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Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and FAO/IAEA Agriculture and Biotechnology Laboratory, Seibersdorf

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Installation and calibration of soil water monitoring equipment, Dubai, UAE

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To Our Readers

In January we embarked on the new programme of work for the 2004-05 biennium. We are now operating within one of three new sub-programmes, "*Sustainable Intensification of Crop Production Systems*" within the Food and Agriculture Programme, which also involves the Plant Breeding and Genetics Section and the Insect Pest Control Section. This is a major departure from the previous programme structure where each of the five Sections within the Joint Division implemented its own sub-programme.

A major activity early in 2004 was the preparation of the programme performance review (PPR) for the 2002-03 biennium. The actual achievements (outcomes achieved in terms of performance indicators) were assessed and baseline data and targets were established. We are presently preparing the programme of work and budget for the 2006-07 biennium. A new project E1.08 will be introduced in 2006 as the current projects E1.01 and E1.02 are phased out in 2007. The objective of this new project will be to increase crop water productivity in smallholder farms through better systems of harvesting, delivery, monitoring and control of water resources and improved crop and soil management practices.

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The technical evaluation of new project proposals for the 2005-06 TC cycle has been completed. There were 31 proposals (including 3 regional) covering all areas of soil and water management and crop nutrition, and all but one were approved, subject to reformulation or aggregation in some cases.

Significant changes have taken place in the staffing of the Section. Gamini Keerthisinghe left in mid-January to take up the post of Senior Plant Production Officer in the FAO Regional Office in Bangkok, while Felipe Zapata retired at the end of January. This left the Section seriously under staffed during a very busy period, which was resolved through the assistance of Soil Science Unit professional staff at Seibersdorf and the recruitment of Mr. Pierre Moutonnet, retired former staff member of the Section, for a period of 4 months. We are pleased that Mr. Claude Bernard was able to commence duties in early May, taking over most of the activities formerly managed by Felipe, and we are looking forward to welcoming a new staff member, Mr. Rachid Serraj, in August, to fill the post vacated by Gamini.

Beginning with the last issue of the Soils Newsletter, a much more attractive presentation was introduced with the inclusion of colour on the front page and elsewhere in the text. The previous major change was the introduction of the larger page size in June 1998. Further improvements will be made progressively in future issues. We invite our readers to contribute to the Newsletter by submitting high quality colour photos with captions for the front page. This issue will be the last that I introduce as Section Head, as I will take early retirement on August 21 after 7 years of rewarding service with the Agency. Therefore, I would like to take this opportunity to thank all of my friends and colleagues, both within and outside the Agency, for their dedicated support that enabled the sub-programme to deliver the planned outputs and outcomes to Member States.

With my very best wishes for your future endeavours.

Phillip Chalk

Staff

IAEA Headquarters, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, Vienna International Centre, Wagramer Strasse 5, P.O. Box 100, A-1400 Vienna, Austria; Telephone (43-1) 2600 + ext.; Fax (43-1) 2600 7; e-mail: Official.Mail@iaea.org

NAME	TITLE	E-MAIL ADDRESS	EXTENSION
James D. DARGIE	Director	J.Dargie@iaea.org	21610

Soil and Water Management & Crop Nutrition Section

NAME	TITLE	E-MAIL ADDRESS	EXTENSION
Phillip M. CHALK (Soil Fertility, Plant Nutrition)	Head of the Section	P.M.Chalk@iaea.org	21648
Claude BERNARD (Soil and Water Conservation)	Technical Officer	C.Bernard@iaea.org	21693
Ruth ROSSI	Secretary	R.Rossi@iaea.org	21646
Rosario LEON DE MUELLNER	Secretary	R.Leon-De-Muellner@iaea.org	21647

FAO/IAEA Agriculture and Biotechnology Laboratory, Soil Science Unit, A-2444 Seibersdorf, Austria

NAME	TITLE	E-MAIL ADDRESS	EXTENSION
Erik BUSCH-PETERSEN	Head, FAO/IAEA Agri-culture and Biotechnology Laboratory	E.Busch.Petersen@iaea.org	28267

NAME	TITLE	E-MAIL ADDRESS	EXTENSION
Gudni HARDARSON (Soil Microbiology, Plant Nutrition)	Head of the Unit	G.Hardarson@iaea.org	28277
Lee K. HENG (Soil Scientist; Soil Physics)	Technical Officer	L.K.Heng@iaea.org	28263
Martina AIGNER	Senior Laboratory Technician (50%)	M.Aigner@iaea.org	28212
Leopold MAYR	Senior Laboratory Technician	L.Mayr@iaea.org	28305
José Luis ARRILLAGA	Laboratory Technician	J.L.Arrillaga@iaea.org	28306
Stefan BOROVITS	Laboratory Technician		28304
Gerhard ECKHARDT	Laboratory Technician		28307
Maria HEILING	Laboratory Technician (50%)	M.Heiling@iaea.org	28272
Christine FICKER	Laboratory Attendant		28420
Elisabeth SWOBODA	Secretary	E.Swoboda@iaea.org	28281

Staff changes

Mr. Gamini Keerthisinghe left the Agency on January 13 after almost 7 years of service to take up the post of Senior Plant Production Officer in the FAO Regional Office in Bangkok. Gamini first joined the Agency as a Soil Scientist/Plant Nutritionist on April 26, 1997, bringing with him a wealth of experience in agriculture gained in both developing (Sri Lanka, Philippines) and developed (Germany, USA, Australia) countries within Universities (Peradeniya, Justus Liebig, Penn State), the CGIAR (IRRI) and CSIRO, Australia, over a period of 17 years since obtaining his Ph.D. He was given a Merit Award by the Agency in 2003 in recognition of his valuable contribution to the work of the Section. We miss the keen sense of humour that Gamini brought to the workplace and wish him all the best for his new assignment with FAO.

Mr. Felipe Zapata retired on January 31 after almost 25 years of service with the Agency. A full account of Felipe's achievements was given in the foreword to the last Newsletter. We wish Felipe all the best for a well-earned retirement, and look forward to seeing him now and again as he moves between his residences in Vienna and the south of France.

Mr. Pierre Moutonnet rejoined the Agency on January 19 on a temporary assignment to assist the Section during the period of staff vacancies. Pierre was a former staff member of the Section who took early retirement in June 2001. It was a great assistance to have Pierre back with us due to his familiarity with Agency procedures and the management of TC and co-coordinated research projects. Pierre finished his assignment on May 18, and returned with his wife to their home in the south of France. We thank Pierre for returning to Vienna on short notice to help with the workload.

Mr. Claude Bernard joined the Section on May 4 as a Soil Scientist, to fill the post vacated by Felipe Zapata. Claude has a Ph.D. in Soil Science from Laval University (Canada). His background is in research on soil erosion and associated water pollution, using conventional and radio-isotopic techniques. Claude was involved with the IAEA in the past years, through his participation in CRP F3.10.01 and D1.50.08. Before joining the IAEA, he worked as a researcher in soil and water conservation at the Québec Ministry of Agriculture, Fisheries and Food, and at the Research and Development Institute for the Agri-Environment also based in Québec. We welcome Claude to the Section and look forward to working with him.

Ms. Rebecca Hood-Nowotny left the Soil Science Unit at the FAO/IAEA Agriculture and Biotechnology Laboratory on May 10 after 7 years of service with the Agency. Rebecca joined the Soil Science Unit first as a consultant writing Standard Operating Procedures on total N and N-15 analyses in July 1996, and later she became a Staff Member of the Unit working on Plant Nutrition. Among her skills, her deep theoretical and practical knowledge of various methods used in soil science and crop nutrition should be mentioned. She has successfully developed an indirect isotope method to quantify nutrient availability from organic nutrient sources and this method is now being transferred to developing Member States as part of the Joint FAO/IAEA Programme. The scientific work that Ms. Hood-Nowotny produced during her stay at the Seibersdorf Laboratory has been published in several international scientific journals and conferences. We thank Rebecca for her excellent contribution to the work of the sub-programme and wish her and her family all the success for the future.

Future Events

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

First RCM of CRP on "Selection for Greater Agronomic Water Use Efficiency in Wheat and Rice Using Carbon Isotope Discrimination" (D1-20.08), 27 September-1 October 2004, Vienna, Austria

Seven research contractors from Algeria, People's Republic of China, India (2), Morocco, Pakistan and Yemen; two technical contractors from Australia and Mexico and two agreement holders from the Philippines (IRRI) and USA are expected to attend this meeting. The main purpose of this first coordination meeting will be to review the experimental plans of the participants and establish work plans, methodologies and protocols in accordance with the specific objectives of the CRP. To facilitate this process all participants will be requested to present a report highlighting their on-going work related to the project and specific activities planned for the CRP.

Second RCM of CRP on "Assess the Effectiveness of Soil Conservation Measures for Sustainable Watershed Management Using Fallout Radionuclides" (D1-50.08), 4-8 October 2004, Istanbul, Turkey

Twelve research contractors, one technical contractor and seven agreement holders are expected to participate to

this meeting. The local organizer is Dr. Sevilay Haciyakupoglu from the Istanbul Technical University. At the first RCM, the participants presented their objectives, approaches and work plans for the programme. Discussions were held on these elements, and several issues to be considered by the participating research teams were identified. The second RCM will allow participants to report on the work accomplished and the progresses achieved in their respective projects. The focus will be put on the results obtained from the application of standardized protocols and testing different models to convert radioisotope data (^{137}Cs, ^{210}Pbex, ^{7}Be) to soil movement data. If needed, modifications to experimental work plans will be suggested and discussed. Finally, activities for the next 18 months will be identified.

Fourth RCM of CRP on "Development of Management Practices for Sustainable Crop Production Systems on Tropical Acid Soils Through the Use of Nuclear and Related Techniques" (D1-50.06), 15-19 November 2004, Vienna, Austria

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

Third RCM of CRP on "Integrated Soil, Water and Nutrient Management for Sustainable Rice-Wheat Cropping Systems in Asia" (D1-50.07), 7-11 February 2004, Dhaka, Bangladesh

Seven research contractors from Bangladesh, China (2), India (2), Nepal, Pakistan, two technical contractors from Australia and the Philippines (IRRI) and two Agreement holders from Australia (CSIRO) and India (CIMMYT), are expected to participate in the meeting. The results obtained since the 2nd RCM will be reviewed and discussed and the main achievements evaluated according to the objectives of the CRP. The RCM will be held concurrently with the 13th Regional Technical Coordination Committee meeting of the Rice Wheat Consortium for the Indo Gangetic Plains.

IAEA Guest Meeting

1st Joint European Stable Isotope Users Group Meeting (JESIUM), 30 August-3 September 2004, Vienna, Austria

It is hoped the meeting will bring together as many national stable isotope groups as possible. To date these include:
- Stable Isotope Network Austria (SINA)
- Stable Isotope Mass Spectrometers Users Group (SIMSUG), UK
- Arbeitsgemeinschaft Stabile Isotope (ASI)/German Association for Stable Isotope
- Research (GASIR)
- Societe Française des Isotopes Stables (SFIS), French Stable Isotope Society
- Benelux IRMS Users Group

Please note we would be happy to include other national groups.

Stable isotope methodologies over the past few years have become a crucial research tool in a wide range of scientific fields. The purpose of the meeting is to bring together a wide range of stable isotope scientists from all over Europe, to encourage communication across disciplines and country boundaries. The meeting will provide an opportunity to discuss theoretical and methodological difficulties and to exchange techniques and ideas, a chance to discuss our successes and our failures.

Meeting themes:

- **Health and nutrition. Past and present**
  Convenors: Peter Schadewaldt, Olav Rooyackers
  Keynote speaker: Tasmin O'Connell

- **Isotope ecology**
  Convenors: Annette Gieseman, Pascal Boeckx
  Keynote speaker: Phil Ineson

- **Isotope physiology**
  Convenors: Richard Robins, Wolfgang Wanek
  Keynote speaker: Jeleh Ghashghaie

- **Hydrology and earth science**
  Convenors: Manfred Groening, Christoph Spötl
  Keynote topic: Beagle 2 Project. Mission to Mars.

- **Stable isotopes in the atmosphere and bio spheric exchange**
  Convenors: Francesca Cotrufo, Andreas Richter
  Keynote speaker: Nina Buchmann

- **Methodology**
  Convenors: Christophe R. Quetel, Tom Preston
  Keynote speaker: Willi Brand

- **A stable future!**
  Convenors: Roland Bol, Rebecca Hood
  Keynote speaker: Tom Conrads

The emphasis will be on practicalities. There will be a session dedicated to the presentation of interesting practical techniques. This will take place in the laboratory and shall have a number of stations where people can demonstrate their techniques either in real time, with video or with a computer. The best device, which has made the

work a lot easier, or novel approach presented will receive a prize. Young scientists in particular are encouraged to present their work and a prize will be awarded for the best presentation to someone under 35 years of age.

More details can be found out at:
http://chemsrv0.pph.univie.ac.at/JESIUM/
For enquires contact: jesium.oekologie@univie.ac.at
For the Scientific Committee please contact:
Dr. Rebecca Hood-Nowotny on:
Rebecca.Hood@chello.at

Non-FAO/IAEA Meetings

1) 13th International Soil Conservation Conference, 4-9 July 2004, Brisbane, Australia. Information on this conference can be found at http://ww.icms.com.au/isco2004

2) VIII European Society for Agronomy Congress, 11-15 July 2004, Copenhagen, Denmark. The theme of the conference is "European agriculture in a global context". More information can be obtained at http://www.esacopenhagen2004.kvl.dk/

3) 4th International Conference on Land degradation (ICLD4), 12-17 September 2004, Cartagena, Murcia, Spain. Further information about this conference can be found at http://www.upct.es/icld4

4) 5th International Symposium of the International Scientific Centre for Fertilizers (CIEC), 27-30 September 2004, Pretoria, South Africa. The theme of the conference is "Fertilizers and Fertilization for Sustainability in Agriculture: The First World Meets the Third World – Challenges for the Future. More information can be obtained at: http://www.up.ac.za/academic/plansoil/15ciec/

5) 4th International Crop Science Congress, 26 September-1 October 2004, Brisbane, Australia. Information on this congress can be found at:
http://www.cropscience2004.com

6) 3rd International Nitrogen Conference, 12-16 October, Nanjing, People's Republic of China
Information on this congress can be found at http://www.issas.ac.cn/n2004

7) XIV International Congress on Nitrogen Fixation, 28 October-01 November 2004, Beijing, People's Republic of China. Information on this congress, which was originally planned for 1-6 November 2003, and then postponed, can be found at: http://www.n2fix.com

8) Stable Isotopes Users Group (SIMSUG) Meeting, 10-13 April 2005, University of York, UK. Programme topics will be similar to the SIMSUG 2003 Meeting http://www.chm.bris.ac.uk/simsug/

9) 10th International Symposium on Nitrogen Fixation with Non-Legumes, 13-16 July 2005, Oaxaca, Mexico

10) XV International Plant Nutrition Colloquium, 14-19 September, Beijing, People's Republic of China. The theme for the colloquium is "Plant Nutrition for Food Security, Human Health and Environmental Protection". More information can be obtained at:
http://www.ipnc15.com

11) III World Congress on Conservation Agriculture, 3-7 October 2005, Nairobi, Kenya
The congress theme is "Linking production, livelihoods and conservation". More information can be obtained at http://www.act.org.zw/Congress/congress.htm

Technical Cooperation 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)

In East Asia and the Pacific region extensive land degradation and the conversion of agricultural land into other uses (urbanization, infrastructure and industrial development) are factors contributing to reduced agricultural productivity. The principal land degradation processes are nutrient depletion, acidification, salinization, pollution, and soil erosion. 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 utilization of marginal lands, and c) prevention and restoration of soil degradation.

The overall objective of this project is to develop improved soil, water, nutrient and crop management practices while counteracting predominant soil degradation processes in order to increase and sustain crop productivity. Two complementary approaches are utilized to achieve this main objective. Part I of this project deals with the restoration of soil fertility, and implementation commenced during the 2001-2002 cycle. The specific objective of Part II of this project is to measure soil erosion/sedimentation and associated pesticide contamination. For this purpose, the fallout radionuclide ^{137}Cs and related techniques are 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 carrier for pesticides that may become toxic to aquatic plants and animals. Conventional and radiotracer techniques are applied to assess potential pesticide contamination levels in soil, water and crops. This part of the project started with the project formulation meeting held in February 2002, Beijing, People's Republic of China and will be implemented through 2004. The mid-term project review meeting was held in Jakarta, Indonesia, 17-23 October 2003.

- **Regional Training Course on "Exchanging Experiences in the Use of the ^{137}Cs Technique in Soil Erosion/Sedimentation Studies", 5-9 July 2004, Kuala Lumpur, Malaysia**

This meeting was scheduled in Part II of the project. The purpose of the meeting is to review the participating countries' progress reports, to increase the skills in using ^{137}Cs data for assessing soil movement and to improve the understanding of the relationships between soil loss and soil quality degradation. The local organizer of the meeting is Dr. Zainudin Othman, of the Malaysian Institute of Nuclear Technology (MINT). Dr. Robert Loughran, from the University of Newcastle (NSW-Australia), will provide a lecture to the participants.

- **Final Project Evaluation Meeting of Part I "Integrated Nutrient, Crop and Water Management Practices for Increased Crop Production", 6-10 September 2004, Bangkok, Thailand**

The main purpose of this meeting will be to review the overall achievements of Part I of the project. It is anticipated that all counterparts from countries in the project (Bangladesh, People's Republic of China, India, Indonesia, Republic of Korea, Malaysia, Mongolia, Pakistan, Philippines, Sri Lanka, Thailand and Viet Nam) will attend this meeting. All participants will be requested to present a report highlighting the major achievements of the project and these will be critically evaluated in line with the specific objectives. The local organizer of the meeting is Ms. Jaria Prasatsrisupab, Nuclear Research in Agriculture, Department of Agriculture, Bangkok and the meeting will be held at the Kasetsart University-Home, Bangkok.

Past Events

Technical Cooperation Projects (TCPs)

FAO/IAEA TCP on "Improvement of Crop Productivity" (IVC/5/025)

This project was aimed at improving the productivity of coconut groves planted on quaternary sandy soil along the Cote d'Ivoire seashore through their association with legume trees. Old coconut groves are not productive and should be replanted; but resource-poor farmers have no means for buying mineral fertilizers. In previous research, it was shown that associated legume trees could provide N for coconut. From the very beginning small producers were involved in this project with the help of the regional Extension Services. Four 12-ha demonstration pots were established along the seashore at Assinie Canal, Jacqueville, Grand-Lahou and Modeste (Grand Bassam).

After four years of implementation, the following outputs/outcomes were achieved:

1. From the socio-political standpoint:

- Seashore coconut planters are very well informed and are adopting the new technology
- Regional Extension Services are also informed and trained for the technology transfer
- Decision-makers were made aware of the issue; they fully understood the support the smallholder farmers will need if old groves are be cut down with no income for several years.

2. From the scientific standpoint:

- Several research technicians have been trained at monitoring of soil water transfers using soil moisture neutron probes and sets of tensiometers
- Three researchers have been trained in isotopic techniques in agriculture: nitrogen-15 labelled fertilizer was used for measuring biological nitrogen fixation and mineralisation of soil organic matter
- One scientific article was published: N'goran A., Zakra N., Yoro G., Ballo K. et Cleemput ON. (2003). Evaluation de la productivite dune association cocotier/legumineuses arborees agee de quinze ans. Agronomie Africaine 15 (2):51-60.
- Two scientific articles are in preparation:

*N'goran A., Ballo K, Zakra N., Zapata F. et Cleemput O. V.: Estimation de la fixation biologique de 1'azote par Acacia auriculiformis Cunn. ex Benth. et Acacia mangium Wild. sur sable quaternaire en Côte-d'Ivoire.

*N'goran A., Ballo K, Zakra N., Kouame C., Zapata F. et Cleemput O.V.: Decomposition de litiere d'Acacia auriculiformis Cunn. ex Benth. et Acacia mangium Wild. sous cocotiers plantes sur sables quaternaires en Côte d'Ivoire,
- One Ph.D. thesis is in preparation.

Fuelwood (Acacia spp.) harvested in a coconut plantation in Côte d'Ivoire

FAO/IAEA TCP on "Increasing the Productivity of Crop/Livestock Production System" CPR/5/014)

The objective of this project is to increase livestock production in Northwest China using appropriate feed supplementation strategies coupled with achieving a sustainable increase in wheat and rice production through the application of biofertilizers. The Project is being implemented at the Gansu Agricultural University, College of Grassland Science, Lanzhou, People's Republic of China. The Technical Officer, Mr. Gudni Hardarson, travelled to Lanzhou from 21-28 November 2003 to review progress on the application of biofertilizers, revise the work plan and guide the counterpart on the application of nuclear techniques.

TCP proposals for the 2005-06 cycle

The technical evaluations of proposals for 3 regional projects and 28 national projects from 24 Member States in all regions were completed on May 14 by professional staff in the Section and the Soil Science Unit. The combined technical expertise of all staff was required to complete the evaluations, as all of the various aspects of soil, water and nutrient management were addressed in the proposals.

Staff Training

FANci Breath Test Analyser (Ms. Maria Heiling), 3-5 November 2003, Leipzig, Germany

The purpose of the travel was to undergo detailed technical training on the ^{13}C analyser and to discuss the modified new software of the FANci-2 analyser with the developer of the equipment.

The FANci breath test analyser is an instrument developed to determine $^{13/12}CO_2$ in breath samples. The principle of measurement is based upon the specific absorption of infrared light (NDIR: Non-depressive Infrared Spectroscopy) and the main field of application is human medicine, in particular the diagnosis of *Heliobacter pylori* and liver function disorders. In conjunction with methods developed in the Seibersdorf laboratory this equipment could be a useful tool in soil carbon research particularly in developing Member States.

APSIM Simulation Model (Ms. Lee Heng), 24 November-5 December 2003, Perth, Western Australia

Ms. Lee Heng visited Dr. Senthold Asseng at the CSIRO Division of Plant Industry to work on APSIM simulation using wheat data collected from the 'Rainfed CRP'. The purpose was to evaluate the various cropping options, water management, N fertilizer (rate and timing), cultivars, planting dates, for short- to long-term sustainability of crop productivity in developing countries. The simulation results carried out on data from Jordan and Morocco indicated that yield was limited by rainfall and its distribution. Nitrogen fertilizer is needed to increase yield in the wet years; however, the effect can be detrimental in dry years. The results also indicated that having initial stored soil moisture was beneficial in the dryer years; early planting after the first rains and the use of early maturing cultivars are both important, to escape the terminal drought experienced in these regions.

Non-FAO/IAEA Meetings

Nitrogen Fertilizer Rapid Assessment Project (NFRAP) Workshop, 12-16 January 2004, Kampala, Uganda

The workshop was organized under the auspices of SCOPE (Scientific Committee on Problems of the Environment). The workshop is the first of a series of Rapid Assessment Workshops to be organized within the International Nitrogen Initiative (INI), where various components of the global nitrogen cycle will be examined in detail to determine the state-of-the-art and future directions and research needs. The objective of the workshop was to assess the fate of synthetic fertilizer N in the context of the overall N inputs to agricultural systems, with a view to enhancing the efficiency of mineral N use and reducing negative impacts on the environment.

Approximately 45 participants drawn from advanced research institutes, national agricultural research systems, the fertilizer industry (represented by IFA) and international organizations (IAEA, IRRI, IFDC, TSBF/CIAT) participated in the workshop.

The workshop was opened in plenary with a keynote presentation by Dobermann and Cassman on "Environmental dimensions of fertilizer N: what can be done to increase nitrogen use efficiency and ensure global food security?"
The workshop was then organized under four cross cutting topics/working groups (WG):
1. Efficiency of N fertilizer use as determined by product, method and time of application, soil, crop and their interactions.
2. Role of emerging technologies on the efficiency of N fertilizer use.
3. Pathways of N loss and their impacts on human health and the environment.
4. Societal response to meeting N input needs in different regions.

Mr. Phillip Chalk participated as a discussant in WG 2, and refereed two background papers:
(i) "An assessment of fertilizer nitrogen recovery efficiency by grain crops across scales" by Krupnik et al.
(ii) "Regional variation of nitrogen inputs and sources" by Boyer et al.

Each working group produced a draft review or synthesis paper covering the background paper topics and other relevant information. The output from the workshop will be a book published by Island Press in the SCOPE Rapid Assessment Project Series, to be distributed at the third International Nitrogen Conference, 12-16 October 2004, Nanjing, People's Republic of China.

The workshop provided an important forum for the presentation and discussion of the latest information and research approaches on the global N cycle. It addressed the often-opposing interests of producing more food while exercising responsible natural resource management. Better management of N fertilizer can reduce N losses, increase N fertilizer use efficiency by crops and reduce environmental pollution while maintaining or increasing crop yields and quality. This is one of the major goals within several of the coordinated research projects (CRPs) within sub-programme E1, as well as several technical cooperation projects (TCPs). The stable isotope, ^{15}N has a direct role to play in estimating fertilizer N use efficiency and fertilizer N losses. Thus, our CRPs on rice wheat systems and conservation agriculture were seen to be highly relevant to the objectives of the workshop and to the global challenge of increasing resource use efficiency overall.

Joint SIBAE (Stable Isotopes in Biospheric-Atmospheric Exchange) – BASIN (Biosphere – Atmosphere Stable Isotope Network) Conference, 1-3 April 2004, Interlaken, Switzerland

The aim of SIBAE and BASIN is to improve the understanding of carbon cycle processes in the atmosphere and biosphere (terrestrial and aquatic ecosystems) using variations in the natural abundance of the stable isotopes of carbon and oxygen. This joint conference follows a meeting in Banff, Canada, May 12–14, 2002, and a workshop in Orvieto, Italy, November 18–21, 2003, where the state-of-the-art was presented and the latest developments were reviewed

The analysis of carbon isotope ratios ($\delta^{13}C$) in plant and soil material as well as CO_2 proved to be a useful tool to address global changes in carbon stocks at various temporal and spatial scales. The measurement of ^{13}C in atmospheric CO_2 provided a scientific breakthrough by allowing the partitioning of atmospheric CO_2 exchange between the ocean and the terrestrial biosphere. It is anticipated that the use of ^{18}O in CO_2 will bring the next breakthrough by allowing the partitioning of terrestrial CO_2 exchange between photosynthetic uptake and soil respiration. $\delta\ ^{13}C$ ratios in atmospheric CO_2 decreased by -0.025 ‰ per year during the 1980's, but approached almost zero between 1990 and 1993. Understanding such changes in the isotopic signatures of CO_2 requires detailed knowledge about the ^{13}C signatures of different compartments and fluxes in terrestrial ecosystems and the ^{13}C fractionation, taking place during the biospheric CO_2 exchange with the atmosphere.

Ms. Maria Heiling, Soil Science Unit, participated in the conference and presented a poster jointly authored with Ms. Hood-Nowotny titled "The influence of soil temperature and N fertilization on below-ground carbon allocation and turnover of maize".

Conference on Women and Sustainable Rural Development in Europe, 07-10 June 2004, Nicosia, Cyprus

This conference was organized at the Cyprus Agricultural Research Institute under the auspices of the EU. Ms. Lee Heng presented an invited paper on "FAO/IAEA activities in soil and water management and crop nutrition: improving livelihoods and food security".

Status of Coordinated Research Projects

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

Project Officer: P.M. Chalk

This CRP commenced on 1 October 2001 with an anticipated duration of five 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, P.R. of), Jiarong Pan (China, P.R. of), 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: E. Humphreys (CSIRO-Australia) and R. Gupta (CIMMYT-India). The first RCM and training workshop was held 4-8 March 2002, in Vienna and Seibersdorf, Austria. The second RCM was held 08-12 September 2003, in Nanjing, People's Republic of China, and the third RCM is planned for Dhaka, Bangladesh, in February 2005. The CRP was reviewed after the second RCM and has been approved for five years.

Selection for Greater Agronomic Water-Use Efficiency in Wheat and Rice Using Carbon Isotope Discrimination

Project Officer: R. Serraj

This CRP commenced on 1 November 2003 with an anticipated duration of five years. 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) to develop within (a) 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 programme scientists to determine the most effective breeding strategies for application of carbon isotope discrimination in their environments.

Seven research contractors from Algeria, People's Republic of China, India (2), Morocco, Pakistan and Yemen; two technical contractors from Australia and Mexico and two agreement holders from the Philippines (IRRI) and USA have been selected for this CRP
Details can be obtained at:
http://www.iaea.org/programmes/nafa/d1/crp/list-part-d12008.pdf
The first RCM will be held from 27 September to 1 October 2004, the IAEA Headquarters in Vienna, Austria.

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

Project Officer: R. Serraj

Participating in this CRP are nine contract holders: K. Aihou (Benin), B. Zhang (People's Republic of China), C. Ovalle Molina (Chile), C. Cervantes (Costa Rica), J.M. Ndufa (Kenya), Z. Rahman (Malaysia), S. Nissanka (Sri Lanka), P. Ebanyat (Uganda) and R. Chintu (Zambia); and five agreement holders: M. Adams (Australia), S. Recous (France), L. Verchot (ICRAF-Kenya), N. Sanginga (TSBF-CIAT, Kenya) and M. Smith (UK). Participants have established links with CGIAR centres (IITA, ICRAF), international funding institutes (IFS, DFID, USAID) and a range of national institutes for effective implementation of the project activities. Through these linkages they have been able to obtain considerable financial and human resources in addition to the inputs from the Agency. The experimental work is progressing well in line with the main objectives and the project is well positioned for significant contributions in understanding the role of trees in agricultural systems and in contributing to the development of improved agroforestry systems. It is encouraging to note that the contract holders are actively involved in dissemination of information emanating from this project to end-users through presentations at national and international meetings and publications in scientific journals. The third RCM was held in Colombo, Sri Lanka in June 2003 and the fourth and final RCM will be held in 2005.

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 (Consultant)

This CRP commenced 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); 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 third RCM was held in Ouagadougou, Burkina Faso, 18-22 August 2003. For details on the meeting refer to the Past Events Section. The progress made in implementation of the CRP is satisfactory. Individual work plans were updated and issues for completion of the CRP were defined.

More research is needed to identify mechanisms of Al-resistance and P-efficiency, and methods to characterize/evaluate crop genotypes adapted to acid soil (Al toxicity and low P) conditions. Also, long-term field studies to assess the sustainability of improved agricultural production practices are required. In this respect, a series of recommendations were provided and are included in the report of the meeting that is available at: http://www.iaea.org/programmes/nafa/d1/crp/3rcm.burkinafaso.pdf

The fourth and final RCM will be held in Vienna, Austria, 15-19 November 2004.

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

Project Officer: C. Bernard

This CRP was approved in March 2002 and commenced this year with an anticipated duration of five years (2003-2007). This project will be implemented together with another 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 ^{7}Be 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 (People's Republic of China), Xinbao Zhang (People's Republic of China), M. Benmansour (Morocco), M. Rafiq Sheikh (Pakistan), W. Froehlich (Poland), Nelu Popa (Romania), V. Golosov (Russia), S. Haciyakupoglu (Turkey), and Hai Son Phan (Viet Nam); one technical contractor: D.E. Walling (UK) and seven agreement holders: P. Wallbrink (Australia), A. Klik (Austria), D. Lobb (Canada), J. Onda (Japan), H. Liniger (WOCAT-Switzerland), J. Ritchie (USA), T. Yang (USA), are currently participating in the project. The participants are representing multi-disciplinary and inter-institutional teams involved in soil erosion/sedimentation research. The individual studies cover a wide range of conditions (land use, environment, spatial scales) that should allow a robust testing of the potential of the FRNs to assess the efficiency of soil conservation practices. The first Research Coordination Meeting plus technical workshop was held in Vienna and Seibersdorf, Austria, 18-22 May 2003. The next RCM will be held in Istanbul, Turkey, from 04 to 08 October 2004.

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 project are included in their Newsletters and corresponding websites.

Integrated Soil, Water and Nutrient Management in Conservation Agriculture

Project Officer: C. Bernard

This CRP was approved in October 2003, with an anticipated duration of 5 years. It was advertised in the previous Newsletter. Proposals for research contracts and agreements are due by 31 July 2004. The first RCM is planned for March 2005.

Laboratory Activities

Research

"Below ground nitrogen in soybean"
M. Aigner, M. Heiling and G. Hardarson

Most studies using ^{15}N isotope dilution methodology on biological nitrogen fixation (BNF) have concentrated on the above ground plant parts and below ground N (BGN) has been largely ignored. Due to the lack of measurements of BGN the N contribution of leguminous crops in cropping systems has been largely underestimated with the N balance often being reported negative after legume growth when it should have been positive had the BGN been considered.

Several scientists have recently published data on BGN measurements using ^{15}N foliar labelling methodologies. These papers have revealed large proportions of legume N or legume-derived N below ground in roots and adjacent soil. As an example the data of Khan et al. (2002) is presented in Table 1.

Table 1. Below ground recovered ^{15}N in several legumes (Khan et al. 2002)

Crop	Below ground recovered ^{15}N (% of total recovered ^{15}N in crop)
Fababean	32
Chickpea	35
Mungbean	11
Pigeonpea	42
Wheat	5

Greenhouse experiments were conducted at the Seibersdorf Laboratory to quantify the amount of N below ground. The stem ^{15}N labelling technique of McNeill (1999) was used to label the soybean plants including root systems. The soybeans were grown under greenhouse conditions in pots with 1 kg of soil. Stem labelling was performed 14 days after sowing by inserting a thread connected to a vial through the stem. The vial contained 2 ml of 0.075M urea solution having 94 atom % ^{15}N excess. 4.23 mg ^{15}N was applied to soybean and the ^{15}N recovery measured in shoots, roots and soil (Table 2). Parallel experiments were conducted to quantify biological nitrogen fixation by the soybean using the ^{15}N isotope dilution method.

Table 2. ^{15}N recovery in the various plant parts of three soybean cultivars as well as soil when the ^{15}N was applied through stem labelling

			[mg] ^{15}N (% recovery)				
Variety	Harvest* (DAP)	Applied	Straw	Pods	Roots	Soil	Total
Chippewa	1 (27)	4.23	2.95 (69.7)	-	0.47 (11.2)	0.045 (1.1)	3.47 (82.0)
	4 (72)		1.04 (24.6)	1.07 (25.3)	0.61 (14.5)	0.225 (5.3)	2.95 (69.7)
M129	1 (27)	4.23	3.42 (80.9)	-	0.36 (8.5)	0.038 (0.9)	3.82 (90.3)
	4 (72)		1.60 (37.8)	0.59 (13.9)	0.67 (15.8)	0.199 (4.7)	3.05 (72.2)
Clay	1 (27)	4.23	3.33 (78.6)	-	0.35 (8.3)	0.054 (1.3)	3.73 (88.1)
	4 (72)		0.63 (14.8)	1.58 (37.4)	0.53 (12.6)	0.232 (5.5)	2.98 (70.3)

*Results from harvests 1 and 4 only.

Table 2 illustrates good total recovery of the applied ^{15}N. The time course shows that at 27 DAP most of the ^{15}N was found in the straw and roots. Only about 1% of the applied ^{15}N was found in the soil at that time. At 44 DAP the ^{15}N in roots had already reached maximum level (Data not shown). Later in the growing season there was translocation of N from the straw to pods in the above ground plant parts. During the growing season there was a continuous increase of ^{15}N in the soil from approximately 1 to 5 % of the applied ^{15}N.

Previous greenhouse experiments have shown that approximately 10-11% of dry matter or total N of soybean is in the recoverable roots. This is significantly lower than the below ground %^{15}N recovery in the present experiment, which was approximately 25-27 %, i.e. 17-21% in the roots and the attached soil and 6-8% in the soil (Fig. 1). This is a much higher value than the amount of dry matter or total N in soybean root.

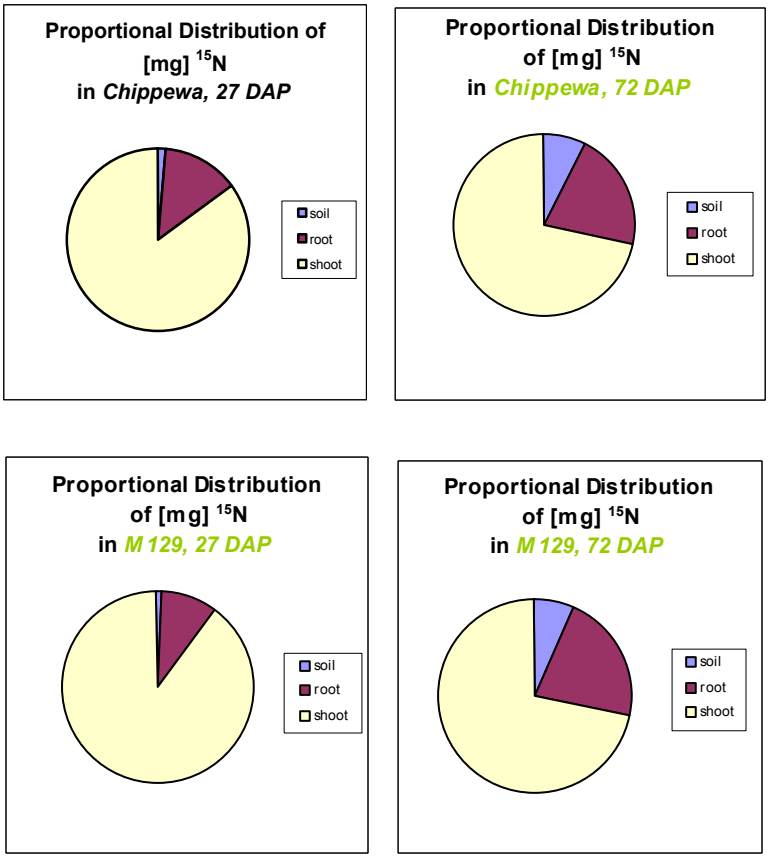
Also, it could be observed that below ground N increased with time. At 27 DAP below ground N was 10-14 %, at 44 DAP 20-22 %, at 58 DAP 22-29 % and at 72 DAP 25-27%.

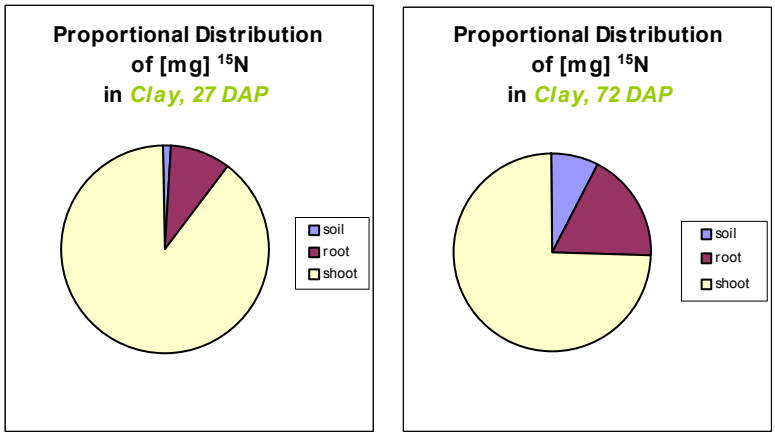
References

Khan DF, Peoples MB, Chalk PM and Herridge DF (2002). Quantifying below-ground nitrogen in legumens. 2. A comparison of ^{15}N and non-isotopic methods. *Plant and Soil* 239:277-289.

McNeill A (1999) Enriched stable isotope techniques to study soil organic matter accumulation and decomposition in agricultural systems. *In*: Application of Stable Isotope Techniques to Study Plant Physiology, Plant Water Uptake and Nutrient Cycling in Terrestrial Ecosystems. CLIMA, Nedlands, Australia, pp. 105-119.

Fig. 1. Proportional distribution of recovered ^{15}N in three soybean cultivars, harvested at 27 and 72 days after planning (DAP)





"Carbon isotope discrimination, grain yield and WUE of wheat under semi-arid and arid environments"
L.K. Heng

Low and unpredictable rainfall is a major factor affecting the agricultural productivity in many parts of the world. Appropriate water management practices together with the use of drought tolerance crop genotypes are some of the strategies, which can help to increase crop productivity in these tough environments.

The carbon isotope discrimination (Δ) technique has been used as a screening tool for improving water-use efficiency (WUE) and yield in several crops. However, Δ is influenced by both the stomatal conductance and photosynthetic capacity of mesophyll during the growth period, and so many internal and external factors such as salinity, soil moisture supply and nitrogen level can affect these values. As a result, highly variable relationships between yield and/or WUE and Δ have been reported, ranging from strongly positive to strongly negative, making it difficult sometimes to use Δ as a water stress assessment tool. In order to better utilize Δ as a diagnostic tool, the influence of the various attributes on Δ, yield, and drought tolerance must be better understood.

This report is a synthesis of Δ, yield and WUE data of wheat carried out as part of "Management of Nutrients and Water in Rainfed Arid and Semi-Arid Areas for Increasing Crop Production" Coordinated Research Programme (CRP) (see http://www.iaea.org/programmes/nafa/d1/index.html). The CRP covered a wide range of crops in the arid and semi arid regions. The objective was to determine if relationships exist between the above traits for wheat and if Δ was a suitable selection tool for yield and WUE.

The experimental data were collected from plant samples taken during harvest from field experiments in the following countries: People's Republic of China, India, Jordan, Morocco and Pakistan. They were ground before analysed for $\delta^{13}C$ by a mass spectrometer at the FAO/IAEA's laboratory in Seibersdorf, Austria. The results of carbon isotope ratio were expressed in the delta notation as $\delta^{13}C$ (‰)

$$\delta^{13}C_{sample}(‰) = (\frac{R_{sample}}{R_{standard}} - 1)\, x\, 1000,$$

where $\delta^{13}C_{sample}$ is the isotope ratio in parts per mil (‰), R_{sample} and $R_{standard}$ are the $^{13}C/^{12}C$ molar abundance ratios of the plant material and the Pee Dee Belemnite (PDB) standard, respectively. The data were re-expressed as carbon isotope discrimination (Δ) using the following equation:

$$\Delta(‰) = \frac{\delta^{13}C_{air} - \delta^{13}C_{sample}}{1 + \delta^{13}C_{sample}}$$

where $\delta^{13}C_{air}$ is assumed to be -8‰ relative to PDB, a value which is widely used for free atmospheric CO_2.

The results showed that there was genotypic variation in carbon isotope discrimination within plant organs in wheat, with Δ values lowest in the grain component. There was also genotypic variation in Δ in different environments, with Δ lowest in the driest regions (Jordan compared with People's Republic of China, the latter has a higher growing season rainfall). There were also good correlations between Δ and grain yield in all studies; however, the correlations were negative in two (People's Republic of China and India) and positive in the other three countries (Jordan, Morocco and Pakistan), indicating different factors were responsible for the variation in Δ. Positive correlations are often observed in field trials especially in the Mediterranean or similar environments where there is a strong reliance on within-season rainfall.

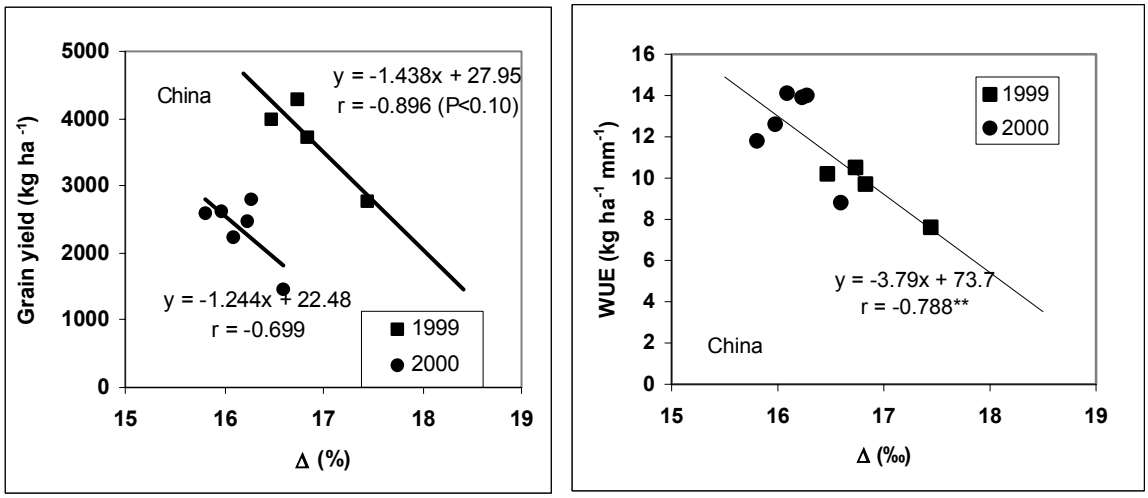


Fig. 1. The relationship between Δ and grain yield (left) and WUE (right) of wheat for People's Republic of China. $^{**}P<0.01$

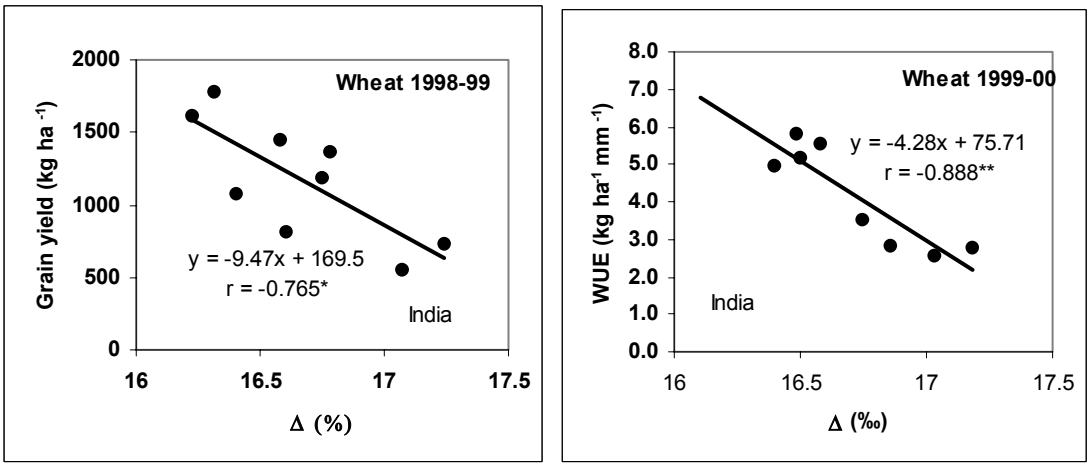


Fig. 2. The relationship between Δ and grain yield (left) and between Δ and WUE (right) for India $^{*}P<0.05$, $^{**}P<0.01$

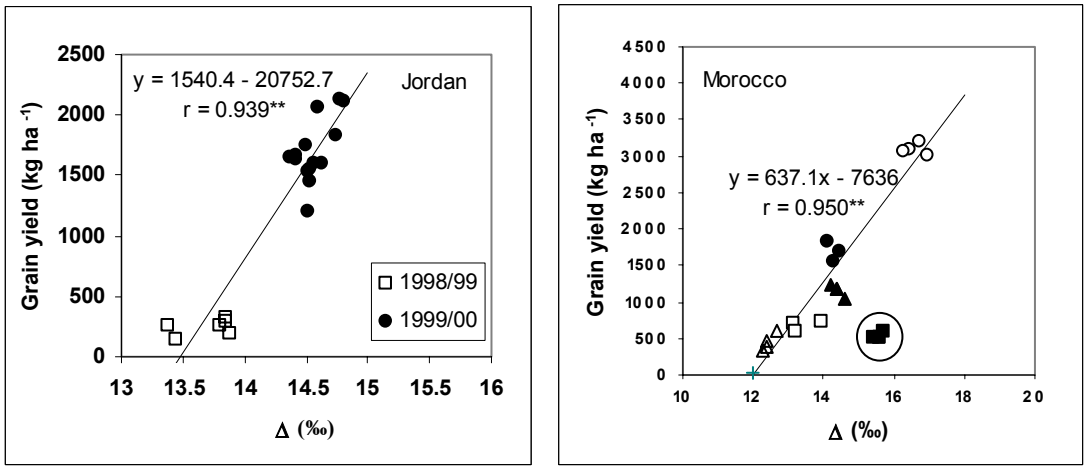


Fig. 3. The relationship between Δ and grain yield in Jordan (left) and Morocco (right)

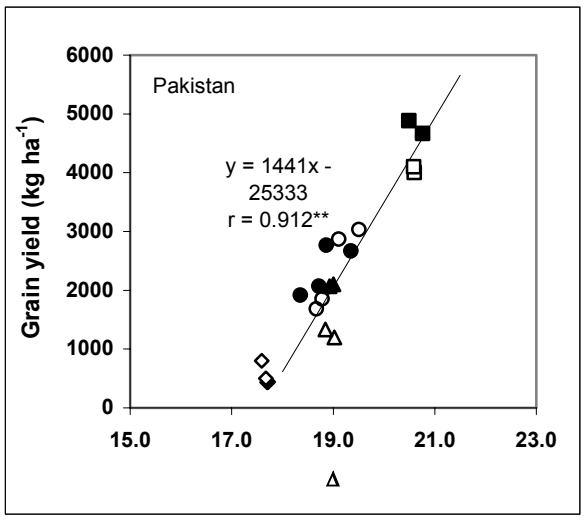


Fig. 4. The relationship between Δ and grain yield conducted at NIFA and at farmers' fields in Pakistan

The above contrasting results showed that it is difficult to predict the outcome in a particular environment and in using Δ as a selecting tool for yield and WUE.

Training

Fellowships

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

Mr. R. P. Nallahandy (SRL/03014P) received training on the use of isotope tracer technology to measure biological nitrogen fixation and conducted an experiment on early nodulation and biological nitrogen fixation in soybean under the supervision of Mr. Gudni Hardarson.

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

Supportive Services

Isotope Analysis

The Soil Science Unit performed more than 10,000 stable isotope measurements on approximately 4,500 samples during 2003. Of these analyses more than 2,000 were at natural abundance and approximately 4,000 at enriched levels.

The table shows a significant reduction in the number of samples received where just ^{15}N analysis at an enriched level is requested from more than 6000 samples in the previous years to 3700 in 2003. These types of samples can be measured by an emission spectrometer like the NO-I7. A mass spectrometer is not necessary and therefore with the benefit of external quality assurance many Member States are now doing their own analyses of enriched ^{15}N samples. However, requests for analysis at natural abundance have increased over the past years, i.e. $^{15}N/^{14}N$, $^{13}C/^{12}C$, $^{18}O/^{16}O$ and are now nearly half of the samples analysed. These analyses can only be performed by mass spectrometry and many Member States lack facilities for such analyses.

Number of samples analysed by the Soil Science Unit as well as total number of measurements done in previous years:

Year		2003	2002	2001	2000	1999
	CRP	3228	5019	4923	5048	5624
	TC	373	402	752	413	498
	Seibersdorf research	994	1006	3409	5109	3832
Total number of samples		**4595**	**6427**	**9084**	**10570**	**9954**
Requested analysis:	^{15}N enriched	3671	5667	8875	10076	9694
	^{15}N nat.ab.	233	39			
	^{13}C nat.ab.	1374	3407	2846	2964	2268
	^{16}O nat.ab.	546	219	62	105	
Total number of analyses		**5824**	**9332**	**11783**	**13145**	**11962**
Total number of measurements		**10406**	**16640**	**19167**	**17952**	**15580**

Proficiency Testing Exercise "EQA2003"
M. Aigner

The seventh round of proficiency testing in ^{15}N and total N analyses of plant materials was conducted during the period January to October 2003.

As in the previous years a test panel containing three different plant materials with unknown ^{15}N abundance and total N contents, including instructions for results reporting, was sent to each participating laboratory. Five months (April to August 2003) was given to submit the results. The choice of the instruments and methods was up to the participants. A certificate covering the period of the year 2003 and stating the successful participation in the exercise is provided to those labs that submitted "class I results", i.e. fully within the accepted control limits set by the Soil Science Unit.

Thirty-five applicants were provided with the test panel, twenty-three laboratories (i.e. 66 %) reported within the deadline (Table 1). Four laboratories reported technical problems, one did not receive the test panel and one lab sent a technician for training and will do the analysis afterwards. Six laboratories did not report or give any explanation. An increasing number of laboratories (Belgium, Brazil, P.R. of China, Kazakhstan, New Zealand, Pakistan and Thailand) are using a mass spectrometer for ^{15}N abundance determination, while the rest used emission spectrometers.

Eleven laboratories (Argentina-2 labs), Belgium, Chile, Côte d'Ivoire, Iran, Mauritius, Poland, Syria, Turkey and Uzbekistan received certificates.

Table 1.: Summary of response

Region	Number of participating laboratories	Number of laboratories receiving the certificate	Number of laboratories producing satisfactory results	Number of laboratories producing results outside control limits	Number of laboratories not submitting results
Africa	10	2	1	2	5
Latin America	7	3	2	0	2
East Asia & the Pacific	9	0	3	2	4
West Asia	5	3	1	1	0
Europe	4	3	0	0	1
TOTAL	35	11	7	5	12

The Islamic Republic of Iran is a newcomer in the EQA-project and the laboratory showed an outstanding performance in the first proficiency testing exercise.

Laboratories in Argentina-1, Argentina-2, Brazil, Chile, Côte d'Ivoire, Syria, Turkey and Uzbekistan showed a sustainable and good performance in the last three to seven years.

The Department of Agriculture in Thailand has started with ^{13}C measurements at the natural abundance level and received a standard material for testing from the Soil Science Unit. It will be the first lab to start with a proficiency testing exercise on ^{13}C abundance and total carbon analysis in plant materials next year in the frame of EQA2004.

It is also planned to produce a ^{15}N labelled soil reference material in 2004 and include analysis of ^{15}N abundance and total N in soil in future proficiency testing exercises.

Publications

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Hardarson, G (2004). Enhancement of Symbiotic Nitrogen Fixation in Grain Legumes: Selected Results from the FAO/IAEA Programme, *In* Symbiotic Nitrogen Fixation ed. R. Serraj. Oxford & IBH Publishing Co., New Delhi, pp. 163 – 172.

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International Atomic Energy Agency
Wagramer Strasse 5, P.O. Box 100,
A-1400 Wien, Austria

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