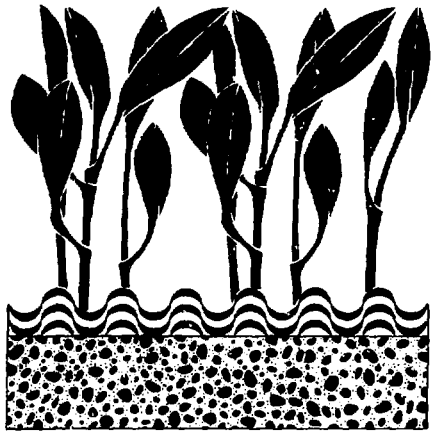

Soils Newsletter

JOINT FAO/IAEA DIVISION
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ADDENDUM

1. The 2nd. paragraph from the bottom of page 2, concerning the title of the training course in Seibersdorf Laboratory should be corrected to read

..."The Use of Isotopes and Radiation Techniques in Studies of Soil/Plant Relationships with emphasis on Soil Water Management Practices"...

2. On page 9, under FAO/IAEA Training Course Announcements, the title and the date of the interregional training course in Seibersdorf Laboratory be corrected to read

Title:

1. The FAO/IAEA INTERREGIONAL Training Course on "The Use of Isotopes and Radiation Techniques in Studies of Soil/Plant Relationships with Emphasis on Soil Water Management Practices".

Date

31 May - 9 July, 1993

We are sorry for the inconvenience.

TO OUR READERS

Welcome again to our Soils Newsletter, the first one for 1992.

On behalf of my colleagues in the Soil Fertility, Irrigation and Crop Production Section and the Soil Science Unit at the IAEA Seibersdorf Agricultural Laboratory, may I express to all readers our gratitude for your valuable comments and suggestions concerning the improvement of our Soils Newsletter. As usual, we have a number of things to tell you:

As our readers are already informed, we have 6 Co-ordinated Research Programmes (CRPs) in progress, but beginning from 1993 we plan to initiate some new CRPs on "The Use of Nuclear and Related Techniques in the Evaluation of the Agronomic Effectiveness on Phosphate Fertilizers, in particular Rock Phosphates", and "Improving the Nitrogen Use Efficiency of Irrigated Wheat in the Developing World", in co-operation with CIMMYT from Mexico and IFDC from the USA. These CRPs are to be implemented within the framework of the programme area "Optimizing the Use of Plant Nutrients for Sustainable Agricultural Practices and Environmental Protection".

One Research Co-ordination Meeting was held in the first semester of 1992 on "The Use of Nuclear and Related Techniques in Assessment of Irrigation Schedules of Field Crops to Increase the Effective Use of Water in Irrigation Projects", in Vienna, from 3 to 7 February, and an FAO/IAEA Consultants Meeting on "The Preparation of a Manual for Measuring Greenhouse Gases from Agriculture", held also in Vienna, from 7 to 10 April. The manual is planned to be published as a IAEA-TECDOC, in the second semester of 1992.

The staff from our Section continually provided technical assistance for 65 technical co-operation projects for the Member States in Africa, Asia and Pacific, Latin America, Middle East and Europe. I strongly believe that by adequate technology transfer to the Member States, the desired objectives - to increase food production - will be achieved.

Two training courses were held in the first semester of 1992: The FAO/IAEA Interregional Course on "The Use of Isotope and Radiation Techniques to Enhance Biological Nitrogen Fixation" in Seibersdorf, Austria, from 1 June to 3 July, and the FAO/IAEA Regional Course on "The Use of Isotope and Radiation Techniques in Studies of Soil/Plant Productivity" at the Chilean Commission of Nuclear Energy in Santiago, Chile, from 23 March to 24 April. Both training courses were very rewarding and successful.

In 1993, we will organize one FAO/IAEA Interregional Training Course on "The Use of Isotopes and Radiation Techniques in Studies of Soil/Plant Relationships with Emphasis on Crop Production on Acid Soils", in Seibersdorf and Vienna, Austria, and one FAO/IAEA Regional Training Course in Ankara, Turkey, on "The Use of Nuclear and Related Techniques in Studies on Soil/Plant Relationships with Emphasis on Salt-affected Soils".

Before I end this foreword, I would like to welcome Dr. Waldemar Klassen as a new Deputy Director of the Joint FAO/IAEA Division, to wish him lots of success and to thank all of my colleagues at all levels, both at Headquarters and in the Soils Unit from the Seibersdorf Laboratory, for their contribution to our programmes. Also, I would like to remind all our readers that any

relevant contribution on the recent advances in nuclear and related techniques in soil fertility, plant nutrition, irrigation and crop production research will be published in our Newsletter. I would be very pleased to receive your valuable comments and suggestions for future improvement of our publication.

I wish you all the best.

Christian Hera, Section Head.

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3. Staff Change

As you must have noticed, there has been a change of post in Headquarters. Dr. Cevat Kirda is getting ready to leave us and to go back to Turkey. As Mr. Kirda was the Technical Officer of some 22 Technical Co-operation Projects and in charge of two Co-ordinated Research Programmes, he was contracted as an in-house expert until 31 October 1992, in order not to distrupt these activities. It is hoped that this arrangement would bridge the gap until his successor is recruited, and our programmes would not suffer in the meantime.

Marius Willem Quist from the Agricultural University Wageningen, Netherlands, with a master degree in tropical and temperate forestry, specialized in ecology, forest operations and management, joined us in May 8, 1992. After his first assignment as an APO in Senegal, he is now working in the Seibersdorf Laboratory on the greenhouse gases effect and the measurement of soil erosion using the Cs-137 radio-isotope technique.

Ingrid Puschnig, Austrian, who was working for the last 15 years with the Department of Safeguards, joined us on March 10, 1992, as our Section secretary. All our staff wishes her a very warm welcome and all the best.

CO-ORDINATED RESEARCH PROGRAMMES

A. IN PROGRESS

1. Increasing and Stabilizing Plant Productivity in Low Phosphate and Semi-arid and Sub-humid Soils of the Tropics and Sub-tropics

(Project Officer: Saliya KUMARASINGHE)

A mid-term review of this programe was conducted by Dr. V. Middelboe (Royal Veterinary and Agricultural University, Fredereiksberg, Denmark) in December 1991, visiting the IAEA Headquarters and the Agency's Laboratories in Austria, and the contract holders in Kenya, Morocco and Tunisia. The mission concluded that the programme is making satisfactory progress and recommended that SIDA's financial support towards this programme be continued for at least another 2 years. Based on this and the annual review of the SIDA projects held in Vienna in April 1992, we are pleased to report here that SIDA was recommended an extension of this programme for a total duration of 5 years, ending in 1994. The present contract holders (10) are: Messrs. M. Abdou (Egypt), I. Ofori (Ghana), D.O. Nyamai (Kenya), M. Bazza (Morocco), N. Afolabi (Nigeria), L. Cisse (Senegal), D. Amara (Sierra Leone), A. Mustafa (Sudan), M. Mechergui (Tunisia), and Ms. Bui Thi Hong Thanh (Vietnam). In addition, there are five agreement holders: Messrs. W. Horst (Germany), N. Sanginga (Nigeria), A. Haystead (New Zealand), P. Hoegberg and K. Johanson (Sweden).

Two Research Co-ordination Meetings (RCMs) have been held in Vienna (1989) and Nairobi (1991). The third RCM is planned to take place in Tunis from 5 - 9 October 1992, in collaboration with the Institut National Agronomique de Tunisie in Tunis.

2. The Use of Nuclear and Related Techniques in the Management of Nitrogen Fixing Trees for Enhancing Soil Fertility and Soil Conservation

(Project Officer: S.K.A. DANSO)

This project is largely funded from the IAEA Regular Budget and a grant for 2 participants donated by OPEC fund. Participation in this CRP now stands at 14. One CRP has so far been held in Vienna, and the second is planned for 17 - 21 August 1992. We are busy preparing for this. The initial experiments are largely to assess nitrogen fixation in some multipurpose nitrogen fixing trees commonly used or of potential use in Agroforestry. Initially, the N-15 isotope dilution technique is being used to assess the progression of nitrogen fixation with age of tree, and some initial studies on comparison of nitrogen fixation capabilities of different nitrogen fixing trees and the effect of pruning on nitrogen fixation have started. Participation in the CRP is full and no new admissions are anticipated.

3. Improvement of Yield and N2 Fixation of Grain Legumes with the Aim of Increasing Food Production and Saving N-Fertilizer in the Tropics and Sub-tropics of Asia

(Project Officer: S.K.A. DANSO)

Participation in this CRP has increased to 13, two of whom are Agreement Holders. The most recent entrants are from India (Agreement Holders), Viet Nam (2 Contractors) and one Contractor from Malaysia. With the end of the programme being only about 2 years away, it is not envisaged to admit any more participants. We are grateful to UNDP for the continued funding of this CRP, the aim of which continues to be the selection or breeding of grain legumes for enhanced yield with increased dependence on atmospheric N2 fixation, and reduced dependence on soil and fertilizer nitrogen. Three RCMs and one Workshop have already been held, and we are soon to hold the fourth RCM in Harbin, China (13 - 17 July, 1992). Encouraging results have been obtained so far, indicating that nodulation and N2 fixation trails are veritable, and that it is possible to breed for enhanced N2 fixation and yield in grain legumes.

4. The Use of Nuclear and Isotopic Techniques to Improve Crop Production on Salt-affected Soils

(Project Officer: Cevat KIRDA)

The participants of this programme received their final Research Contracts in 1991. The field-works however still continue in 1992. All research contracts will be extended, cost-free to the IAEA, until the final Research Co-ordination Meeting in 1993.

Some of the results obtained during the earlier phase of this programme were presented at the International Symposium on Strategies for Utilizing Salt-affected Lands, 17-25 February 1992, Bangkok, Thailand, sponsored by the International Society of Soil Science. A short excerpt from the abstract of the presented paper is given below:

"In the programme, a wide range of crop species, including some tree species were screened. The results reported show that a wide genetic variability exists for salt tolerance in all crop and tree species. The field crops screened include lentil (Egypt, Bangladesh), rice (Pakistan, India), soybean (Pakistan), wheat (Cyprus, Bangladesh), barley (Bangladesh, Pakistan) faba bean (Cyprus), maize (Pakistan), sorghum and millet (Nigeria). Among the tree species tested for salt tolerance include Casuarina and Melaleuca (Senegal), Eucalyptus (Senegal, Pakistan), Parkinsonia and Terminalia (Pakistan). The preliminary results on the soil amelioration experiments showed that both millet and sorghum grown in salt affected soils resulted in a significant decrease in both soil salinity and sodicity. Similarly, barley, rice (Basmati 370), wheat and Sesbania acyleata ameliorated salt affected soils. The studies on plant physiological mechanisms controlling salt tolerance have also been addressed in the programme where Na-22 and Cl-36 are being used. The initial results showed that salt tolerance of barley varieties is partly due to selective uptake of K over Na, and lowered shoot to root ratio of Na and Cl. Salt tolerant cultivars of soybean generally avoided a build-up of Na in their tissues and accumulated more K than the sensitive counterparts."

5. Assessment of Irrigation Schedules of Field Crops to Increase Effective Use of Water in Irrigation Projects

(Project Officer: Cevat KIRDA)

The first Research Co-ordination Meeting of this programme was held in Vienna, Austria, 3 to 8 February 1992. A brief report of the meeting is given in another section (meetings held) of this Newsletter.

6. Use of Molecular Biology in Studies of Microbial Ecology

(Project Officer: Gudni HARDARSON)

Based on the recommendation of a Consultants Meeting, this Co-ordinated Research Programme was initiated by FAO/IAEA in 1991. Only cost-free agreement holders, i.e. experts in the field of molecular biology have participated in the preparatory work of the above programme. The objective of the programme is to develop and test molecular biology methods to be used in developing countries to study microbial ecology in particular:
1) To improve biological nitrogen fixation of the legume/Rhizobium symbiosis and to reduce excessive use of N fertilizer and its associated ground water pollution, 2) to develop and test methods for monitoring the fate of genetically engineered micro-organisms in natural ecosystems and 3) to transfer selected molecular biology methods for studying soil microbial ecology to developing countries and to train scientists in their use.

The Joint FAO/IAEA Division is now in the position to add five research contractors, from developing countries to the present programme. Application

forms can be obtained from the Joint FAO/IAEA Division or your National Atomic Energy Authority. Applications should be send to the Head, Research Contracts Administration Section, IAEA, before October 15, 1992

B. NEW CO-ORDINATED RESEARCH PROGRAMME

The Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture through its Soil Fertility, Irrigation and Crop Production Section is planning to initiate a new CRP on "The Use of Nuclear and Related Techniques in the Evaluation of the Agronomic Effectiveness of Phosphate Fertilizers, in particular Rock Phosphates". This CRP is to be implemented within the framework of the programme area D1.03 - "Optimizing the Use of Plant Nutrients for Sustainable Agricultural Practices and Environmental Protection" as it would appear in the IAEA's Programme of Work and Budget for 1993/1994.

The programme's goals will include the following:

i) Assessment of the initial "available" phosphorus status of the soil, and the changes of the available P status of the system after a fresh-application (immediate effect) and after a long-term application (residual effect).

ii) Quantitative evaluation of the uptake and use of P fertilizers by the crops under a variety of soil and climatic conditions. In particular, this project aims at the agronomic evaluation of natural rock phosphates and means/ways of enhancing their efficiency through chemical (e.g. partial acidification, concentration) and biological processes (e.g. selecting suitable plant genotypes, organic manuring/composting, and microbially mediated effects including mycorrhiza). Isotope-aided experiments in the laboratory, greenhouse and field will be carried out for this purpose. The IAEA Agriculture Laboratory at Seibersdorf has developed and is routinely applying these techniques for the evaluation of the rock phosphates in connection with the FAO Fertilizer Programme.

The successful implementation of the proposed programme will bring benefits to both the developing and developed Member States.

This announcement is a call for submission of applications from both advanced laboratories (research agreement holders) and developing countries' institutes (contractors) with appropriate facilities and expertise in the above areas of study. Application forms can be obtained from the Joint FAO/IAEA Division or your National Atomic Energy Authority. Application should be sent to the Head, Research Contracts Administrative Section, IAEA, before October 15, 1992.

TRAINING COURSES

1. The FAO/IAEA Regional Training Course on the Use of Isotope and Radiation Techniques in Studies of Soil/Plant Productivity, from 23 March - 24 April, 1992, was held at the Chilean Commission of Nuclear Energy (CCHEN) and the National Institute for Agriculture and Livestock Research (INIA), in Santiago, Chile.

The objective of the course was to give scientists from the Latin American region a sound working knowledge on the relevant isotope and radiation techniques in research on soil/plant productivity. Spanish was the working language of the course. The course focused on the use of nuclear techniques in solving major soil limitations affecting crop productivity of cultivated land in Latin America.

Fifteen participants from Argentina (2), Costa Rica (2), Cuba (2), Ecuador (1), Mexico (2), Nicaragua (1), Uruguay (2), Venezuela (2), and Chile (1) successfully concluded the training. In addition to local staff from the organizing institutes, the following scientists were recruited as invited lecturers: Dr. S. Urquiaga (Brazil), Dr. J.J. Pena-Cabriales (Mexico), Mr. R. Goyenola (Uruguay) and Dr. M.F. L'Annunziata (USA). Dr. Ines Pino was the Course's Director.

Dr. C. Hera, Head of the Soil Fertility, Irrigation and Crop Production Section was present at the Opening Ceremony and delivered lectures during the first week of the course, while Dr. F. Zapata, Technical Officer of the course, delivered lectures and guided practical sessions on various aspects of the use of isotope techniques in soil/plant studies during the last 2 weeks of the course.

A four-day field-trip (12-15 April) was taken to Temuco, Southern Chile (for practicals/demonstrations on biological nitrogen fixation by grain and forage legumes at the INIA Experimental Station in Carrilanca) and to Chillan (for conferences on the research carried out in various nitrogen-fixing systems, i.e.: grain legumes, Azolla and trees, using isotope techniques within the framework of FAO/IAEA Co-ordinated Research Programmes). Dr. P. Baherle of INIA and the Course's Deputy Director was the excursion leader. Former IAEA trainees (Ms. L. Barrientos, Mr. R. Campillo, Mr. I. Vidal) and IAEA contractors (Messrs. L. Longeri and C. Ovalle) participated as lecturers/instructors in the above activities.

The good co-operation between participants, local staff and invited lecturers helped to ensure a smooth implementation of the course. The training location was very satisfactory and in accordance with the course's requirements. The experience and motivation of the participants contributed to make this course a very rewarding and successful one.

2. The FAO/IAEA Interregional Training Course on the Use of Isotope and Radiation Techniques to Enhance Biological Nitrogen Fixation Seibersdorf (near Vienna), Austria, 1 June - 3 July 1992.

Twenty participants out of nearly 110 applications have been selected to take part in the course, which this year emphasizes on biological nitrogen

fixation. The preparatory work was in progress during the Newsletter was written. We will have more information on this training course in the next issue.

3. FAO/IAEA Training Course Announcement for 1993

Title:

1. The FAO/IAEA INTERREGIONAL Training Course on "The Use of Isotopes and Radiation Techniques in Studies of Soil/Plant Relationships with Emphasis on Crop Production on Acid Soils".

Date:
31 May - 2 July, 1993.

Place:
IAEA Agricultural Laboratory, Seibersdorf and Vienna, Austria.

Language:
English.

The course is organized for about 20 selected scientists from developing countries from all contintents.

Title:

2. The FAO/IAEA REGIONAL Training Course on "The Use of Isotopes and Radiation Techniques in Studies of Soil/Plant Relationships with Emphasis on Salt-affected Soils".

Date:
15 February - 19 March, 1993.

Place:
Ankara, Turkey.

Language:
English.

This course is organized for about 20 selected scientists from the Middle East and European countries.

Further details, if necessary, may be obtained by writing to the Section Head, Soil Fertility, Irrigation and Crop Production Section, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, P. O. Box 100, Wagramerstrasse 5, A-1400 Vienna, Austria.

MEETINGS HELD

1. The first Research Co-ordination Meeting on "The Use of Nuclear and Related Techniques in Assessment of Irrigation Schedules of Field Crops to Increase Effective Use of Water in Irrigation Projects"
   3 - 7 February 1992, IAEA Headquarter, Vienna, Austria

   Scientific Secretary: Cevat KIRDA

The meeting was attended by 15 participants in the programme (Brazil/Libardi, People's Republic of China/Fujun, Cote d'Ivoire/Pene, Ecuador/Calvache, Egypt/El-Haris, France/Haverkamp, Ghana/Adiku, Hungary/Kovacs, Malaysia/Ahmad, Morocco/Bazza, Pakistan/Iqbal and Waheed, Romania/Craciun, Turkey/Anac, and USA/Hopmans), and they all presented reports on their past experiences on irrigation practices. The reports covered irrigation of a wide range of crops including sugarbeet, sugarcane, wheat, cotton, common bean, potato, groundnut, corn and the like. From the highlights of the presented reports and future research plans of the participants, it was understood that the deficient irrigation practice is a high priority research area in all countries participating in this programme. From the discussions held it became clear that data on crop yield response to deficient irrigation is lacking for better management of existing irrigation projects in many countries. Yield response to water varies from crop to crop and there are even significant genotypic differences within given species. Crop water requirement for high yield and economic yield varies not only from crop to crop but with different soil, climate and socio-economic conditions existing in different countries. Therefore, the objectives envisaged in the project will have high practical value and the experimental data produced will be very valuable to increase the effective use of scarce water resources in arid-zone irrigation projects.

Irrigated agriculture is by nature "high input agriculture", and fertilizer application therefore logically complements irrigation. Without fertilizer application, soil productivity cannot be sustained and high crop yield cannot be achieved. Therefore, some of the participants in the programme wanted to study fertilizer interactions with different irrigation treatments. Among the questions addressed were fertilizer N recovery, fertilizer use efficiency, leaching, volatilization, denitrification and the like, all concerned with N fertilizers. It is therefore envisaged that the use of N-15 technique in fertilizer research would be a useful topic to discuss at a separate session. The third day of the meeting, 5 February 1992, was spent in the IAEA's Laboratory, Seibersdorf, and the group received series of lectures regarding the N-15 technique.

The meeting provided a good forum to discuss experimental guidelines that the research contractors would follow in the field experiments. Each research contractor had already received some tentative guidelines previously prepared by Dr. C. Kirda, project officer. Some of the participants had already initiated field experiments, taking into consideration what was suggested in the tentative guidelines. During the meeting, the experimental treatments, optional activities and the list of data to be recorded were discussed. Basic concepts in crop water consumption studies were reviewed and the methods were recommended to measure all the terms of water balance within the plant root zone.

Excerpts from presented reports:

G. and T. Kovacs
Research Institute for Irrigation
Szarvas, Hungary

Field experiment was done using 5 irrigation treatments (including the rainfed) at two fertilizer levels. Nitrogen fertilizer (AS) was labelled with 1 % of N-15 stable isotope to examine the effect of irrigation on the fertilizer N use efficiency by isotope method. The irrigations were maintained at different growth stages of maize in 4 replicates.

According to the plan of the CRP, the deficit irrigation practice has to be compared with the traditional ones to assess its advantages in soil productivity under irrigated agriculture. Two watering regimes should have been established: 1) normal watering, where available water (AW) is allowed to fluctuate within 50 % to 100 % level, 2) deficit irrigation, when the AW is maintained within the limits of 30 to 60 %. For measuring the soil water status, neutron moisture gauge was used and the evaporation data were recorded including the standard class-A pan results.

The results showed that there was no interaction among fertilization, DM yield, and Fert. N utilization. However, signficant differences among the irrigation treatment were observed.

I. and M. Craciun
Research Institute for Cereals
and Industrial Crops
Fundulea, Romania

The study of plant response to water deficits has been one of the major research topics because drought is the main environmental factor limiting plant productivity. In this study, a line source sprinkler irrigation design was used to study maize crop yield response to water. The results show that a reduction in crop evapotranspiration (ET) does not necessarily imply that water use efficiency would increase because a reduction in ET is followed closely by a reduction in grain yield. High soil moisture content gave a reduction of maize grain yield for all genotypes in the well-irrigated treatments (in 1991 - wet year) becaue of limiting root development as a result of limiting respiration of root and nutrient uptake. A high irrigation water use efficiency can be obtained for maize when irrigation was applied (at 50 % of the available water in the first 80 cm of the root zone) at flowering and yield formation stage.

B.C. Pene and K.G. Edi
Agricultural Water Management
IDESSA-DCI/FCS
Bouake, Cote'd Ivoire

A field study on sugarcane yield response to furrow irrigation regimes was carried out at IDESSA experiment station of FERKESSEDOUGOU, in the northern part of Ivory Coast. The purpose of this work is to find out the

optimum amount of irrigation water needed during the growing period of a cane crop. The cane variety M 3145, has performed well for three years (plant and two ratoon crops). Crop water uptake is computed according to a water balance simulation model. The results show that cane and sugar yield response curves as a function of irrigation water and evapotranspiration (water production functions) have a linear pattern. However, the treatment requiring about 600 mm of irrigation water appears to be the best with 14.2 mm of water needed per ton of canes and per hectare (TC/ha), in other words, 0.9 kg of extractable sugar was produced per cubic meter (ES/m3) of water utilized.

M.M. Iqbal, S.M. Shah, and W. Mohammad
Nuclear Institute for Food and Agriculture
Peshawar, Pakistan

Although Pakistan has one of the most elaborate irrigation networks in the world, water use efficiency has been low. Beside huge losses from canal to the field, the water is applied to crops without regard to whether plants need it at that stage. If the efficiency of the utilization is increased, considerable saving of water would occur which could be used to bring more area under cultivation.

Two experiments, one each in spring and summer of 1991, were conducted with potatoes - a crop which is gaining increasing importance in Pakistan. The spring experiment was intended to study different methods of determining the need for irrigation. The methods used were: irrigation applied on the basis of pan evaporation (when cumulative evaporation totalled 25 mm), soil moisture content (when depletion occurred to 0.65 and to 0.5 of field capacity) and farmers' practice along with a non-irrigation treatment. There were unusually heavy intermittent rains during the growing period which coincided with tuber formation and ripening stages, hence the differences in tuber yield between different treatments were not significant.

The summer experiment was aimed at identifying growth stages of potato which are less sensitive to water stress so that irrigation could be avoided without sacrificing yield, and studying the effect of the deficit irrigation of fertilizer use efficiency. There were 10 irrigation and two fertilization (normal and low) treatments. The irrigation treatments employed one stress and two stresses at vegetative, flowering, tuber formation and ripening stages in addition to normal watering at all stages, stress watering at all stages and the traditional practice. The quantity of irrigation in case of normal watering was equal to the sum of pan evaporation since the last irrigation and was weighted for crop cover. The stress watering received half the amount of normal watering. The results showed that maximum yield was obtained with normal watering at all stages and with one stress at ripening stage. The lowest yield on the other hand was produced by stress watering at all stages and by stress watering at vegetative and flowering stages. Normal yield, on the average, led to higher yield than low fertilization. These preliminary results indicated that ripening was the least sensitive growth stage for irrigation.

Wang Fujun
Department of Applied Physics
Beijing Agricultural University
Beijing, People's Republic of China

The effect of deficit irrigation on yield, yield components and nitrogen fertilizer use efficiency was examined in the study. It was shown that water stress imposed at different plant growth stages have a different effect on wheat growth, yield components and nitrogen uptake. Exposing wheat to two water stress cause significant yield decrease. Yield of wheat was 9.83 kg/plot when no water stress existed, however with two water stress, the yield was reduced to 6.78 kg/plot.

Exposing wheat to a single water stress at a later growth stage, before grain formation, may not cause significant yield decrease, however, if the stress occurs during the early growth stage, the effect on yield is substantial.

Results so far obtained show that plant with no water stress take up more soil and fertilizer N, therefore, the utilization rate of fertilizer is high. Water stress in the early stage leads to lower grain yield and decrease in N derived from fertilizer. But water stress in the later growth stages leads to an increase of N derived from fertilizer.

J.W. Hopmans
University of California
Davis, USA

In California, surface irrigation is the dominant irrigation method. Irrigated fields vary in size between 20 - 30 ha with furrow lengths as long as 800 m. Hence, irrigation may lead to significant drainage losses, thereby reducing irrigation efficiency. Field-scale monitoring of the soil water status and its variability have led to a new field technique to estimate in-situ soil hydraulic characteristics. Drainage was found to be 50 - 80 % of total field applied water for the first irrigation in cotton. Subsurface lateral water in movements in the irrigated fields made estimations of plant transpiration difficult.

Cotton yield was related to soil salinity and soil texture but did not show a significant correlation with applied water. Soil hydraulic information was used to predict field infiltration. Alternative water management scenarios will be tested for profitability to minimize drainage losses within environmental and engineering constraints.

M.K. El-Haris
University of Alexandria
Alexandria, Egypt

A randomized complete block design experiment was conducted on maize (var. Giza 2) at 2 locations: El-Hamman (60 km West of Alexandria) and Abis (10 km East of Alexandria) during the summer of 1991. The second site was representing high water table areas. Nine irrigation regimes were randomly assigned to the plots and two N fertilizer rates (120 and 240 kg/ha) were

assigned to the subplots within the block. The irrigation treatments were selected to impose single or combined water stress at one or more of the four growth stages of maize (vegetative, flowering, yield formation, and ripening stages) compared to full normal watering and severe stress throughout the season. Furrow irrigation was used for the experiment. Grain yield showed a significant difference among irrigation regimes but not with N fertilizer treatment. The plots that exposed to single or combined stress including flowering stage resulted in higher yield reduction. Several water regimes of low water application gave yields not significantly different from full watering.

P. L. Libardi
CENA, Pinacicaba, S.P. Brazil

Results of an experiment with bean (Phaseolus vulgaris, L.) crop, following the IAEA guidelines design, were presented. Some preliminary results and difficulties experienced were discussed. Most of the difficulties were related to the irrigation system used, namely furrow. The experimental area has a slope of about 10 % and the soil has a B horizon with a very low permeability, which, probably, led to a sub-superficial lateral water movement. This should be one the probable causes of why no irrigation treatment effects could be obtained. In spite of stated problems, we believe that the experiment was worth-while since it gave very important and useful field experience in conducting this kind of experiment which requires a good control of water applications. Therefore, we decided to set up the future field experiments in another area and use a sprinkler irrigation system, not furrow.

S. Adiku
University of Ghana
Faculty of Agriculture
Legon, Ghana

Field experiments were carried out to identify drought tolerant growth stages of cowpea (Vigna unquiculata cv. Asontem) at which irrigation water supply could be withheld or reduced, without significantly reducing yields. A sprinkler irrigation system was used in a randomised complete block design (three replications) to obtain ten (10) water treatments. In the control experiment, no water stress was imposed on the crop. Dry matter yields and the cummulative crop water use were determined for each treatment at the end of the flowering stage.

The highest dry matter yield was recorded for the control (no-stress) treatment, while the least was recorded for the irrigation treatment, involving water stress (all-stress) at both vegetative and flowering stages. The differences were however not significant. Although the crop water use followed a similar trend as the dry matter yield, the water use efficiency of the all-stress treatment exceeded that of the control. There were no significant differences between the water use efficiency among the treatments.

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Institut de Mecanique de Grenoble
Hydrology Department
Domaine Universitaire
Cedex, France

Information on soil characteristics, like soil water retention and hydraulic conductivity as function of water content, is of main importance for the different components of the water balance. A simple method was presented and discussed to predict the shapes of the water retention and hydraulic conductivity from routinely available textural and structural soil data. Using the basic concepts of fractal theory and shape similarity between the water retention curve h(0) and the cumulative penticle-size distribution function F(d), a straight-forward expression was derived, to predict the shape parameters m and n of the closed form VAN GENUCHTEN h(0) equation together with the power exponent of the BROOKS and COREY hydraulic conductivity K(0) equation. The results obtained for a data-bank of more than 900 soils available from a great variety of field experiments carried out in all different countries, show an excellent agreement between predicted and experimental shape parameters.

A. Ahmad
Nuclear Energy Unit
Ministry of Science, Technolgy and Environment
Kompleks PUSPATI
Bangi, Malaysia

Groundnut is presently grown under various soil environment such as flood plains, inland valleys, terraces, single-cropped paddy areas and under young rubber and oil palm. The increasing acreage of abandoned paddy fields (single-cropped or double cropped paddy areas which do not receive enough water for rice cultivation) provide opportunities for expansion of these crops. In Malaysia, groundnuts are mostly grown as a rainfed crop. Depending totally on rainfall, the crop is subjected to risk, due to the varying rainfall duration and distribution. These variations could lead to drought at varying intensities during the cropping season which can affect the growth and yield of the groundnuts. Efficient and economical irrigation schedules are therefore necessary to stabilize and maximize yields.

Preliminary work was done in the field to calibrate a neutron probe and to estimate the hydraulic conductivity by internal drainage method. The experimental plots examined showed high soil spatial variability. For example, the infiltration rate found during hydraulic conductivity studies at two sites, approximately 2 m apart showed values which are very different (approx. 1.6 mm/min and 0.6 mm/min respectively). The plot also showed variable lime content and there appeared also a hard layer about 20 cm below the surface. Therefore, a new experimental plot was chosen. To investigate spatial variability of the plot, three parameters were evaluated. They are soil water storage, organic carbon and physical characteristics of the soil. Systematic gravimetric sampling of the 30 m x 30 m plot was done using a 5 x 5 m grid sampling scheme to a depth of 100 cm at intervals of 10 cm. The experimental design adopted in our work will take into account soil spatial variability.

M. Bazza
Institut Agronomique et
Veterinaire Hassan II
Rabat Institute, Morocco

The study aimed at identifying irrigation management practices which could result in water savings through water-deficit irrigation. Two field experiments, one on wheat and the other one on sugar beet, were conducted and consisted of refraining from suppyling water at specific growth stages as to identify the period(s) during which water deficit would have a limited effect on crop production.

For wheat, and under the climatic conditions of the campaign which were characterized by some precipitation during reproductive stages (over 50 % of the crop requirements), one water application at tillering stage allowed the crop grain yield to be as high as that obtained with three irrigations (one at each of the tillering, heading and grain filling stages). It was concluded that a stress of up to 50 % of the crop requirements can be tolerated provided that the crop was fully developed through adequate water supply during vegetative stage to tillering. Compared to common practice by farmers of the region, this could have saved enough water to triple the area cropped by wheat.

As for sugar beet, through a combination of irrigation frequency and timing, it was possible to subject the crop to different periods of stress with a wide range of water stress severity. The number of water applications ranged from 2 to 12 and the amount of water applied varied from less than 2000 to over 6500 m3/ha, in addition to over 270 mm of precipitation. While root yield higher than normally obtained in the region could be produced with the largest amount of irrigation water applied, large variations between treatments existed due essentially to the timing, the duration and the severity of water stress. Nevertheless, treatments with yields either among the highest or very competitive and with the best efficiency of applied water were those which received six irrigations and which were subjected to some water stress. A severe water stress (no irrigation during up to six weeks) at the end of the cycle, following no water limitation, is one situation. The second one is a stress of up to 50 % of the water requirements during the period of intensive leaf elaboration (8-10 to 20-24 leaves) followed by good watering conditions until one week before the harvest. And finally, the third one is a light stress (less than 20 % of the requirements) during the same period as previously, followed by good watering conditions up to four weeks before the harvest. Compared to what was applied by farmers of the region and what is recommended by the Irrigation Management Agency, such a practice, while allowing for maximum efficiency of applied water and high root and sugar yields, could save enough water to extend the presently cropped area by 30 to 60 %.

S. Anac
University of Ege
Faculty of Agriculture, Bornova
Izmir, Turkey

Several experiments were carried out on potential benefits of deficit irrigation in corn production. The main aims of the research programme were

to find crop yield response of second crop maize, after cotton. The treatments undertaken not only included a number of irrigations, but also the depth of irrigation water and irrigation time. The test crop was hybrid maize (G-4507). Highest water use efficiency was obtained when maize was irrigated twice, at vegetative and flowering stages. Under conditions of water shortage, a single irrigation may save the crop, provided irrigation is made at an early flowering stage. Further work is in progress.

R. A. Waheed
Soil Biology Division, NIAB
Faisalabad, Pakistan

Twenty-five high yielding/salt tolerant wheat genotypes were grown in field plots (7 x 7 sq.m), at moisture levels of -25, -50, and -75 KPa soil matric potential following normal agronomical practices using NPK fertilizer @ 100: 100: 50 kg/ha respectively. Soil moisture tension was maintained with the help of soil tensiometers and plots were irrigated with canal water (EC=0.2dS/m, RSC=Nil, SAR=0.2) as and when required. The yield components and thermal crop co-efficients were recorded. Wide variations in yield components were recorded including plant height (62-118 cm), grain number (37-80), spike length (8-17,6 cm), and grain yield (0.376 to 0.717 kg/sq.m).

A field experiment has been initiated in triplicate plots (8 x 8 sq.m). Soil moisture tensiometers have been installed at 15 and 25 cm depth in each plot and soil moisture will be maintained at -25, -50, and -75 KPa matric potential. Thermal hours, and other important phenological developmental stages will be determined. Grain yield components will also be studied.

A high yielding wheat genotype has been subjected to moisture deficits at four important vegetative/reproductive stages in quadroreplicate plots (9 x 6 sqm). Two levels of NPK fertilizer @ 120: 120: 60 kg/ha and one half thereof have been tried. Soil samples up to 1 m depth for profile salinity have been taken at sowing time. Soil moisture in root zone profile up to 1 m depth is being monitored in two blocks by neutron hydroprobe on a weekly basis. The experiment is in progress.

2. FAO/IAEA Consultants Meeting on Preparation of a Manual for Measuring Greenhouse Gases from Agriculture

7 to 10 April 1992, Vienna, Austria
Scientific Secretaries: Christian HERA and James DARGIE

This meeting was held at the Vienna International Centre. The group consisted of specialists in Soil Science (O. Van Cleemput: Belgium; A. Mosier, W.H. Patrick: USA; K. Smith: UK and R. Wassman: Germany) and Animal Science (J.W. Czerkawski, D. Beever, J. Wallace: UK; K.Johnson: USA; J.B. Rowe and R. Leng: Australia).

The discussions were centred on the emissions of greenhouse gases mainly methane from ruminants and methane and nitrous oxide from soil/plant systems with emphasis on flooded rice systems, and the possible strategies to reduce such emissions. The use of isotope and nuclear techniques where appropriate were highlighted. The main outcome of this meeting is the preparation of a

FAO/IAEA Manual on Measurement of Methane and Nitrons Oxide Emissions from Agriculture which is planned to be published as a IAEA-TECDOC, before the end of this year.

TECHNICAL CO-OPERATION PROGRAMMES

The Technical Co-operation Projects under our section's technical purview is presently 65. In the previous issue, December 1991, Vol. 14, No. 2, we gave summaries of the projects in Asia and Pacific Region. In this issue, we will highlight the projects in the Middle East and Europe Region.

Cyprus

Radio Isotopes in Agriculture

Ministry of Agriculture and Natural Resources, Agricultural Research Institute, Nicosia
Counterpart: I. Papadopoulos

This project initiated in 1989 was implemented with the objective of improving fertigation practices (i.e., fertilizer applied via irrigation water) for increasing fertilizer use efficiency, as well as achieving more effective use of irrigation water supply available in the country. Several experiments which have been completed until now have immediate practical implications. For example, P applied via fertigation is much more affective and significantly higher yields are obtained with only 14% P of the traditionally used basal applications. The amount of N supplied to the plant over a given time can be controlled, and so too is the form of N because nitrification may be less important in the fertigation systems. The counterparts are using ^{15}N labelled fertilizers to assess what forms of N give the least leaching and reduced nitrate levels in vegetables and fruits. They received laboratory equipment, isotopically labelled fertilizers, both ^{15}N and ^{32}P, and automated continuous flow analyzer for routine determination of N and P. Analysis of their samples for ^{15}N are being done in the IAEA's Laboratories, Seibersdorf, Austria.

Iran

Nuclear Techniques in wheat production

Center for Nuclear Agriculture and Medicine, Atomic Energy Organization of Iran, Karadj
Counterpart: F. Madj

The main trust of the project started in 1987 is on plant breeding, and to this effect project counter parts are collaborating with Seed Improvement Institute of the Ministry of Agriculture in Karadj. Their existing research programme, having direct relevance to soils research, mainly falls in three areas: (1) screening soybean varieties for high biological nitrogen (BNF) potential, (2) studies on soybean yield response curves, the effects of different rates of starter N fertilizer on BNF of soybean, (3) field evaluation of Rhizobium in relation to BNF of soybean. They received expert assistance and laboratory equipment, including a neutron moisture gauge and a sample preparation set up for ^{15}N analysis.

Jordan

Nuclear Techniques in Agriculture

University of Jordan, Faculty of Agriculture
Department of Soil Science and Irrigation, Amman
Counterpart: B. Hattar

This project deals with three subject areas: (1) soil water conservation under rainfed, dry farming areas in Jordan, (2) improvement of N fertilizer practices, and (3) biological nitrogen fixation of lentil, a grain legume of high popularity in the Middle Eastern Countries. The results of last three years of field experiments showed that the efficiency of N-fertilizers commonly used in Jordan, mostly ammonium sulfate, is very low, less than 20 %. The high soil pH (~8) and the method of application (usually broadcasting) are among the reasons for the low efficiency obtained. Results on crop rotation showed that continuous wheat, traditionally adapted in the area, should be discontinued, and either fallow-wheat-lentil or wheat-lentil rotations should be preferred for higher benefits from winter rains. Their results on BNF showed that no benefits can be gained from inoculation of lentil crop in Jordan. The indigenous strains of Rhizobium are as effective as commercial inoculants. The assistance provided included expert, research fellowship training and laboratory equipment, including provision of ^{15}N labelled fertilizer and sample analysis for ^{15}N.

Portugal

Nitrogen fixation

Departamento de Pedologia, Estacao Agronomica Nacional, Oeiras
Counterpart: E. Sequeira

Through implementation of this project, the counterparts received expert assistance on the use ^{15}N isotope dilution technique to assess biological nitrogen fixation (BNF) of leguminous crops, including forage legumes, planted in Portugal. The assistance also included provision of laboratory equipment to upgrade their laboratories for isotopic studies. The project also provides analytical services for ^{15}N analysis. Their field experiments on BNF are progressing well. They also initiated a nitrogen balance experiment to estimate the extent of nitrate leaching to ground water, from high rate of nitrogen fertilizers used in the agricultural areas. They hope to modify existing fertilizer practices to minimize nitrate leaching.

Spain

Nuclear Techniques in Agriculture

Consejo Superior de Investigaciones Cientificas,
Estacion Experimental Del Zaidin, Granada
Counterpart: Jose-Miguel Barea

Through implementation of this project, initiated in 1988, the counterpart institute has achieved a good analytical capability for

continuous use of ^{15}N in their research programmes, including screening of leguminous tree species for high nitrogen fixation potential. They received a SOPRO emission spectrometer and a metal vacuum line, sample preparation set up, for ^{15}N analysis. The assistance included training of their staff on pretreatment of plant samples for ^{15}N analysis and use of the emission spectrometer.

Turkey

Soil Fertility and Plant Nutrition

Turkish Atomic Energy Agency,
Nuclear Agriculture Research Center, Saraykoy, Ankara
Counterpart: Basri Halitligil

Through implementation of this project, started in 1991, the counterpart institute plans to upgrade their laboratory facilities to promote the use of stable isotopes, mainly ^{15}N, and other related nuclear techniques in agricultural research programmes in the whole country. To this effect, they organized a national training course on the use of ^{15}N in agricultural research in April 1992, and through the existing project, outside experts were invited to give lectures at the training. The equipment provided to the institute include several neutron moisture gauges, ^{15}N labelled fertilizers, Kjeldahl digestion and distillation set up. The project also has funds for fellowship training.

ANNOUNCEMENT OF A SEMINAR

FAO/IAEA Seminar for Asia and Pacific on Nuclear Related Methods in Soil/Plant Aspects of Sustainable Agriculture
5 to 9 April 1993, Colombo, Sri Lanka

This seminar is planned to be held in Colombo, in collaboration with the Atomic Energy Authority of Sri Lanka. It is intended for scientific personnel working with isotope and nuclear techniques in soil fertility, irrigation and crop production studies. Emphasis is placed on research aimed at developing sustainable agricultural practices with minimum inputs. The seminar will provide a forum to review the recent progress in soil fertility and crop production research among isotope and nuclear techniques in the Asia and Pacific region.

Priority will be given to counterparts and collaborators of IAEA Technical Co-operation projects, and Reserach Contract holders including those involved in CRPs. The official announcement and information sheets have been dispatched to the relevant authorities of the Member States of the FAO and IAEA in the Asian and Pacific region.

For additional inquiries or to receive the announcement, please contact the Scientific Secretary of the seminar, Dr. K.S. Kumarasinghe, Soil Fertility, Irrigation and Crop Production Section, Joint FAO/IAEA Division, Wagramerstrasse 5, P.O.B. 100, A-1400 Vienna, Austria.

ANALYTICAL SERVICES FOR ROUTINE N-15/N-14 RATIO DETERMINATION AT SEIBERSDORF

The Soil Science Unit of the Agriculture Laboratory performs routine N-15/N-14 ratio analysis in "plant samples" by using a mass spectrometer in support of the Reserach Contract and some Technical Co-operation Projects lacking the appropriate analytical facilities.

It is essential that Contractors (Co-ordinated Research Programmes) and Counterparts (Technical Co-operation Projects) follow the instructions on "Sampling and Sub-sampling Procedures" given in pages 41-44 of the Training Manual: "Use of Nuclear Techniques in Soil/Plant Studies". Training Course series no., IAEA, 1990, Vienna, Austria. Samples which are not processed within the procedures mentioned before won't be accepted for analysis.

For instance:

i) Samples which are not finally ground and
ii) Samples identified only with running numbers.

Please note that in case you send "fertilizer standards" in solution, you must indicate the chemical from (ammonium, nitrate, urea, etc.), nitrogen concentration (mg N/ml) and estimated atom % N-15 excess as well.

Upon consultation and previous authorization of the corresponding Technical Officer, soil samples may be accepted for analysis as an exception, provided that they contain at least 0.1 % total N.

For more detailed information on these topics, please write to Ms. Helga Axmann, IAEA Seibersdorf Laboratory, Vienna.

FROM OUR READERS

1. Phosphorus Retention in two Soils Derived from Volcanic Ashes

I. Pino, M.C. Urbina, W. Luzio, L. Cases
Atomic Energy Commission, Santiago, Chile

The kinetics of phosphorus adsorption was studied as a function of time and soil depth in two volcanic ash soils. The soil samples were shaked in a orthophosphate potassium solution labelled with P-32 at different time intervals from 0 to 192 h. The adsorption kinetics was characterized by a rapid process of chemical sorption followed by a slower and prolonged interchange reaction. The utilization of P-32 allows a quick quantification of the values of phosphorus retention in the soils studied.

2. Estimation of Symbiotic Dinitrogen Fixation by Nodulating Plants Using Variation in Natural N-15 Abundance

Ma Changlin, Yao Yunyin, Chen Min, Liu Xiaolan, Liu Zeyin, Wang Zhidong, Hou Jingqin, Luo Yongyun, He Fengru
Institute for Application of Atomic Energy, CAAS, Beijing

Samples were collected from Institute's farming field and some sites near by. σ N-15 values of total soil N was 6.39±0.42 % for the Institute's field and it changed from 5.03±0.26 % to 1.66±0.49 % in the nearby areas. σ N-15 value for total soil N in the Institute varied in the order of 6.09±7.71 % vertically, and from 6.52 to 7.13 % horizontally.

In an experiment conducted for measuring 15N value of different parts of soybean, which was grown hydroponically in N-free medium, nodules enriched with N-15 and σ N-15 value was 10.54±0.30 %. Above ground parts, depleted N-15. σ N-15 values were between -2.25±0.48 -4.16±0.75 %, which indicated that fractionation occurred in the course of dinitrogen fixation and transportation of N2 products.

% Ndfa for different soybean cultivars was estimated by natural N-15 abundance method which showed significant variations in different cultivars. Measurements of N-15 in other plants, especially for herbs, showed that σ N-15 values for N2 fixing plants were much lower than that for non-N2-fixing plants. Generally, this difference was between 3-5 N-15 units. It is suggested that we could estimate dinitrogen fixation by natural N-15 abundance method.

3. Evaluation of Five Different Irrigation Regimes Applied to Common Bean

L. Molina, M.A. Alfaro
General Directorate of Nuclear Energy (DGEN), Guatemala

An experiment was conducted at DGEN to evaluate the effect of different irrigation regimes for common bean. The treatments were established on the basis of water requirement calculated using class A pan evaporation data. The experimental design was a randomized block with five treatments and three replications. The water was applied every 7 days. The treatments were: the basic level, as calculated from evaporation data, and 0.5, 0.75, 1.25 and 1.5 times of the basic level.

Tensiometers and neutron moisture gauge were used to assess soil water status under different treatments. Yields from different treatments were recorded. The preliminary results showed that dry matter production as well as grain yield were increased when water was applied in 1.5 times the basic level water application.

4. The Use of Isotope Methods in Methane Emission Studies in a Polar Region

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Institute of Soil Science and Photosynthesis
Academy of Sciences of the USSR, 142292, Pushchino
Moscow, USSR

Measurements of methane generation and methane oxidation rates with the use of 14CH3COO, H14CO3, 14CH 4 were carried in tundra soil profiles of two typical landscapes in Lolyma-Indigirka lowland (Northeastern Eurasia). Methane fluxes to the atmosphere and the concentration of methane in the soil air were measured in the same profiles. Through measurements it was possible to make an estimation of input of methane generation and methane oxidation processes to methane budget in the seasonal thaw layer and to methane emission from soils to the atmosphere. Seasonal variations of methane fluxes appeared to be connected with microbial activity influenced by seasonal moisture variations as well as by the kind of vegetation cover.

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