

# 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  
Laboratory, Seibersdorf  
International Atomic Energy Agency  
Vienna, Austria



# CONTENTS

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A.	TO OUR READERS .....	1
B.	STAFF .....	3
C.	FUTURE EVENTS .....	4
D.	PAST EVENTS .....	7
E.	STATUS OF CO-ORDINATED RESEARCH PROJECTS .....	19
F.	TECHNICAL CO-OPERATION PROJECTS .....	22
G.	LABORATORY ACTIVITIES .....	24
H.	PUBLICATIONS .....	29

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## A. TO OUR READERS

In response to Agenda 21 produced by the Earth Summit in Rio de Janeiro in 1992 the UN System launched EARTHWATCH, a worldwide environmental program. The IAEA joined this initiative through a series of activities on environmental monitoring, impact assessment and environmental protection. Recognizing that soil erosion and associated sedimentation are serious threats to sustainable agricultural production and environmental protection, two IAEA Divisions, the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and the Division of Physical and Chemical Sciences, joined forces to plan, organize and implement activities on the use of fallout radionuclides, in particular Cesium-137, to assess soil redistribution, and hence erosion and sedimentation, through the establishment of two Co-ordinated Research Projects. These studies have now been successfully completed with a number of significant achievements.

The Cesium-137 technique provided reliable erosion and sedimentation data over a medium-term (40 year) period in a range of environments and scales worldwide. Soil erosion rates averaged from 0 to  $>100 \text{ t ha}^{-1} \text{ y}^{-1}$  and demonstrated that local land use exerted a greater influence than climate, lithology or soil type. However, the influence of the latter can be readily distinguished. Standardised methods and protocols for the application of the technique were successfully developed. Currently these are being documented through the production of a handbook on “Assesment of Soil Erosion and Sedimentation using Environmental Radionuclides”. Cesium-137 redistribution is an established nuclear technique that should be broadly disseminated through Technical Co-operation Projects. The provision of modern counting equipment to developing countries is crucial in this regard, particularly for low activity samples from the southern hemisphere, as counting time is the limiting step in the methodology.

As there is an urgent need to control soil erosion and associated land degradation worldwide the Joint FAO/IAEA Division in close collaboration with the Land and Water Development Division (AGL) of FAO and UNEP, plans to develop further initiatives in this field. A panel of experts met recently to discuss ways and means to bring the recent methodological developments more into the agricultural context, in particular to assess the impact of land use and the effectiveness of specific soil conservation technologies. The fallout radionuclide redistribution approach has the potential to improve understanding of the relationships between rates of soil loss and soil quality, soil carbon and nutrient redistribution and the fate of agrochemicals and related contaminants in the environment. The panel concluded that while the Cs-137 technique is cost effective, providing reliable, spatially-distributed and time-integrated data, it was mainly developed for documenting long-term (about 40 years) average erosion rates. There is a pressing need for methodologies that will provide short-term soil erosion and redistribution rates in the context of soil conservation strategies. In this regard it was felt that there was considerable scope for further development of methodologies based on the combined use of Cs-137, unsupported Pb-210 and Be-7. The panel recommended the formation of a new research network on “Using fallout radionuclides to evaluate the effectiveness of soil conservation measures for sustainable crop production”.

The sub-programme in Soil and Water Management & Crop Nutrition of the Joint Division supports the efforts of other UN organizations (FAO, UNEP), the CGIAR (ICARDA, ICRAF) and other advanced research institutes in combating land degradation and soil erosion. Full advantage will be taken of existing frameworks such as WOCAT (The World Overview of

Conservation Approaches and Technologies), co-sponsored by FAO and UNEP, among others, through standardized approaches and methodologies. WOCAT is a worldwide network of soil and water specialists, organized as a consortium of national and international institutions operating in a de-centralized manner. A wealth of information on soil and water conservation (SWC) technologies is stored in a database with easy access through books, CDs, maps and the Internet. WOCAT promotes sustainable land management, thus contributing to the implementation of the United Nations Conventions, such as the Convention to Combat Desertification (CCD), the Framework Convention on Climate Change (FCCC), and the Convention for Biodiversity (CBD).

The sub-programme looks forward to planning this initiative in 2002 with implementation of a new Co-ordinated Research Project in 2003.

With my very best wishes

Phillip Chalk  
Head, Soil and Water Management  
& Crop Nutrition Section

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Elisabeth KRAMPF	" "

### **3. Staff Changes**

Mr. Norbert Jagoditsch and Ms. Mirta Matijevic were transferred to other Units within the Agriculture and Biotechnology Laboratory, Seibersdorf, effective January 1, 2001. Both of these technical staff made valuable contributions to the work of the Soil Science Unit. Mr. Jagoditsch was responsible for site preparation, planting, maintenance and harvesting the annual cropping programme while Ms. Matijevic was responsible for quality assurance for routine <sup>15</sup>N analysis. We wish them well in their new positions.

## C. FUTURE EVENTS

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

- ⇒ **Third RCM of CRP on "Management of Nutrients and Water in Rainfed Arid and Semi-arid Areas for Increasing Crop Production", 24 - 28 September 2001, Vienna, Austria**

Twelve contract holders and five agreement holders will participate in this RCM. Ms. Lee Heng, SSU, Seibersdorf Laboratories, and Mr. Gamini Keerthisinghe, SWMCN Section, will serve as Scientific Secretaries as the former Project Officer, Mr. Pierre Moutonnet, will be leaving the IAEA on 30 June 2000. The participants will present the major results and conclusions of their research covering the period from 1998-2001. General conclusions and recommendations will be formulated and guidelines updated accordingly. Data sets for running the plant growth simulation models of DSSAT and APSIM will be collected.

- ⇒ **Second RCM of CRP on "Development of Management Practices for Sustainable Crop Production Systems on Tropical Soils Through the Use of Nuclear and Related Techniques", February 2002, Brasilia, Brazil**

Eight research contractors; one technical contractor and five agreement holders will participate in the second RCM. Mr. Segundo Urquiaga, EMBRAPA-Seropedica is the local organizer. The participants are expected to present their progress in the implementation of the experimental plans. The results obtained during the period 1999-2001 will be reviewed and the work plan for future work updated in accordance with the project objectives. F. Zapata is the Project Officer and will serve as the Scientific Secretary.

- ⇒ **First RCM of CRP on "Integrated Soil Water and Nutrient Management for Sustainable Rice-Wheat Cropping Systems in Asia", March 2002, Vienna, Austria**

Seven research contractors and four agreement holders are expected to attend the meeting. Mr. P. Chalk is the Project Officer and will serve as the Scientific Secretary.

### ***TECHNICAL CO-OPERATION PROJECTS (TCPs)***

- ⇒ **FAO/IAEA Regional TCP for Europe on "Fertigation for improved crop production and environmental protection" (RER/5/011)**

- **Regional training course, 2 – 8 July 2001, Ankara, Turkey**

A training course on "The use of the neutron probe and <sup>15</sup>N-labelled fertilizer under fertigation" will be conducted at the Nuclear Agriculture and Animal Sciences Research Centre. The Technical Officer for the Project, Ms. Lee Heng, will participate. The local organizer is Doç. Dr. Mahmut Basri Halitligil. It is anticipated that counterparts from the 8 participating countries in the region (Bulgaria, Cyprus, Greece, Hungary, F.Y.R. Macedonia, Romania, Slovenia, Turkey) will attend the training course. The course will cover all practical aspects of fertigation as well as the application of the nuclear techniques to estimate water and N fertilizer use efficiency.

⇒ **FAO/IAEA TCP on “Irradiated sewage sludge for increased crop production” (EGY/8/014)**

- **In-country workshop, February 2002, Cairo Egypt**

A 5-day in-country workshop is being organized to cover the technical aspects of irradiation of sewage sludge for elimination of pathogens and its application to agricultural land as a nutrient source and soil conditioning agent. The local organizer is Dr. Rawia El-Motaium, Atomic Energy Authority, Nuclear Research Center, Anshas. The Project Technical Officers, Mr. O. Gueven (NAPC) and Mr. P. Chalk (NAFA) as well as regional and local experts will participate in the workshop.

#### ***NON-FAO/IAEA MEETINGS***

⇒ **International Meeting on “Direct Application of Phosphate Rock and Related Appropriate Technology - Latest Developments and Practical Experiences”, 16 – 20 July 2001, Kuala Lumpur, Malaysia**

This meeting is organized by the International Fertilizer Development Center (IFDC), in collaboration with the Malaysian Society of Soil Science (MSSS) and with the support from the Potash & Phosphorus Institute (PPI) and the World Phosphate Institute (IMPHOS). Details on the meeting have been reported in the previous newsletter.

F. Zapata and Lee K. Heng will participate as invited lecturers to report on activities of the Joint FAO/IAEA Programme, related to the main theme of the meeting.

F. Zapata will present a paper on “FAO/IAEA Research Activities on Direct Application of Phosphate Rock for Sustainable Crop Production”. Lee K. Heng will present a joint paper with P. Sale, La Trobe University, Australia on “Towards Developing a Decision Support System for Phosphate Rock Direct Application in Agriculture”.

⇒ **XIV International Plant Nutrition Colloquium, 27 July – 3 August 2001, Hanover, Germany**

The main objective of this colloquium is to provide opportunities for researchers studying all aspects of plant nutrition to review recent advances in plant nutrition and to exchange new knowledge, information, ideas, and techniques. The Colloquium will cover research work on physiological aspects, plant soil relationships, plant quality, plant health, soil nutrient dynamics and nutrient management in relation to the environment. Gamini Keerthisinghe will present a paper on “Integrated approach for improved phosphorus nutrition of plants in tropical acid soils”.

⇒ **12<sup>th</sup> World Fertiliser Congress, 3 – 9 August 2001, Beijing, People’s Republic of China**

The theme of this Congress, which is being jointly organized by the Chinese Academy of Sciences (CAS) and the International Scientific Center of Fertilizers (CIEC), is *Fertilization in the Third Millennium – Fertilizer, Food Security and Environmental Protection*. Mr. Phillip Chalk, Head of the Soil and Water Management & Crop Nutrition Section, and co-authors,

will present a keynote lecture on *Nitrogen Fertilization and Its Environmental Impact*. More information can be obtained by e-mail [CIEC2001@iae.syb.cn](mailto:CIEC2001@iae.syb.cn) or the web <http://www.pb.fal.de>

⇒ **11<sup>th</sup> Nitrogen Workshop, 9 – 12 September 2001, Reims, France**

The workshop is being organized by the Unité d'agronomie de Reims et de Laon, INRA. It will emphasize the understanding of organic matter cycling in soils (C and N) and recent developments in tools for managing soil and fertilizer nitrogen. Contributions from intensive, low-input and organic agricultures (including forests) are welcome. More information can be obtained by e-mail [Nworkshop@reims.inra.fr](mailto:Nworkshop@reims.inra.fr) or the web <http://www.inra.fr/Internet/Projects/11Nworkshop>

⇒ **“Soil Science: Past, Present and Future”, Joint Meeting of the Czech Society of Soil Science and the Soil Science Society of America, 16 – 20 September 2001, Prague, Czech Republic**

This international conference will cover 4 major themes: Interpretation of soil data at different scales in time and space, soil geographic information systems, transport processes in soil with special reference to preferential flow, and heavy metals and organic pollutants in soils. Field tours to southern and northern Bohemia have been organized as part of the programme. More details can be obtained from Dr. Lubos Boruvka [Boruvka@af.czu.cz](mailto:Boruvka@af.czu.cz)

⇒ **“Third Viennese Workshop on Stable Isotopes in Biological and Environmental Research”, 8 – 9 November 2001, Vienna, Austria**

This workshop will be held at the Institute of Ecology and Conservation Biology, University of Vienna. The workshop will consist of four general sessions: Techniques, Geosciences & Hydrology, Plant & Soil and Ecology. For further information and details please contact Dr. Susanna Wiener, Institute of Ecology and Conservation Biology, University of Vienna. Email: [Siber@pflaphy.pph.univie.ac.at](mailto:Siber@pflaphy.pph.univie.ac.at)

⇒ **“Towards Integrated Soil, Water and Nutrient Management in Cropping Systems: the Role of Nuclear Techniques”, Symposium 59, 17<sup>th</sup> World Congress of Soil Science, 14 – 21 August 2002, Bangkok, Thailand**

A half-day Symposium will be convened within the 17<sup>th</sup> World Congress of Soil Science, which has as its theme, *Soil Science: Confronting New Realities in the 21<sup>st</sup> Century*. Mr. Phillip Chalk, Head of the Soil and Water Management & Crop Nutrition Section, is the convenor of Symposium 59 and Dr. Sakorn Phongpan, Senior Scientist, Nuclear Research in Agriculture Section, Agricultural Chemistry Division, Department of Agriculture, Chatuchak, Bangkok, is the Thai Co-convenor. The Symposium will focus on the application of nuclear techniques in studies of soil organic matter dynamics and nutrient cycling, evaluation and management of nutrient sources, water management and conservation, soil erosion and sedimentation, plant tolerance to environmental stress, environmental and pollution studies and advances in nuclear-based methodologies and instrumentation. There has been an excellent response to the call for contributions to the symposium that closed on April 30. Financial support will be provided by the Agency to a limited number of participants from developing countries, selected on the basis of the abstracts received. Detailed information on the Congress can be obtained at <http://www.17wcsc.ku.ac.th>



## D. PAST EVENTS

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

- ⇒ **First FAO/IAEA Co-ordination Meeting on “The Comparison of Soil Moisture Neutron Probe with Time Domain Reflectometry and Capacitance Methods”, 21 – 23 March 2001, Vienna, Austria**

A Co-ordination Meeting was held at IAEA Headquarters and Seibersdorf Laboratories with the participation of four individual research contract holders: C.T. Hignett (Australia), P. Cepuder (Austria), J.P. Laurent (France) and S.R. Evett (USA). Ms. L.K. Heng, Soil Science Unit, Seibersdorf Laboratories, also participated. Ms. Heng is conducting field/laboratory experiments in support of the project. Several kinds of soil water content (SWC) measurement devices including the soil moisture neutron probe (SMNP), Sentek EnviroSCAN, Sentek Diviner 2000, Trime tube-probe, and conventional time domain reflectometry (TDR) systems from Soil Moisture, Inc. (Trase system) and Dynamax, Inc. are being compared in laboratory and field experiments under different soil and climatic conditions. These comparisons were based on the recommendations of a Consultants Meeting held in Vienna, 23 – 25 November 1998, published in IAEA-TECDOC-1137: “Comparison of soil water measurement using the neutron scattering, time domain reflectometry and capacitance methods”. This document is available, upon request, to the SWMCN Section. A selected bibliography on this topic is available from our home page: [http://www.iaea.org/programmes/nafa/d1/public/d1\\_pbl2\\_1.pdf](http://www.iaea.org/programmes/nafa/d1/public/d1_pbl2_1.pdf). A report of the Consultants Meeting and the progress reports of the four research contract holders, are also available upon request to the SWMCN Section. Recommendations from the Co-ordination Meeting are given below:

#### *General Recommendations*

- None of the devices could be used successfully without taking into account special knowledge that is often missing from the respective instruction manuals.
- Installation of access tubes is a major concern for the systems that rely on capacitance or frequency domain measurements, including the Sentek and Trime systems mainly due to the small radial measurement volume around the tube, which renders these systems susceptible to errors caused by small air gaps or soil disturbance. In stony soils, the installation of TDR waveguides is problematic. The manufacturers offer a range of access tubes and equipment needed for their installation in different soils. However, these accessories are expensive and should be taken into consideration before deciding to purchase a particular system.
- Calibration of all these devices is required for successful measurement of SWC. The only systems that are less dependent on soil-specific calibrations are the conventional TDR systems. Each device measures a specific volume of soil, all of which are much smaller than the volume measured by the SMNP. This specificity should be considered in the design of soil sampling required for establishing calibration curves.

- The project needs to be extended for two more years for further comparison and fine tuning of results and to expand the scope of the project to include soil water potential measurement devices. The progress of the project will be reviewed in 2003.
- The results of this project will be used for (1) publication of an IAEA-TECDOC, and (2) writing a manual collating all specific skills, information, guidelines, and precautions necessary for the successful utilization of these devices.
- Selected publications will be made available through the Agency's web page.
- The devices under scrutiny should be tested at two levels:
  - A basic one that evaluates the device when used according to the manufacturer's recommendations and with the factory calibration.
  - An advanced level that includes fine tuning by an expert user, including changing of the calibration curve and specific methods of use not included in the manufacturer's manual.

### ***Specific Recommendations***

#### **Interpretation of SWC measurements**

- Measurements should be interpreted in terms of absolute values of SWC at successive depths and dates. This is a must for inter-comparison of these devices. Also, such SWC measurements are needed when results are compared with data from soil physical studies such as porosity, field capacity,  $K(\theta)$ ,  $D(\theta)$ , wilting point, etc.
- Interpretations also should be made in terms of the soil water balance. For soil water change in storage calculations, only the slope (or slope and exponents) of the calibration need to be known accurately. Evapotranspiration (ET) can be calculated properly over a period of time (e.g. 1 week, 10 d) if the change in storage is known. However, for accurate ET measurements, water flows below the root zone should be evaluated. This requires the ability to measure SWC well below the root zone, a capability that is lacking with some devices due to their limited length.
- The periodicity of data logging required should be evaluated. Often, a space of one week to 10 d is sufficient. Automatic data loggers allow much more frequent measurements, which are not always necessary for agricultural purposes and may lead to data management and analysis problems.
- Interpretations should include evaluation of the different tube installation and calibration requirements induced by specific soil structures such as stony soils, dry soils, highly structured soils, layered soils, clays with large dielectric relaxation, hard clays, etc.
- Flexibility of the systems in terms of depth of measurement and vertical measurement intervals should be evaluated.
- Software from the manufacturers should be evaluated in terms of its usefulness, flexibility, ability to analyze data with output on user-chosen time steps.

- Manufacturers' manuals should be evaluated and suggestions for improvement made.

#### **Specific guidelines for the TRIME-Tube system**

- Before any new utilization, the configuration of the system has to be visualized, downloaded and stored using the SM-TOOLS utility delivered with the TRIME instrument or available on the Imko Web site (www.imko.de). This provides the opportunity: i) to restore the initial calibration in case of problems, ii) to verify if any particular "material calibration" has been introduced inside the instrument, iii) to modify it if needed, iv) to back calculate "pseudo-transit-times" that could be used to correct water-content measurements that have been taken with a non, or badly, calibrated TRIME.
- The standard calibration curve used by the TRIME software operating inside the instrument seems to have been established on the basis of data that have been acquired with previous versions of the system, namely: other plastic access tubes than the ones that are sold now. That is probably why the standard water-content readings taken with recent systems differ significantly from reference measurements issued from SMNP and gravimetry. Therefore, this standard calibration curve has to be updated. This can be done using the data gathered by the teams acting in the frame of this FAO/IAEA project.
- Increasing the diameter of the access tube should be investigated. This could ease the installation of access tubes, increase the sensitivity of the device, and improve the availability/cost of access tube materials.

#### **Specific guidelines for the Sentek devices**

- Care should be taken to evaluate soil salinity when using these devices due to the dramatic effect of salinity on reported water contents.
- The limitations of these devices in terms of measurements at depths greater than the devices allow should be considered when choosing a system.
- The size of the solar power system should be evaluated due to a lack of capacity experienced in regions with low total sunshine hours.

⇒ **Final RCM of CRP on “The Use of Isotope Techniques in Studies on the Management of Organic Matter and Nutrient Turnover for Increased, Sustainable Agricultural Production and Environmental Preservation” , 26 - 30 March 2001, Serdang, Malaysia**

Eleven contract holders and five agreement holders participated in this final RCM. Ms. Rosenanai Abu Bakar, Universiti Putra Malaysia (UPM), was the local organiser and Mr. Gamini Keerthisinghe, the Project Officer, served as the Scientific Secretary. The meeting was officially opened by the Dean of the Faculty of Agriculture of UPM, Prof. Mohd. Yusof Hussein. A total of six Technical Sessions were held during which each participant gave a 45-minute presentation on the progress of his/her research work. The Technical Sessions were followed by a Session in which participants were divided into five working groups to review the progress towards achieving CRP objectives, collate information and formulate conclusions. The conclusions were presented by the leader of each working group in the final Session

chaired by the Scientific Secretary. An explanatory model was developed for synthesis and evaluation of data obtained from varying agro-ecological regions to obtain meaningful information on residue management practices. A field visit was organised to an oil palm plantation in Banting, where different residue management techniques including zero-burning land preparation methods were demonstrated. A report of the RCM is available from the Scientific Secretary upon request.

⇒ **Second RCM of CRP on “The Use of Nuclear Techniques for Developing Integrated Nutrient and Water Management Practices for Agroforestry Systems” , 7 - 11 May 2001, Kuala Lumpur, Malaysia**

Eight contract holders, four agreement holders, one Consultant and the Scientific Secretary, Mr. Gamini Keerthisinghe, attended this RCM which was officially opened by the Dean of the faculty of Agriculture, Universiti Putra Malaysia (UPM), Prof. Mohd. Yusof Hussein. Ms. Zaharah Rahman, UPM, was the local organiser. The participants presented the major results and conclusions of their research covering the period from 1999-2001. 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 Sabah Bernam, where different agroforestry systems are practiced. A report of the RCM is available from the Scientific Secretary upon request.

⇒ **Final RCM of CRP on “The Assessment of Soil Erosion through the Use of <sup>137</sup>Cs and Related Techniques, as Basis for Soil Conservation, Sustainable Production and Environmental Protection”, 21 - 25 May 2001, Vienna, Austria**

This fourth and final RCM was held at the IAEA Headquarters. Eleven research contract holders, one technical contractor and three agreement holders participated in the meeting. Dr. E. Garcia Agudo, former IAEA staff member in the Isotope Hydrology Section and scientific secretary of the Sedimentation CRP was invited as a consultant. In addition, IAEA staff members and observers attended the meeting. F. Zapata acted as the Scientific Secretary for the meeting. The programme consisted of seven technical sessions, of which five were devoted to the presentations of the participants. Each participant gave a 45-minute presentation highlighting the major achievements of the project. Each session was followed by 30 minutes of general discussion on the papers presented. Prof. Andreas Klik, Department of Hydraulics and Rural Water Management, University of Agricultural Sciences, Vienna arranged a field excursion to visit soil erosion measuring sites and other activities related to soil conservation in Austria. Participants were then divided into three working groups to review progress towards achieving the CRP objectives, collate information, and formulate conclusions. The group leaders presented the conclusions and recommendations in the final Session. A final report of CRP is available from the Scientific Secretary upon request.

### ***CONSULTANTS MEETINGS***

⇒ **FAO / IAEA Consultants Meeting on “Increasing the Use of Biological Nitrogen Fixation (BNF) in Agriculture” 13 – 15 March 2001, Rome, Italy**

Nine consultants, together with representatives from IFAD and UNDP, 28 professional staff from FAO headquarters and two professional staff from IAEA attended the meeting at

FAO Headquarters. Mr. R. N. Roy, FAO and Mr. G. Hardarson, IAEA Seibersdorf Laboratories served as Scientific Secretaries.

Mr. Hans Wolter, Director, Land and Water Development Division (AGL) welcomed and introduced the participants. The meeting was officially opened by Ms. Louise O. Fresco, Assistant Director-General, Agriculture Department, FAO. Introductory remarks on the option for raising finance for BNF development were given by Mr. Andrew MacMillan, Principal Advisor, Investment Centre Division, followed by introduction of the agenda and logistics by Mr. R.N. Roy, Land and Plant Nutrition Management Service.

The consultants presented reviews of several aspects of developmental work and research in the field of biological nitrogen fixation. These were complemented by papers from the IAEA and FAO. The review papers are expected to be published as a special issue of the journal *Plant and Soil*.

After the presentations, two working groups were formed: one on maize-legume based farming systems (mainly Africa and Latin America ) and one on rice-legume based farming systems (mainly Asia). Recommendations for future follow-up by actions by FAO were formulated.

Dr. M. Niamir-Fuller, UNDP-GEF Regional Co-ordinator for Africa, gave an introduction to the Global Environment Facility (GEF) – structure and operational principles.

The three days meeting was closed by presentation of the summary and conclusions of the working groups by Mr. Andrew MacMillan, TCIU and concluding remarks and thanks to the participants were made by the Chairman, Mr. Hans Wolter, Director, AGL. A web-page for the press was prepared by Mr. R.N.Roy and placed on the FAO web-site.

⇒ **FAO/IAEA Consultants Meeting on “Assessment of Soil Conservation Technologies for Sustainable Agricultural Production”, 28 - 30 May 2001, Vienna, Austria**

In connection with the final meeting of the CRP on Soil Erosion, a Consultants Meeting was convened to review recent developments in nuclear and related techniques for measuring soil erosion and ongoing work in soil/water conservation technologies to control soil erosion and associated sedimentation. The discussions focused on the “World Overview of Conservation Approaches and Technologies” (WOCAT) methodology as a framework for the evaluation of soil and water conservation”. Three experts from Australia, Brazil and the UK and one representative each from FAO, Rome, Italy and UNEP, Nairobi, Kenya attended the meeting. F. Zapata served as Scientific Secretary.

The panel identified priority areas of research in soil and water conservation and recommended that a CRP on the above topic should be implemented.

## **TECHNICAL CO-OPERATION PROJECTS (TCPs)**

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

- **First Project Co-ordination Meeting, 21 - 23 February 2001, Vienna**

The meeting was held at IAEA-HQ with seventeen participants from developing countries (fourteen from Member States from the Europe Region plus three scientists from the West Asia Region as invited speakers). Eight countries were finally nominated for participating in this project: Bulgaria, Cyprus, Greece, Hungary, F.Y.R of Macedonia, Romania, Slovenia and Turkey. A detailed report is available from the Scientific Secretaries of the meeting: L.K. Heng and P. Moutonnet. The following guidelines were adopted at the meeting:

Nuclear techniques (soil-moisture neutron probe,  $^{15}\text{N}$ -labelled fertilizer) will be used respectively for:

- Monitoring soil-water status and calculating soil water balance and water use efficiency.
- Assessing crop recovery of N-fertilizer, residual N-fertilizer in the soil and N loss by mass balance.

Water requirements depend on the local climatic conditions and on crop demand. The Penman-Monteith formula is recommended, as it is being applied in the FAO CROPWAT model. Irrigation water requirement for a cropping season is calculated by deducting the potential effective rainfall from the total water requirement.

Crop nutrient requirements should be evaluated considering the optimal rates of the main nutrients (N, P and K) recommended to farmers by Extension Services. The ability of soils to provide these nutrients during the cropping season should be considered. Special attention should be paid to the restricted volume of the root system under drip irrigation that will limit the natural contribution of the soil to the crop nutrient requirements. The nutrient requirements will be estimated ( $\text{kg ha}^{-1}$ ) for each element. The decision to apply the full amount through fertigation or part as basal fertilizer depends on crop and soil conditions.

Fertigation should be carried out throughout the cropping season, on a *concentration* basis using a Dosatron type fertilizer injector. This enables the application of different rates of soluble fertilizers ( $\text{N}_0$ ,  $\text{N}_1$ ,  $\text{N}_2$ ,  $\text{N}_3$ ) and supplying irrigation water to the main plots. Usually,  $\text{N}_2$  corresponds to 100% of the locally recommended N-fertilizer rate;  $\text{N}_1$  and  $\text{N}_3$  correspond to 50% and 150%, respectively. Only N will be applied at different rates and the other nutrients will be applied at adequate levels. Micro-plots ( $1 \text{ m}^2$ ) studies using  $^{15}\text{N}$  will be conducted for calculating the nitrogen recovery by the crop, residual fertilizer in soil and N loss by mass balance.

$^{15}\text{N}$ -labelled fertilizer (1 kg Urea at 5 atom %  $^{15}\text{N}$  excess) was distributed to all the participants during the meeting. Dosatron injectors (two per country) were purchased.

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

- **First Project Co-ordination Meeting, 21 - 23 February 2001, Beijing, China**

Of the eleven participating countries (Bangladesh, China, India, Malaysia, Mongolia, Myanmar, Pakistan, Philippines, Sri Lanka, Thailand and Viet Nam) all project co-ordinators attended the meeting except for the counterpart from Bangladesh. The Technical Officer of the Project, Mr. Gamini Keerthisinghe served as the Scientific Secretary. The presentations of the participants highlighted the need to identify management practices to improve soil fertility and increase crop production in the East Asia and the Pacific region. Many countries in this region are experiencing a progressive shortage of land available for cultivation, mainly due to industrialization, urbanization and gradual degradation of the ecosystem. Thus, the overall objective of this project is to develop improved soil, water, nutrient and crop management practices while counteracting predominant soil degradation processes. The focus will be on rice-based cropping systems, which play an important role in the food security of the region. With regard to fertilizer efficiency, the emphasis will be on nitrogen, as it is the most costly input and it is not efficiently used in rice-based cropping systems (only about 30-40 % of applied N is utilized by crops). In addition to conventional techniques, the use of <sup>15</sup>N-labelled fertilizers was discussed for estimating N fertilizer use efficiency under different management practices. China was elected as the lead country to co-ordinate the project activities. National work plans were established for each participating country considering the local needs and constraints of crop production.

⇒ **FAO/IAEA TCP on “Integrated Nutrient and Pest Management Practices for Crop Mutants in Rice Based Cropping Systems” (BGD/5/022)**

- **Project Formulation Workshop, 11 - 15 March 2001, Dhaka, Bangladesh**

This workshop was organized to support the counterparts in Bangladesh to formulate a realistic work plan to identify integrated fertiliser, water and pest management practices to increase crop production. Representatives from the Bangladesh Institute for Nuclear Agriculture (BINA), Department of Agricultural Extension (DAE), Bangladesh Atomic Energy Commission (BAEC), Bangladesh Agriculture Development Corporation (BADC), Bangladesh Rice Research Institute (BRRI), K. Kahn & Company Limited (responsible for commercial production of rhizobial inoculant), Danish International Development Assistance (DANIDA) funding the Integrated Soil Fertility and Fertilizer Management Project (SFFP), FAO and UNDP attended. Mr. Gamini Keerthisinghe, the Technical Officer, served as the Scientific Secretary. The main objective of the project will be to explore the possibility of growing early maturing rice mutants followed by short duration grain legumes (chick pea, lentil) developed by BINA through radiation techniques to increase overall crop production in areas affected by drought. Effective rhizobial strains produced by BINA will be used to increase the production of grain legumes and to optimize biological nitrogen fixation. Isotope techniques will be used to evaluate the contribution of legume crops to nitrogen availability of soils and nitrogen uptake by subsequent crops. A work plan was established considering the achievements made so far in past and on-going TC-projects and related projects funded by other funding bodies. A series of discussions were held with representatives from FAO, UNDP and DANIDA on various possibilities of collaboration in implementation of the project.

⇒ **FAO/IAEA Regional TCP for Latin America on “Plant Nutrition, Soil and Water Management” (RLA/5/036), ARCAL XXII**

- **Final Project Evaluation Meeting, 26 - 30 March 2001, Irapuato, Mexico**

This was the fourth and final Meeting of the project co-ordinators. The Meeting was hosted by the “Centro de Investigacion y Estudios Avanzados del Instituto Politecnico Nacional” (CINVESTAV-IPN) at Irapuato, Gto., Mexico. The local organizer was Dr. Juan Jose Pena-Cabriales. The project co-ordinators from the eight participating countries (Argentina, Brazil, Chile, Cuba, Mexico, Guatemala, Uruguay and Venezuela) attended the Meeting. Members of the local team also participated as support staff. The objectives of the meeting were mainly to evaluate the achievements of the project and to prepare the final report as per instructions given in ARCAL document 9812. In particular, the rate of accomplishment of the Activity Plans and associated budget, results obtained and the achievement of the objectives were critically analysed.

The main objectives of this project were: a) to improve the productivity of the cultivated land through the identification and development of adequate soil, water and nutrient management practices, b) to identify suitable nuclear techniques to evaluate practices to improve soil fertility and management, and to improve the quality of the analytical services rendered by the laboratories of the region, and c) to contribute to the transfer of those technologies of proven efficiency to the producers through agricultural extension services. Specific objectives of the project were: d) to develop strategies for the integrated and efficient use of chemical fertilizers and alternative nutrient sources for different cropping systems, and e) to determine improved soil and water management practices, to sustain productivity of land resources and control their degradation.

The wide diversity and complexity of the agricultural production systems in Latin America and the Caribbean region is determined not only by the contrasting differences in soil, climate and topography, etc. but also by the socio-economic and cultural differences between the countries of the region. This poses a great challenge to develop technologies and formulate practical recommendations for the adequate management of inputs to intensify agricultural production while conserving the natural resources base. The project was approved during the last quarter of 1996, and started implementation with the First Meeting of project co-ordinators held in Irapuato, Mexico, 30 September - 4 October 1996, where the First Activity Plan of the project (1997-1998) and associated budget were prepared. The Second Meeting of project co-ordinators was held in Santiago, Chile, 23 - 27 March 1998 to assess progress in implementation and to elaborate the new Activity Plan of the project (1999-2000) and associated budget. At this meeting, the implementation of the Regional Network of Field Trials were critically analysed in relation to the specific objectives of the project (points d) and e) mentioned above). During the Third Meeting held at Oaxaca, Mexico, 20 - 24 March 2000 the results obtained in the Regional Network of Field Trials were evaluated, and with the assistance of an expert in agricultural extension, the Final Activity Plan of the project was formulated with special emphasis on the dissemination of the results obtained to farmers in order to achieve the desired impact of the project.

During this final Meeting, the project co-ordinators presented the country reports, which were followed by in-depth discussion. Thereafter, the participants in working groups prepared summarized tables and wrote the chapters of the Final Report. At the end of the meeting, in



Plenary Session, the participants adopted the Final Report and provided conclusions and recommendations. The complete report of the Meeting is available in the SWMCN Section.

All the objectives of the project mentioned above were fully achieved due to the firm commitment of the participating countries and the provision of additional funding obtained by the project co-ordinators through national competition. The main outputs /achievements of the project were summarized by the project co-ordinators as follows:

1. The project has greatly contributed to the sustainable intensification of food production in the region by generating knowledge and developing technologies on integrated nutrient and water management in several cropping systems through the use of isotopic techniques and neutron moisture meters. This was obtained by implementing a regional network of 42 field trials focused on well-defined farmers' problems. The field trials covered three main agro-ecosystems of regional economic importance. The results were published in scientific journals and papers were presented at national and regional scientific meetings such as CLACS-99, Chile, November 1999 and ISCO-2000, Argentina, October 2000. Some results will be presented at the forthcoming CLACS-2001, Cuba, November 2001, and the 17<sup>th</sup> World Congress of Soil Science, Bangkok, Thailand, 2002.
2. These technologies were further pilot-tested and translated into practical recommendations for dissemination to the farmers and producers through several mechanisms selected on a national basis by the project co-ordinators. This included 41 demonstration trials in farmer's fields, 11 field days, 3 workshops with producers and one with extension personnel. In addition, 24 press releases, 23 radio and TV communications, 2 video films, 6 extension leaflets and a project document for inclusion in the web page of the IAEA Technical Co-operation Programme were also prepared.
3. The project clearly confirmed the value and practical usefulness of the nuclear techniques for generating new technologies on integrated soil, water and nutrient management in agricultural production systems. This was achieved through strengthening of the national capacities to utilise nuclear techniques. Over 200 specialists of the region have been trained in 8 regional workshops, 6 national training events and 11 fellowships. Also, 26 expert missions (about 6 m/m) were fielded for technical backstopping and exchange of scientific information. In this context, a major achievement was the recognition of 6 isotopic laboratories by the IAEA as Regional Laboratories and from these, 4 have submitted their application for accreditation as ARCAL Regional Centres.
4. This project has greatly contributed to the exchange of information and the establishment of a long-lasting collaboration among the institutions involved in each country and the region. The "nuclear teams" are multi-disciplinary and in most cases inter-institutional. Six technical manuals and one book to illustrate the role of nuclear techniques on the main topics of the project have been published in Spanish for wide distribution in the region. One special issue in the scientific journal TERRA dedicated to the results of the project is in an advanced stage of preparation.
5. The financial contributions of the participating countries to the project was approximately 3 times more than the IAEA contribution, demonstrating their firm commitment to the implementation of the project. Estimated cost: benefit ratios considering only the productivity gains resulting from the new technologies were on the average of 1:79 for the project.

The participants formulated a series of conclusions and recommendations and endorsed the project on “Controlling Land Degradation in Latin America and the Caribbean region” prepared by Cuba for submission to the ARCAL Programme for the 2003-2004 biennium. The integrated approach adopted and the experiences gained in the successful implementation of this project are being utilised in a Regional TC project for Africa on “Combating Desertification in the Sahel” (RAF/5/036) in the 2001-2002 biennium.

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

The objective of this project is to intensify sustainable food production in the rainfed agriculture of countries in the Sahel, in order to enhance food security while combating desertification. The main focus is to develop and promote the adoption of improved and integrated soil, water and nutrient management technologies in cropping systems, pilot tested through the use of nuclear and related techniques. The main goals of the project are, in the short term, to improve the productivity of the system; and in the long term, 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.

- **First Project Co-ordination Meeting, 19 - 23 February 2001, Ouagadougou, Burkina Faso**

The meeting was held at the Palm Beach Hotel, Ouagadougou, Burkina Faso. The local organizer was Dr. A.B. Bado, Chairman of the National Atomic Energy Authority (ANEA) of Burkina Faso. F. Zapata, the Technical Officer assisted in conducting the meeting. The objectives of this first co-ordination meeting were to develop the First Activity Plan of the project and to establish regional co-ordination for implementing the project activities during the biennium 2001-2002.

The meeting was attended by 18 officials of relevant national organizations working on desertification from the four participating countries: Burkina Faso, Mali, Niger and Senegal. The following activities were carried out:

- a) Presentation of the country reports on desertification, which were followed by in-depth discussion to make an assessment of the desertification problems at the national and regional levels. A presentation of the activities of the UNDP office to combat Desertification and Drought (UNSO) was also made.
- b) The Technical Officer presented the project: objectives, strategies, potential use of nuclear techniques, expected outputs and main general activities.
- c) Information on desertification projects and initiatives (UNEP, FAO, UNSO, World Bank, Desert Margin Programme and other institutions) was distributed to the participants and the establishment of linkages with them at the national and sub-regional level was discussed.
- d) Preparation of a logical framework for each participating country and for the region.
- e) Preparation of the Activity Plan of each country and the project for the 2001-2002 biennium.

f) Proposal for allocation of IAEA financial resources for the 2001-2002 biennium.

The programme was successfully accomplished and the objectives of the meeting achieved. During the final session of the meeting, a series of conclusions and recommendations were made. A full report of the meeting is available (in French) from the Technical Officer upon request. The second regional co-ordination meeting of the project will be held in Niamey, Niger, during the first half of February 2003

⇒ **IAEA Regional TCP for Africa on “Human Resource Development and Nuclear Technology Support” (RAF/0/011)**

- **National Group Training in Agriculture and Related Fields, 2 – 6 April, Zaria, Nigeria**

Ms. Lee Heng, Soil Science Unit, Seibersdorf, lectured and conducted practical demonstrations in this training course that took place at the Center for Energy Research and Training (CERT). Twenty-two staff members from CERT, the Institute of Agricultural Research (IAR) and Ahmadu Bello University) took part in the activities. The course covered a range of topics including introduction to soil physics in the environment, soil bulk density, estimating water infiltration rates, hydraulic conductivity and pore size distribution and their significance, soil moisture theory and measuring techniques, irrigation scheduling.

#### ***NON-FAO/IAEA MEETINGS***

⇒ **“International Workshop on Conservation Agriculture for Food Security and Environmental Protection in Rice-Wheat Cropping Systems”, 6 – 9 February 2001, Lahore, Pakistan**

Several Ministries of the Pakistan and Punjab Governments organized this workshop in collaboration with FAO, CIMMYT and IWMI. Mr. Phillip Chalk, Head of the Soil and Water Management & Crop Nutrition Section, made a poster presentation to publicize future Joint Division activities in the rice-wheat system through a new FAO/IAEA Co-ordinated Research Project “Integrated Soil, Water and Nutrient Management for Sustainable Rice-Wheat Cropping Systems in Asia” (D1.50.07). The poster and a handout of the project document served to increase awareness among potential NARS contract holders, CGIAR agreement holders and members of the Rice-Wheat Consortium of the opportunity to participate in the CRP, to highlight the importance of an integrated approach to the management of external inputs and natural resources in rice-wheat systems and the role of nuclear techniques in adding value to on-going experiments pilot testing new technologies to increase nutrient and water use efficiencies.

⇒ **International Conference on “Integrated Water Management”, 11 – 13 May 2001, Nicosia, Cyprus**

Ms. Lee Heng, Soil Science Unit, Seibersdorf, was invited to participate cost-free in this conference hosted by the Agricultural Research Institute (ARI) and supported by the EU to establish an international network to promote the effective and sustainable management of scarce water resources in the Euro-Mediterranean region. Discussions centered on water resources; government policies; legal, cultural and social issues; intensive uses; supply infrastructure; application technologies. National contact persons were appointed and

guidelines were provided for the collection of data and formation of a data bank. Water supply facilities for domestic and agricultural purposes were visited.

## **E. STATUS OF CO-ORDINATED RESEARCH PROJECTS**

### **⇒ Use of Isotope Techniques in Studies on the Management of Organic Matter and Nutrient Turnover for Increased, Sustainable Agricultural Production and Environmental Preservation**

Project Officer: G. Keerthisinghe

The fourth and the final RCM of this CRP was held in Malaysia 26 –30 March 2001 at which the overall progress and significant achievements of the project were reviewed and discussed. All contract holders prepared final project reports prior to the RCM, and a majority have prepared manuscripts for inclusion in an IAEA TECDOC. However, some contract holders have to complete analysis of samples, interpretation of data, formulation of conclusions and preparation of final drafts of manuscripts. The Project Officer will edit manuscripts and prepare the TECDOC, which will include the major achievements and conclusions of the project. Participants are also encouraged to prepare manuscripts for publication in scientific journals.

### **⇒ 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 (IITA-Nigeria) and M. Smith (UK). All contract holders have initiated on-station and on-farm experiments in accordance with the work plan and experimental guidelines established at the first RCM. Isotope techniques are being used to quantify nutrient and water dynamics in agroforestry systems in order to modify management practices for better utilization. Linkages with CG centers and other agroforestry projects have been established for effective implementation of project activities. 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.

### **⇒ Use of Nuclear and Related Techniques for Evaluating the Agronomic Effectiveness of Phosphate Fertilisers, in particular Rock Phosphates**

Project Officer: F. Zapata

Technical editing and proofreading of the manuscripts for the production of an IAEA TECDOC is in its final stage. The document is expected to be submitted to the IAEA Publications Committee by June this year.

The process of peer review of the manuscripts submitted for the production of a special issue in the journal *Nutrient Cycling in Agro-ecosystems* has been completed. Ten out of 11 manuscripts have been approved for publication.

The implementation of a joint initiative for the production of a FAO Technical Bulletin on “Use of Local Phosphate Rocks in Sustainable Agriculture” is proceeding on schedule. Two FAO Divisions (AGE/AGL) will produce a bulletin covering aspects pertaining to direct

application of PRs. F. Zapata (AGE) and R.N. Roy (AGL) are the co-ordinators. Details on the proposal prepared by a panel of experts were given in the last newsletter. A full report is available from F. Zapata upon request.

The Joint FAO/IAEA Programme is also collaborating with IFDC to develop a decision support system for direct application of phosphate rocks. Ms. L.K. Heng and F. Zapata (FAO/IAEA) and Norman Chien (IFDC) are involved in implementing this task.

⇒ **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

The final RCM was held from 21 - 25 May 2001, in Vienna, Austria. The Project Officer has prepared the final report of the CRP. A request for external publication will be first submitted to the IAEA with the manuscripts received from the participants and later an updated proposal for the production of a special issue will be submitted to the Editorial Office of the journal *Soil and Tillage Research*. Participants will be informed in due course about the initiation of the process of peer review.

The activities for the production of the handbook on the Cs-137 technique are well underway. Some draft chapters are already available and others are in preparation. It is expected that the first draft of all chapters will be ready by June 2001. Kluwer Academic Publishers will publish the handbook.

As a continuation of the research work on Soil Erosion, it is planned to start a Soil Conservation CRP in 2003 (Refer to Consultants Meetings). Also a proposal for a Regional Technical Co-operation Project in Asia and the Pacific has been submitted to the IAEA for consideration in the 2003-2004 biennium.

⇒ **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 Officer: P. Moutonnet (From 1 July 2001: G. Keerthisinghe & L. Heng)

This project has presently seventeen participants, twelve of whom are contract holders: D.R. Prieto (Argentina), G.X. Cai (People's Republic of China), M.S. Sachdev (India), V.R. Maparla (India), M.J.M. Rusan (Jordan), I.V. Sijali (Kenya), K. El Mejahed (Morocco), I. Mahaman (Niger), M.M. Iqbal (Pakistan), M. Sene (Senegal), M. Mechergui (Tunisia) and T. Sithole (Zimbabwe); and five agreement holders: F. Maraux (France), R.J.K. Myers (ICRISAT-Zimbabwe), A. Bationo (IFDC/ICRISAT-Niger), S. Asseng (Australia) and J. Ryan (ICARDA-Syria). The second RCM was held in Tunis, 6 - 10 March 2000. The research programme was discussed and guidelines were established for the next cropping season. The first field experiments were implemented during the period from 1998 to 1999. Analyses of soil and plant samples were carried out at the FAO/IAEA Seibersdorf Laboratories. Progress of the project will be evaluated at the 3<sup>rd</sup> RCM, which will be held in Vienna from 24 - 28 September 2001.

⇒ **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, 5 - 9 June 2000. Participants in this CRP are eight research contract holders: P. Houngnandan (Benin), S. Urquiaga (Brazil), T. Muraoka (Brazil), V. Bado (Burkina Faso), A. García (Cuba), J.J. Peña-Cabriaes (Mexico), E. Iwafuor (Nigeria), and M. Lopez (Venezuela); one technical contract holder: P. Randall (Australia), and five agreement holders: R. Thomas (CIAT-Colombia), W. Horst (Germany), S.H. Chien (IFDC-USA), B. Vanlauwe (TSBF-Kenya), and K. Sahrawat (WARDA-Cote d'Ivoire). Most contract holders have submitted progress reports from their research work and applied for contract renewal. Guidelines and research protocols established during the first RCM are available in the report of the first RCM. The second RCM is scheduled for February 2002 in Brasilia, Brazil (Refer to future events). The project will undergo a mid-term review immediately after the second RCM.

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

This new CRP was approved in February 2001. The CRP was advertised and applications for Research Contracts and Agreements were invited with the closing date of June 30, 2001. The applications received will be evaluated and applicants informed of the outcome in due course. It is anticipated that 7 contracts and 4 agreements will be awarded. The first Research Co-ordination Meeting will be held in Vienna in the first quarter of 2002.

## **F. TECHNICAL CO-OPERATION PROJECTS**

### **⇒ Operational Projects in 2001**

**BGD/5/017**, Biofertilizers for Increased Legume Production

F. Zapata

**BGD/5/022**, Integrated Nutrient and Pest Management Practices for Crop Mutants in Rice-Based Cropping Systems

G. Keerthisinghe

**BGD/5/023**, Development of Agroforestry-Based Livestock Production Systems

G. Keerthisinghe

**BOL/5/012**, Sustainable Management of Soils, Water, and Plants in the Desaguadero River Basin

F. Zapata

**CHI/5/021**, Improvement of Soil/Water/Nutrient Management to Control Soil Degradation

F. Zapata

**EGY/8/014**, Irradiated Sewage Sludge for Increased Crop Production

P. M. Chalk

**INS/5/030**, Sustainable Agriculture Development in Yogyakarta

G. Keerthisinghe

**IVC/5/025**, Improvement of Crop Productivity

F. Zapata

**INT/5/144**, Saline Groundwater and Wastelands for Plant Production

M. Naqvi

**MAK/5/003**, Soil Fertility Improvement and Water Management

L.K. Heng

**MAR/5/011**, Studying the Fate of Nitrate in Soil and Water Under Intensive Vegetable Production Systems

G. Keerthisinghe

**MLI/5/016**, Assessment of Phosphate Efficiency Use in Sorghum

F. Zapata

**MOR/5/026**, Nuclear Techniques to Improve Water and Soil Management

F. Zapata

**RAF/5/048**, Combating Desertification in the Sahel

F. Zapata



**RAF/5/045**, Biofertilizers for Increasing Crop Production and Soil Fertility for Smallholders  
M. P. Salema

**RAS/5/039**, Restoration of Soil Fertility and Sustenance of Agricultural Productivity  
G. Keerthisinghe

**RER/5/011**, Fertigation for Improved Crop Production and Environmental Protection  
L. K. Heng

**ROK/5/033**, Quality Improvement of Major Crops and Integrated Plant Nutrition  
Management in the Low-Input Agricultural System  
G. Keerthisinghe

**SEN/5/026**, Assessment of Nitrogen and Fertilizer Use Efficiency in Cowpea Varieties  
F. Zapata

**SIL/8/002**, Improved Water Management Technologies in the Inland Valley Agro-Ecology  
G. Keerthisinghe

**UGA/5/020**, Determination of Fertilizer to Increase Crop Production  
P. M. Chalk

**URU/5/024**, Improving Carbon Sequestration in Agricultural Systems  
F. Zapata

**UZB/5/002**, Optimization of Water and Fertilizer Use for Major Crops  
L. K. Heng

**YEM/5/002**, Drip Irrigation and Fertigation for Improved Agricultural Productivity  
G. Keerthisinghe

⇒ **New Technical Co-operation Projects**

Applications for the Agency's Technical Co-operation (TC) Programme for the next biennium (2003-2004) are due at the Agency **no later than 31<sup>st</sup> December 2001**. Information on the Programme can be obtained from the TC Department, IAEA, Vienna, National Atomic Energy Authorities or the web at

[http://www.tc.iaea.org/tcweb/tcprocedures/projectproposals/tcprefsform\\_en.htm](http://www.tc.iaea.org/tcweb/tcprocedures/projectproposals/tcprefsform_en.htm)

Proposals must be made on the appropriate forms available at the abovementioned sources and must be routed through National Atomic Energy Authorities. Support for developing Member States can be obtained for the purchase of equipment and supplies, fellowship training, expert missions, scientific visits and training workshops.

## G. LABORATORY ACTIVITIES

### RESEARCH

#### ⇒ Experimental Work in Progress

- Nitrogen transfer from legumes to non-legumes

G. Hardarson and M. Aigner

Several isotope techniques have been used to measure N transfer from legumes to non-legumes including  $^{15}\text{N}$  isotope dilution,  $^{15}\text{N}_2$  labeling, split root  $^{15}\text{N}$  labeling and leaf or stem  $^{15}\text{N}$  feeding. Most of these methods have shown very little or no direct transfer of N from legumes to non-legumes when grown in mixed cropping systems. However, some studies have been able to quantify N rhizodeposition by legumes and N transfer when the root system of a leguminous plant is decomposing, e.g. during or after cutting or stress.

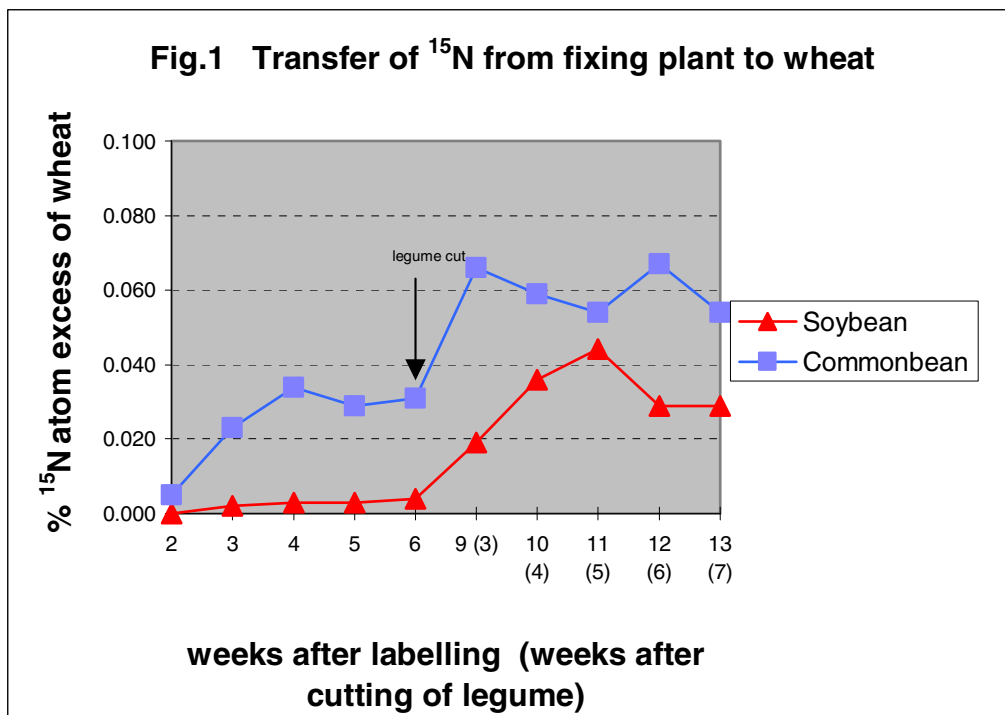
The present study investigated the time course of N transfer from soybean (*Glycine max* (L.) Merr.) and common bean (*Phaseolus vulgaris* L.) to associated wheat (*Triticum aestivum*) using a stem  $^{15}\text{N}$  feeding technique under greenhouse conditions. The objective was to determine if any N transfer occurred during the various growth stages of the legumes. A greenhouse experiment was conducted at the Seibersdorf Laboratory with pots containing four kg of Seibersdorf soil: quartz sand mixture (1:1). The pots were sown with one inoculated soybean (cv. Clay) or common bean (cv. Red Kidney) plant with five adjacent wheat (cv. Capo) plants grown around the legume plants. Two ml of 0.075M urea (~20 atom %  $^{15}\text{N}$  excess) solution was taken up by each legume plant. The legumes were labeled 14, 19, 26 or 32 days after planting (DAP) (only the data from 14 DAP labeling is shown). A single wheat plant was harvested at weekly intervals and dry matter yield, total N and atom %  $^{15}\text{N}$  excess were determined. After 6 weeks, the legumes were cut and the  $^{15}\text{N}$  labeled roots left in the soil. The wheat plants were allowed to regrow to investigate the N uptake from decomposing roots.

The  $^{15}\text{N}$  stem feeding technique was successful in labeling the leguminous plants (soybean: 0.5 % and common bean: 0.9 atom %  $^{15}\text{N}$  excess). Hardly any transfer of  $^{15}\text{N}$  from soybean to the adjacent wheat plants was observed (Fig 1, weeks 2 to 6) whereas a significant amount of  $^{15}\text{N}$  was transferred from the common bean plants to the wheat through the whole growing period. A significant amount of  $^{15}\text{N}$  was taken up by the wheat plants from the decomposing soybean and common bean roots (Fig 1, weeks 9 to 13).

The growth stage of the legumes did not have much influence on the rate of  $^{15}\text{N}$  transfer. However there was a significant difference between the legume species. The adjacent wheat benefited more from N derived from common bean as compared to soybean from which hardly any N was transferred during the growing period.

Percent N in wheat derived from common bean was approximately 3 % during the growing period of the legume compared to approximately 7 % after the legume had been cut. Further studies are warranted to compare the ability of other cultivars or legumes to supply N

to adjacent crops and to measure the below-ground N in various crop systems including nitrogen fixing legumes.



## TRAINING

Training is continuously provided by the Soil Science Unit of the FAO/IAEA Agriculture and Biotechnology Laboratory. The training is in the form of training courses, fellowships or scientific visits. The subject of training is predominantly the use of nuclear technology in soil science, soil and water management, crop nutrition and isotope analyses.

### ⇒ Fellows

The Soil Science Unit trains approximately 10 – 15 fellows annually. The training periods vary from 2 to 12 months. There are two categories of fellows, i.e. *Analytical fellows*, who are accepted for short-term periods of 2 to 4 month to learn isotope analytical techniques used in crop nutrition studies. This form of training includes technical tutoring and hands-on practical sessions. Particular emphasis is given to specific techniques relevant to research conducted under technical co-operation projects, i.e. total N and  $^{15}\text{N}$  isotope-ratio analysis by emission spectrometry. Whenever possible, group training of three to five fellows is organized every year. *Research fellows* are accepted for periods of between four and twelve months to work on projects related to the Unit's research programme. The fellows receive guidance on experimental strategies and the use of isotopes and related techniques relevant to a particular area of research that the fellow will pursue upon return to his or her home country. The fellow is expected to complete and write up a report of the research conducted.

The following fellows were trained by the Soil Science Unit on the use of isotopes in crop nutrition and water management during the first half of 2001:

Ms Rasoavolonomenjanahary,	MAG/00009R	2000-10-16 to 2001-01-15
Ms. J K Petrewska	MAK/00002P	2001-03-01 to 2001-05-31
Mr. M A Khan	PAK/00012P	2001-03-04 to 2001-06-05
Ms E Bautista	PHI/01002P	2001-03-05 to 2001-07-05
Mr. Md Z Haque	BGD/99072R	2001-03-05 to 2001-09-05
Mr. P A Ndakidemi	URT/00015R	2001-03-05 to 2001-09-05
Mr M El Khadir	MOR/01005R	2001-03-06 to 2001-07-05
Mr A Ellafi	LIB/01013R	2001-03-14 to 2001-12-14
Mr. A L Razafinjara	MAG/00011R	2001-04-19 to 2001-07-16

### ***ANALYTICAL SERVICES***

⇒ **Stable isotope analyses (January to May 2001)**

#### **Number of samples received**

CRP	1,663	43.4%
TC	0	0.0%
Seibersdorf	2,167	56,6%
Total	3,830	100.0%

#### **Number of measurements carried out**

	<sup>15</sup> N	<sup>13</sup> C	<sup>18</sup> O	Sum
Reported results	3,509	1,174	129	4,812
Analysis overhead (calibration, blank, QA-std, reps, test)	1,180	627	230	2,037
Total	4,689	1,801	359	6,849

⇒ **Annual Proficiency Testing Exercise on total N and <sup>15</sup>N analyses in plant materials (EQA 2000)**

The fourth interregional proficiency testing exercise on total N- and <sup>15</sup>N analyses of plant materials was performed by the Soil Science Unit from January to December 2000. Twenty nine institutes participated in EQA 2000.

Each laboratory received standard samples consisting of dry powdered  $^{15}\text{N}$ -labeled plant materials to be analyzed for both total N content and atom %  $^{15}\text{N}$  abundance. In addition, a questionnaire was circulated to obtain information on the current status in implementation of a Quality Control Programme. The choice of analytical instruments and methods was up to the participants. Two institutes in China and Brazil used Mass Spectrometers for  $^{15}\text{N}$ -analysis whereas all the others used Optical Emission Spectrometers.

Nineteen laboratories submitted their results in time, four reported technical problems with their instruments, two sent total N, but no  $^{15}\text{N}$ -results. Four laboratories did not report and gave no explanation, one had no budget to perform the analyses and one reported problems with test kit delivery through the customs.

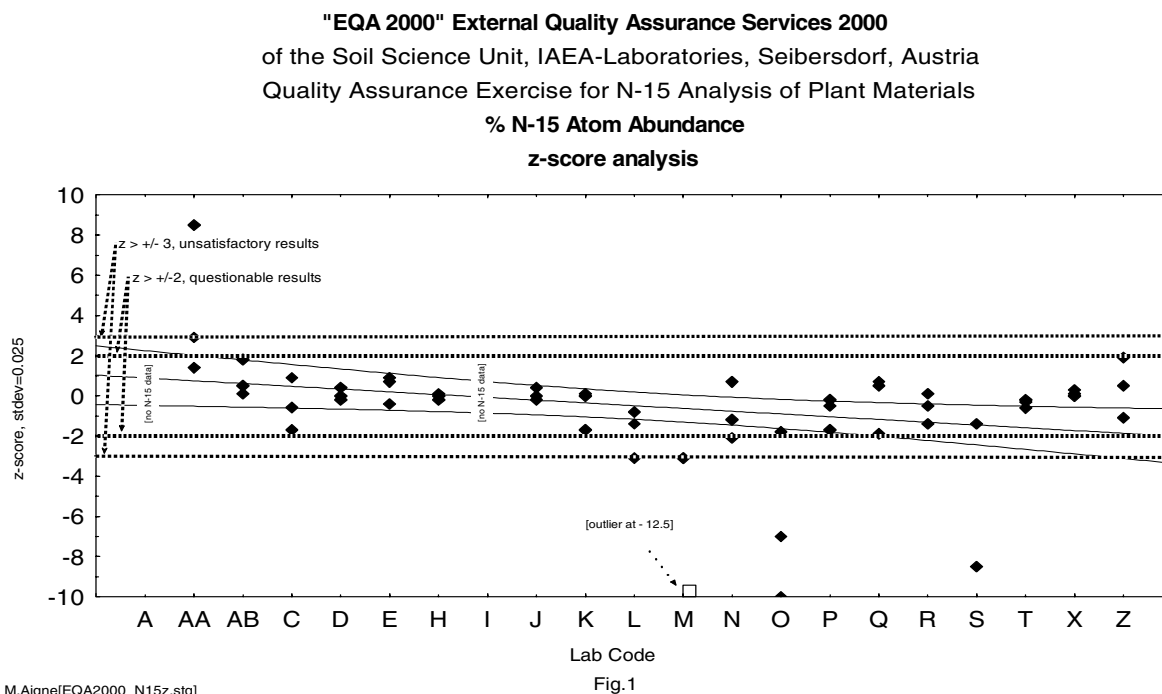
Very good results were received from institutes in Argentina-2, Brazil, Chile, China, Ghana, Malaysia, Niger, Uruguay and Venezuela. Satisfactory results were received from institutes in Argentina-1, Belgium, Ivory Coast, Syria and Turkey. Six laboratories, provided data not fully complying with the control limits established by the Soil Science Unit, but it should be stressed, that the participation and submission of results is highly appreciated although the analytical performance was not yet satisfactory (Figure 6). This gives us the possibility to support these laboratories in correcting their deficiencies.

The results received from participating institutes were evaluated using “z-scores” (Figure 2). The z-score is calculated as follows:

$$z = (\text{measured value} - \text{reference value}) / s$$

where  $s$  is standard deviation calculated by analysis of a range of plant materials with different N and  $^{15}\text{N}$ -contents. The performance in analysis of  $^{15}\text{N}$  by the participants is illustrated in Figure 2.

**Fig.2 Evaluation of  $^{15}\text{N}$  analytical performance of participating laboratories.**



The rating of results based on different regions is summarized in Table 1. Forty three percent of the participating institutes provided very good results and satisfactory results were received from 24 %. The results submitted by the rest (29 %) were not within the limits established by the Soil Science Unit.

**Table 1. Regional distribution of performance in <sup>15</sup>N analysis**

Rating of results/ Region	number of participants	very good	satisfactory	outside control limits	No data submitted
Africa	8	2 (25%)	2 (25%)	0	4 (50%)
Latin America	9	5 (56%)	1 (11%)	0	3 (33 %)
East Asia & Pacific	7	2 (29%)	0	2 (29%)	3 (43%)
West Asia	3	0	1 (33%)	2 (67%)	0
Europe	2	0	2 (100%)	0	0

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