices.

Appropriate linkages have been established to institutions/associations working in soil and water conservation such as the World Overview of Conservation Approaches and Technologies (WOCAT) consortium, World Association of Soil and Water Conservation (WASWC), and the International Association of Hydrological Sciences (IAHS). The activities of this CRP are included in their Newsletters and websites.

⇒ **Integrated Soil, Water and Nutrient Management for Sustainable Rice-Wheat Cropping Systems in Asia**
Project Officer: P.M. Chalk

This CRP commenced on 1st October 2001 with an anticipated duration of 5 years. The overall objective is to improve the productivity and sustainability of rice-wheat cropping systems through increased efficiency of water and nutrient use. The specific research objective is to modify existing water and nutrient management systems, and improve soil management in both traditional and emerging (raised beds, non-puddled soil, direct seeding) tillage systems, for sustainable intensification of cereal production. Seven research contracts were awarded: Md. Akhter Khan (Bangladesh), Qirong Shen (China), Jiarong Pan (China), Yadvinder Singh (India), Manbir Sachdev (India), Ram Munankarmy (Nepal) and Fayyaz Hussain (Pakistan). Two technical contracts were awarded: J.K. Ladha (Philippines) and G. Blair (Australia). There are presently two agreement holders: Elizabeth Humphreys (CSIRO-Australia) and Raj Gupta (CIMMYT-India). The first RCM and training workshop was held 4 - 8 March 2002, in Vienna and Seibersdorf, Austria. The second RCM is planned for 08 - 12 September 2003, in Nanjing, China, with Prof. Q. Shen, Nanjing Agricultural University, as the local organizer.

⇒ **Development of Management Practices for Sustainable Crop Production Systems on Tropical Acid Soils through the Use of Nuclear and Related Techniques**
Project Officer: F. Zapata

This CRP started implementation at the end of 1999 and the first RCM was held in Vienna in June 2000. Eight research contract holders: P. Houngnandan (Benin), S. Urquiaga (Brazil), T. Muraoka (Brazil), V. Bado (Burkina Faso), A. García (Cuba), J.J. Peña-Cabriales (Mexico), E. Iwuafor (Nigeria), and M. Lopez (Venezuela); one technical contract holder: P. Randall (CSIRO, Australia), and four agreement holders: W. Horst (Germany), S.H. Chien (IFDC-USA), B. Vanlauwe (TSBF-Kenya), and J. Diels (IITA, Nigeria) are currently participating in the project. The second RCM was held in Brasilia, Brazil, 11 – 15 March 2002. Overall the progress made in the implementation of the activities of the project is satisfactory. Revised guidelines and research protocols have been produced. They reflect the progress made in the project through a better understanding of the constraints to agricultural productivity in the moist savannahs of Africa and Latin America and the prioritisation of the studies to be undertaken for further implementing the project. The mid-term review of the project was carried out and the extension until completion in 2004 was approved. Participants have started to assemble their data and to publish their results in scientific journals.

Identification of the best-adapted genotypes is considered a strategic component of the project. Some participants and one technical contractor are continuing these studies. At this

stage of implementation of the project work plan, priority was given to the isotopic-aided field studies on nitrogen and phosphorus cycling in cereal-based crop rotations (maize, sorghum and millet). These include the assessment of N inputs from applied fertilizer nitrogen, biological nitrogen fixation (grain legume or cover crops) and nitrogen recycling from incorporation of crop residues, direct application of phosphate rock, and use of lime and other amendments. Some contractors have initiated natural abundance carbon-13 cycling studies in long-term field experiments. Overall, the participants will conduct these studies towards an integrated approach to SWNM in prevailing cropping systems of the savannahs of Africa and Latin America.

⇒ **Use of Nuclear and Related Techniques for Evaluating the Agronomic Effectiveness of P Fertilizers, in Particular Rock Phosphates**

Project Officer: F. Zapata

This FAO/IAEA co-ordinated research project (1993-98) has generated a valuable data set consisting of results from laboratory, glasshouse and field experiments on the agronomic effectiveness of phosphate rock products covering a range of cropping systems and agro-ecological zones. The **IAEA-TECDOC-1272** “Assessment of soil phosphorus status and management of phosphatic fertilizers to optimise crop production” and a special issue in the journal *Nutrient Cycling in Agroecosystems* “Utilisation of phosphate rocks to improve soil P status for sustainable crop production in acid soils” were published in 2002. The **FAO Land and Water Technical Bulletin** on “Use of local phosphate rocks in sustainable agriculture” is in its final phase of editing. The bulletin will be published in the second semester of 2003.

Another initiative is the collaborative project between the Joint FAO/IAEA Division and IFDC to develop a **Decision Support System for Direct Application of Phosphate Rocks (PR-DSS)** during the 2002-2003 biennium. The PR-DSS will be a useful research and extension tool for scientists, extension workers, progressive farmers, planners and agribusiness dealers, thus contributing to promote the use of phosphate rock resources in tropical and subtropical FAO and IAEA Member States. A customized database on phosphate rock solubility has been developed by IFDC during 2002 under contract with IAEA. A Junior Professional Officer is working on this project at IFDC, Muscle Shoals, USA. The IAEA has granted a new contract to IFDC to start the development of the Decision Support System.

The World Phosphate Institute (IMPHOS) is providing financial support to the development of the PR-DSS and field validation. Provisions have been made in the IAEA programme of work and budget 2004-2005 for the continuation of this work and the field validation of the PR-DSS.

Moreover, the Joint FAO/IAEA Division is implementing an Information Technology (IT) pilot project, i.e. **an interactive web-based resource on Direct Application of Phosphate Rocks (DAPR)**. The purpose of this task is to provide scientific and technical services to Member States and to better advise resource managers, including policy makers and farmers, predominantly those in the developing world (i.e., Africa, Asia & Latin America) on the agronomic effectiveness of PRs, i.e. how different PRs perform in the short- and long-term under different environments for different crops, with the ultimate goal of promoting sustainable food security in the developing world. Mr. Ian Ferris, Ms. Lee Heng and Mr. F. Zapata are involved in implementing this activity with the assistance of external consultants. Currently the mainframe has been designed and constructed with appropriate

links to the IAEA website. It is planned to develop further this website. Refer to Future Events, Consultants' Meeting, for details.

⇒ **Assessment of Soil Erosion Through the Use of Cesium-137 and Related Techniques as a Basis for Soil Conservation, Sustainable Production and Environmental Protection**

Project Officer: F. Zapata

Implementation of this project was completed in 2001. The final report of the CRP is available upon request from the Project Officer. Several follow-up activities are being completed to achieve the outputs targeted for this project. Kluwer Academic Publishers published a "Handbook for the Assessment of Soil Erosion and Sedimentation using Environmental Radionuclides" in December 2002. A special issue of the journal Soil and Tillage Research was printed in February 2003. For details please refer to the Publications Section. This project is now closed. New initiatives related to soil redistribution studies such as "The Fate of Pesticides in Agricultural Landscapes" are being implemented as IAEA TC projects. Further research work on the use of fallout radionuclides will be developed in the frame of the new "Soil Conservation" CRPs described previously.

⇒ **Use of Nuclear Techniques for Developing Integrated Nutrient and Water Management Practices for Agroforestry Systems**

Project Officer: G. Keerthisinghe

Participating in this CRP are nine contract holders: K. Aihou (Benin), B. Zhang (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 (Australia). All contract holders have on-station and on-farm experiments under way and the results presented at the third RCM showed that the experimental work is progressing according to the work plan and experimental guidelines established at the first RCM and modifications suggested at the second RCM. Isotope techniques are being used to quantify nutrient and water dynamics in agroforestry systems in order to modify management practices for better resource utilization. The final RCM of the project will be held in 2005.

⇒ **The Use of Nuclear and Related Techniques in the Management of Nutrients and Water in Rainfed Arid and Semi-arid Areas for Increasing Crop Production**

Project Officers: G. Keerthisinghe and L. Heng

The implementation of this CRP was completed in 2002. All contract holders have been requested to submit manuscripts for inclusions in an IAEA-TECDOC. The project officer will collate the manuscripts and prepare the TECDOC, which will include the major achievements and conclusions of the project.

⇒ **Selection for greater agronomic water-use efficiency in wheat and rice using carbon isotope discrimination**

Project Officer: G. Keerthisinghe

This CRP was approved in March 2002 and implementation will start in 2003 with an anticipated duration of 5 years. The project was advertised in the June 2002 issue of the Soils Newsletter and currently, applications for research contracts and agreements are being sought and evaluated. The overall objective is to contribute to increasing the agronomic water-use efficiency (AWUE) of wheat and rice production where AWUE is defined as grain yield/total water use including both transpiration and evaporation. The specific objectives are: (a) to evaluate different strategies for using carbon isotope discrimination as a selection tool for identifying higher yielding genotypes of (i) wheat in water-limited rain-fed stored soil moisture cropping systems, (ii) wheat in irrigated cropping systems and (iii) rice in irrigated cropping systems, (b) within (a) to develop sets of elite isomorphic lines varying in carbon isotope discrimination for use in (c), (c) Using a set of these isomorphic breeding lines evaluated in contrasting cropping environments, assist national program scientists to determine the most effective breeding strategies for application of carbon isotope discrimination in their environments. The first RCM will be held in the first quarter of 2004 in Vienna.

F. LABORATORY ACTIVITIES

RESEARCH:

⇒ **Comparison of soil moisture measuring techniques**

Ms. Lee Heng

Soil water measurement is the key to successful water and nutrient management. Accuracy, precision, speed and ease of use as well as the ability to do profile measurements are the desirable characteristics needed for routine large scale monitoring. The soil moisture neutron probe (SMNP) has been the standard instrumental method for measuring soil water *in situ* for the past 50 years.

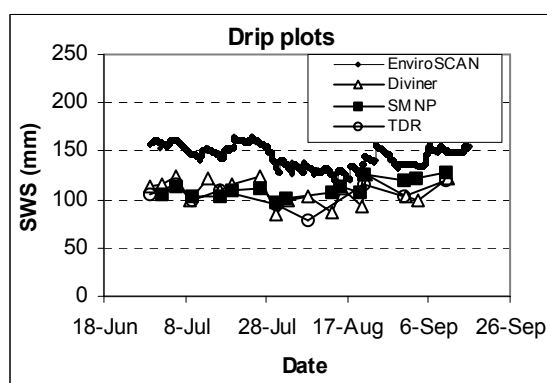
Over the last decade, many new soil moisture sensors have been developed, especially those based on the frequency domain reflectometry (FDR) capacitance technique, due to the rapid developments in the micro-electronic industry. This resulted in many relatively cheap and small sensors being manufactured, giving much more options to the traditional neutron scattering technique. Although the SMNP has been shown to be robust and suited to large-scale field measurements, its radioactive source requires licensing during transportation and storage and training of users on safety regulations. In addition, the SMNP is not adapted to remote unattended monitoring, which is a feature of some of the newer systems.

While the new sensors claim to be cost-effective and accurate with minimal operational skill required, their performance under different soil and cropping systems is only slowly being tested; few papers have described comparisons of these methods with the traditional

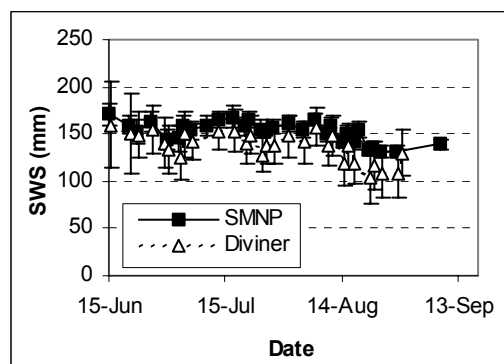
SMNP. However, it is well known that sensors based on capacitance have a small sphere of influence and are very sensitive to small air gaps around the tubes during installation, to cracks and macropores created by root and arthropod activities, as well as positional changes in orientation within the tubes. Therefore, good sensor-tube-soil contact for reliable estimation of soil moisture content is extremely critical. A comparison of these methodologies is needed in order to formulate recommendations and establish guidelines for the Agency's current and future soil water research and training programmes.

The following experiments were part of a larger group of soil moisture sensor comparisons. They were carried out by the Soil Science Unit to compare soil moisture as measured by the SMNP, with frequency domain capacitance probes EnviroSCAN and Diviner 2000, as well as time domain reflectometry (TDR). Tomato under drip and furrow irrigation systems, as well as spring wheat under irrigated and rainfed conditions were compared. Readings were taken regularly over the growing season from June to September. The soil water storage (SWS) was calculated to 60 cm depth, the deepest depth that access tubes can be installed in the rocky Seibersdorf soil. Both the SMNP and Diviner 2000 were calibrated gravimetrically during the course of the experiments.

Comparison of soil water storage (SWS) to 60 cm shows that in general Diviner 2000,



TDR and the SMNP gave similar values, but EnviroSCAN gave almost 50 mm more water under the same conditions. However, the capacitance sensors tend to exhibit considerable



variability in the measurement, as indicated by the greater standard error of the SWS. This is probably due to the small sphere of measurement (2-5 cm radius compared to 15-50 cm for the SMNP). For the same level of precision, more measurement is therefore needed for this type of sensor. Consequently, placement of these sensors is crucial for irrigation scheduling purposes, especially in row crops, as large errors can occur.

⇒ Development of protocols for measuring gross N transformation processes in soils using ^{15}N .

Maria Heiling, José Luis Arrillaga, Leo Mayr and Rebecca Hood-Nowotny

Understanding the processes of nitrogen cycling in the soil is essential to effectively manage the soil fertility resource. It has been demonstrated that only by elucidating the gross processes of nitrogen transformation is it possible to fully understand observed net effects, allowing knowledge-based decisions for nutrient management. Studies of gross N mineralisation, the breakdown of organic N to ammonium, and gross nitrification, the conversion of ammonium to nitrate, un-confounded by other soil processes, are only possible using isotopes. Measurements of gross N transformation processes have been limited to a few

laboratories, mainly in temperate agricultural systems. This is due to lack of expertise in the methodology and limited access to mass spectrometry for ^{15}N isotope-ratio analysis of samples (IRMS), essential for gross N transformation studies. Therefore a protocol for measuring gross N transformation processes, appropriate for adoption in Member States, was developed.



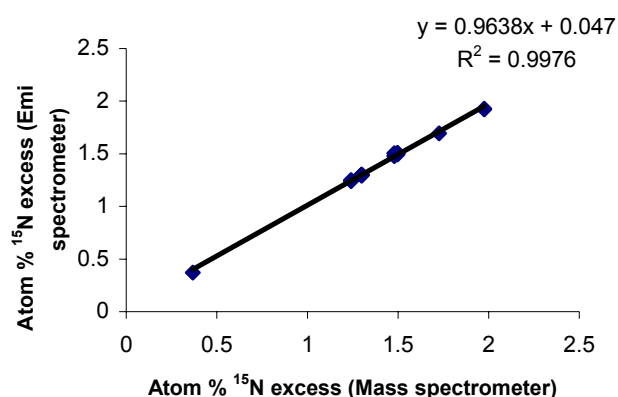
Diffusion technique for preparation of soil inorganic N samples for ^{15}N analysis

mass spectrometer analyses was highly significant, and demonstrated that the emission spectrometer gave comparable results to the mass spectrometer.

The development and dissemination of these techniques through training and publication will enable scientists in Member States to undertake gross N transformation studies and apply that knowledge to improve N management in cropping systems.

Simple methods for measuring the isotopic signatures of soil inorganic N samples were initially developed. While the diffusion technique has become the standard technique for IRMS, its adaptation to isotope-ratio analysis by emission spectrometry was required. It was also necessary to identify and validate simple methods for the measurement of ammonium and nitrate in soil samples.

The diffusion method for the preparation of samples for the emission spectrometer proved to be simple and accurate. The linear correlation with the



Comparison of measurements of ^{15}N in inorganic soil extracts.

⇒ ^{13}C labelling and analysis by an optical breath test analyser

Rebecca Hood-Nowotny, M Khan*, A Haque*, M Khadir*, JP Bonetto*, R Syamsul*, Leo Mayr and Marie Heiling (* IAEA fellows)

For an understanding of the effect of agricultural practices on the global carbon cycle data is required from a range of cropping systems and agro-ecological zones. At present there is insufficient data available. Using the stable isotope of carbon, ^{13}C , it is possible to collect data on carbon turnover from organic materials under different cropping systems, and

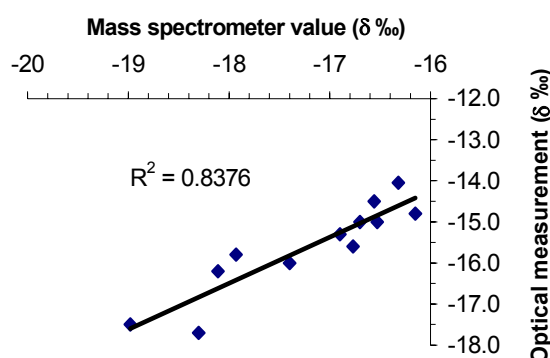
estimate the effect of management (e.g. conservation agriculture practices) on rates of carbon sequestration.

The aim of this work was to develop methods that could be affordably adopted in developing countries to obtain estimates of carbon sequestration under a range of crops and management practices, within a reasonable time frame.

Developments in optical systems (FANCi) for breath testing have provided a robust, low-cost option for undertaking ^{13}C analysis. The relatively low cost of the equipment at US\$ 15000-25000 is within the research budgets of most institutes or universities. The equipment requires relatively low maintenance and minimal training due to its simplicity and optical nature.

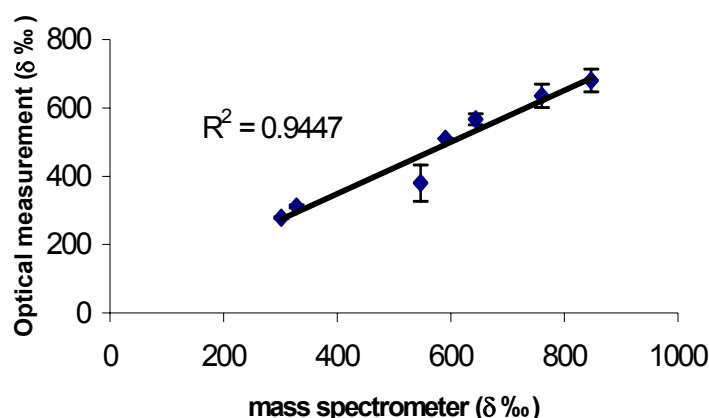
By labelling residues with ^{13}C it is possible to follow their fate and turnover in the soil. A simple procedure for ^{13}C labelling was developed and tested in the laboratory. Sample preparation methods to measure ^{13}C enrichment in soil and plant samples using the optical breath test analyser were developed and compared against results using conventional mass spectrometry systems.

Experiments demonstrated that the optical system is capable of producing comparable results to the mass spectrometer at relatively low ^{13}C enrichment levels. The techniques developed for sample preparation of soil respiration gas and for SrCO_3 conversion to CO_2 , were simple to execute and proved accurate.



Comparison of $\delta^{13}\text{C}$ in CO_2 respired from soils treated with C4 sugars, obtained using the optical breath test analyser and the mass spectrometer.

Further experiments showed that the plant digestion procedure followed by optical analysis gave comparable results to the mass spectrometer for enriched plant samples. This was a major advance as it demonstrated that plant samples could be prepared for ^{13}C analysis using standard digestion apparatus. It was easy to prepare and digest up to 40 samples per day and to analyse one sample on the optical system every 10 minutes.



Comparison of $\delta^{13}\text{C}$ in plant samples prepared using the digestion procedure described for the optical breath test analyser against the value obtained using the conventional mass spectrometer

These techniques will prove to be essential tools in estimating carbon sequestration within a reasonable time frame. They allow an assessment of the carbon credit value of a particular agronomic practice, which can in turn be used by policy makers for decision-making purposes. Further testing and improvement of this methodology is underway.

This work was presented at the 17th World Congress of Soil Science, Bangkok 2002, and at the International Conference on Isotopic and Nuclear Analytical Techniques for Health and Environment, Vienna 2003 and is being published in Communications in Soil Science and Plant Analysis in 2003.

⇒ **LARA nitrogen isotope-ratio system**

The primary goal of this collaborative work with Professor D E Murnick, Rutgers University, USA, was to build, test and characterize a diode laser system for Laser Assisted Isotope Ratio Analysis (LARA) of ^{15}N -enriched samples. Such a device would provide a lower cost, easy to use alternative to the currently used ion beam isotope ratio mass spectrometer (IRMS) and optical emission spectrometry (OES). Secondary goals were to determine whether lasers other than diode devices could be configured for low cost ^{15}N isotope-ratio analysis and to compare various systems with respect to sensitivity, ease of operation and cost.

It will be necessary to obtain considerably more funding than has been provided through IAEA individual research contracts to build prototype instruments for field-testing and development. The current global interest in isotope “fingerprinting” of fertilizers and nitrogen containing explosives, as well as the traditional nitrogen isotope testing market, has drawn interest in this work from potential commercial funding sources.

In summary, diode lasers operating with up to 1 W power at 821 nm near an atomic nitrogen resonance, have been tested. A diode laser system for opto-galvanic spectroscopy has been built and tested. In a parallel effort, miniature UV lasers have been designed which

may provide an alternative to larger expensive molecular nitrogen lasers. A system has also been designed for building discharge pumped atomic nitrogen lasers suitable for opto-galvanic spectroscopy.

The results to date have been encouraging enough for Rutgers University to seek funding for a larger effort to build laboratory prototype instruments for LARA ^{15}N isotope-ratio analysis of samples. Such equipment may be tested at the Agency's Seibersdorf laboratory when available and compared to IRMS and OES.

TRAINING

The Soil Science Unit provides training in the form of courses, workshops, fellowships or scientific visits. The subject of training is predominantly the use and application of isotopes, sealed sources and other nuclear and related techniques in soil and water management and crop nutrition.

⇒ Analytical Fellows - Group Training, 07 October - 29 November 2002

Group training on total N and ^{15}N analyses by optical emission spectrometry included sessions on: Introduction to ^{15}N isotope techniques using mass and emission spectrometry (one week); sample preparation of plant and soil material using Kjeldahl digestion (two weeks); NOI-6/NOI-7 emission spectrometer calibration and measurement of samples prepared during the previous session (three weeks); maintenance, small repairs and troubleshooting of the NOI-6/NOI-7 instruments (in co-operation with the Instrumentation Unit) (one week); quality assurance of total N and ^{15}N analysis and staff consultation (one week).

The following fellows participated in the activity:

Mr. Antoine Gueable, from Ivory Coast (IVC/01006P)

Mr. Armin Djawanas, from Indonesia (INS/02006P)

Ms. Mariama Soumaila, from Niger (NER/02016)

Ms. Fatou Gueye, from Senegal (SEN/02014)

In addition, **Ms. Mavdee Madhou**, from Mauritius (MAR/01002), who received partial training at the University of Agricultural Sciences, Vienna, received individual training on the NOI6 PC emission spectrometer for two weeks.

⇒ Research Fellows (January – June 2003)

Mr. Richard Max Kpange, from Sierra Leone (SIL/02003P), 2003/05/12 to 2003/08/12. Soil water. Supervision: Ms. Lee Heng

Mr. Augustine Rashid-Noah, from Sierra Leone (SIL/01004P), 2003/05/12 to 2003/08/11. Soil water. Supervision: Ms. Lee Heng

Mr. Zoran Dimov, from FYR Macedonia (MAK/03012P), 2003/06/02 to 2003/07/02. Theoretical training on BNF. Supervision: Mr. Gudni Hardarson

Mr Onesimus Semalulu, from Uganda (UGA/03010P), 2003/06/02 to 2003/08/01. Soil water and interregional training course. Supervision: Ms. Lee Heng

⇒ Scientific Visitors (January – June 2003)

The SSU receives Agency-sponsored scientific visits, each for approximately one or two weeks. The purpose is for the visitors to get acquainted with recent developments in the use and application of specific nuclear techniques in soil science and plant nutrition. There is also an opportunity for scientists to get on-the-job training as cost-free interns. Scientific visitors to the SSU were:

Ms. Shama Elamin Dowelbeit, from Sudan (SUD/02040PV), 2003/01/27 to 2003/01/31

Ms. Fauzia Yusuf Hafeez, from Pakistan (PAK/99032PV), 2003/03/31 to 2003/04/04

Mr. Ordan Cukaliev, from FYR Macedonia (MAK/03013PV), 2003/06/23 to 2003/06/27

SUPPORTIVE SERVICES

⇒ Analytical services 1999-2002

Co-ordination: Leopold Mayr

The Soil Science Unit analysed approximately 6500 samples in 2002 for C, N and O stable isotope-ratios both at enriched and natural abundance levels. The total number of samples was significantly less than each of the previous 3 years (see Table below).

Number of samples analysed in the SSU during the past four years

Source and type of analyses	2002	2001	2000	1999
CRP	5019	4923	5048	5624
TC	402	752	413	498
Seibersdorf research	1006	3409	5109	3832
¹⁵ N enriched	2801	6176	7512	7686
¹³ C natural abundance	502	147	389	260
¹³ C natural abundance + ¹⁵ N enriched	2866	2699	2564	2008
¹³ C natural abundance + ¹⁵ N natural abundance	39	-	-	-
¹⁸ O natural abundance	219	62	105	-
Total number of samples	6427	9084	10570	9954

The reduction was largely due to fewer samples (mainly ¹⁵N enriched) generated from Seibersdorf research and Member States. The total number of samples from CRPs and TCPs has remained relatively constant, but there has been an increasing demand for analysis of samples at natural abundance levels for ¹³C, ¹⁵N and ¹⁸O, with a much weaker demand for analysis of ¹⁵N-enriched samples. This is indirect evidence that Member States are becoming more independent in analysis of ¹⁵N-enriched samples through optical emission spectrometry, supported by the Agency through equipment purchases and repairs and by the annual External Quality Assurance exercise conducted by the Soil Science Unit for total N and ¹⁵N analyses. On the other hand, demand from Member States for isotope-ratio mass spectrometric (IRMS) analysis of samples at natural abundance has increased due to the more varied and sophisticated nature of the research being conducted, and the general lack of IRMS capability.

Although the number of samples analysed in 2002 decreased from previous years, the total number of measurements (including repetitions and internal standards) has remained relatively constant over the past 4 years (see Table below). This is due to more requests for analysis of multiple isotopes in the one sample and because of the increasing number of non-standard samples (e.g. ^{13}C in alkaline soils and ^{13}C in CO_2 gas, etc), which require more testing, calibration and development work.

Number of stable isotope measurements carried out in the SSU during the past four years

Type of measurement	2002	2001	2000	1999
^{15}N enriched level	10277	14007	13611	12115
^{15}N natural abundance	517	-	-	-
^{13}C natural abundance	5846	4801	4341	3465
^{18}O natural abundance	-	359	-	-
Total number of measurements	16640	19167	17952	15580

The facility to measure ^{15}N at natural abundance level was set up in the SSU in 2002. Rooms and equipment, which have been used in the past years with ^{15}N enriched materials could not been used due to possibilities of cross contamination. A new site for sample preparation was found which complies with the requirements. The analysis method was set up and validated against certified reference materials.

G. PUBLICATIONS

- Management of Crop Residues for Sustainable Crop Production. IAEA-TECDOC-1354. (May 2003). 243 p.
- Neutron and Gamma Probes: Their Use in Agronomy. Training Course Series No.16. Second Edition. IAEA, Vienna, Austria (2003), 73 p.
- Les sondes à neutrons et à rayons gamma: Leur applications en agronomie. Collection Cours de Formation No.16. Deuxième Edition. AIEA, Vienne, Autriche (2003), 71 p.
- Las sondas de neutrones y gamma: Sus aplicaciones en agronomía. Colección Cursos de Capacitación No. 16. Segunda Edición. OIEA, Viena, Austria (2003), 77 p.
- Zapata, F.** (Ed.). Field Application of the Cs-137 Technique in Soil Erosion and Sedimentation Studies. (Special Issue, Soil & Tillage Research, Vol.69, Nos. 1 – 2, 188 p. (2003).
- Zapata, F.** 2003. Introduction to the Special Issue. Soil & Tillage Research 69: 1 – 2.
- Zapata, F.** 2003. The use of environmental radionuclides as tracers in soil erosion and sedimentation investigations: recent advances and future developments. Soil & Tillage Research 69: 3 – 13.
- Zapata, F.** (Ed.). Handbook for the Assessment of Soil Erosion and Sedimentation Using Environmental Radionuclides. Kluwer Academic Publishers, Dordrecht. 219 p. (2002).
- Zapata, F.,** Garcia-Agudo, E., Ritchie, J.C. and Appleby, P.G. 2002. Introduction. In: Handbook for the Assessment of Soil Erosion and Sedimentation Using Environmental Radionuclides. (F. Zapata, Ed.). Kluwer Academic Publishers, Dordrecht. Pp. 1 – 13.

- Keerthisinghe, G., Chalk, P.M., Zapata, F.** 2003. Plant Nutrition: Challenges and Tasks Ahead. In Proceedings of the IFA-FAO Agricultural Conference on "Global Food Security and the Role of Sustainable Fertilization", 26 - 28 March 2003, Rome, Italy. 15 pp. http://www.fertilizer.org/ifa/publicat/PDF/2003_rome_keerthisinghe.pdf and slides 10 pp. http://www.fertilizer.org/ifa/publicat/PDF/2003_rome_keerthisinghe_slides.pdf
- Nario, A., Pino, I., **Zapata, F.**, Paz Albornoz, M., Baherle, P. 2003. Nitrogen (^{15}N) fertiliser use efficiency in peach (*Prunus persica*) cv. Goldencrest trees in Chile. Sci. Hort. 97: 27 – 287.
- Hood, R.C.** 2002. Plant N uptake from plant and animal organic residues, measured using the soil pre-labelling N-15 isotope dilution approach. In: Integrated Plant Nutrient Management in Sub-Saharan Africa " (Eds. Vanlauwe, B., Diels, J., Sanginga, N. and Merckx, R.). CABI, Wallingford, UK. Pp. 123 – 131.
- Hood, R.** 2002. The Use of Stable Isotopes in Soil Fertility Research. In: Soil Fertility and Crop Production. (Ed. Krishna, K.R.). Science Publishers Inc., Enfield USA, Plymouth UK. Pp. 313 – 335.
- Ximena Videla and **Hood, R.** 2002. The effect of polyphenols on gross mineralisation and nitrification. Suelo Y Nutricion Vegetal 1 – 6.
- Kamilov, B., Ibragimov, N., Esanbekov, Y., **Evet, S. and Heng, L.** 2003. Drip irrigated cotton: Irrigation scheduling study by use of soil moisture neutron probe. International Water & Irrigation. 23: 38 – 41.

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