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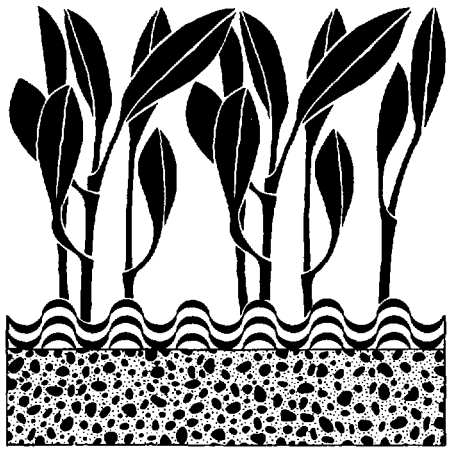

Soils Newsletter

JOINT FAO/IAEA DIVISION
OF ATOMIC ENERGY
IN FOOD AND AGRICULTURE

INTERNATIONAL
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CONTENTS

TO OUR READERS

With great pleasure we present another issue of the Soils Newsletter which marks now two years of publication. The enthusiastic feedback we have received from our readers is encouraging. We consequently expect an ever increasing growth rate of the Soils Newsletter contents and worldwide readership.

This issue begins with a brief account on the recently held Joint FAO/IAEA Research Coordination Meeting on Isotope-Aided Micronutrient Studies in Rice Production with Special Reference to Zinc Deficiency. Summary reports of technical assistance projects executed in Africa and Asia and mention of technical assistance advisory missions in Latin America are presented. This is followed by an account of the representation of the IAEA at the FAO Regional Seminar on Rain-Fed Agriculture in the Near East with mention of the principal conclusions and recommendations of this international seminar. As customary, the activities of the Agriculture Section at the Seibersdorf Laboratory are included in our Soils Newsletter. We conclude this issue with summary reports on FAO/IAEA Interregional Training Courses on the Use of Isotopes and Radiation Techniques in Studies on Soil/Plant Relationships (23 April - 8 June 1979, Seibersdorf, Austria), and on the Use of ^{15}N in Soil Science and Plant Nutrition (21 May - 17 June, Leipzig, German Democratic Republic), along with an announcement of a forthcoming FAO/IAEA Training Course on the Use of Radiation Equipment for Soil Moisture Studies.

We hope you find our Soils Newsletter of interest and thank you for your encouragement.

SOIL FERTILITY, IRRIGATION
AND CROP PRODUCTION SECTION

CHANGES IN STAFF

Assoc. Prof. Felipe Zapata from the Soils Department of La Universidad Agraria "La Molina", Lima, Peru joined the Agricultural Section of the Agency Laboratory at Seibersdorf on 1 April 1979. He is involved in the planning and implementation of experimental field trials of FAO/IAEA Joint Division experiments on dinitrogen fixation and nitrogen fertilizer efficiency.

Prof. R.V. Olson returned to Kansas State University, Manhattan, Kansas, U.S.A. in May 1979 after spending four months with the Soil Fertility, Irrigation and Crop Production Section. During his stay Prof. Olson assisted in the planning and implementation of field experiments related to the FAO/IAEA Dinitrogen Fixation Programme. He also assisted in the evaluation of reports of an FAO/IAEA Coordinated Research Programme on Nitrogen Residues and also introduced results from his experimental work in the U.S.A. Prof. Olson also contributed highly to the organization of an Advisory Group Meeting on Nuclear Techniques in the Development of Fertilizer and Water Management Practices for Different Cropping Practices to be held in Ankara, Turkey during 8-12 October 1979. We anticipate Prof. Olson's participation in this meeting.

Report on the FAO/IAEA RESEARCH COORDINATION MEETING ON ISOTOPE-AIDED MICRONUTRIENT STUDIES IN RICE PRODUCTION WITH SPECIAL REFERENCE TO ZINC DEFICIENCY

Vienna, Austria

10-14 September 1979

The final meeting of participants in the FAO/IAEA Coordinated Research Programme on Isotope-Aided Micronutrient Studies in Rice Production with Special Reference to Zinc Deficiency was held at the IAEA Headquarters in Vienna during 10-14 September 1979. The participants in the meeting, in addition to staff members of the Joint FAO/IAEA Division included Dr. K.G. Tiller, Australia; Dr. L. Rahman, Bangladesh; Dr. F. Amer, Egypt; Dr. D.L. Deb, India; Dr. G. Soepardi, Indonesia; Dr. Tai Soon Kim, Korea; Ms. C.M. Rosales, Philippines; Ms. P. Snitwongse, Thailand; Dr. A. Aydeniz, Turkey; and Dr. P. Giordano, U.S.A. Dr. K.B. Mistry served as the Scientific Secretary to the meeting.

The participants presented and critically discussed consolidated reports of work carried out under the coordinated research programme. A brief summary of the main findings of the programme and recommendations of the meeting is given below:

1. Isotope-aided greenhouse and field experiments were undertaken in eight Member States to evaluate the efficiency of rates, sources and methods of zinc application to flooded rice and assess the residual effects of zinc fertilizers. The use of zinc-65-labelled fertilizers permitted direct quantitative evaluation of different zinc fertilizer practices in terms of per cent utilization of zinc fertilizer in addition to conventional parameters of grain yield and total uptake of zinc. In general, 5 kg Zn/ha as zinc sulphate broadcast and incorporated in soil was a more effective means of zinc application for flooded rice than surface applications, root dip in 2 per cent zinc oxide suspension and foliar spray of zinc sulphate solution. Isotopic tracer data indicated that under field conditions the average per cent utilization of the zinc fertilizer by the rice crop was 2% for the 5 kg Zn/ha broadcast and incorporation treatment while the corresponding value for 5 kg Zn/ha surface application at transplanting was 1.5%. For two Member States where availability of soil zinc was extremely low unusually high values of per cent utilization of zinc fertilizer upto 6% were obtained. Higher rates of 10 and 20 kg Zn/ha sometimes depressed yield. While the combined urea-zinc fertilizer was equally effective as zinc sulphate in terms of grain yield, it was usually more effective in supplying zinc to rice. Average per cent utilization of the combined urea-zinc fertilizer broadcast and incorporated in soil by rice was nearly 20% higher than the value for zinc sulphate broadcast and incorporation treatment. The incorporation of organic matter had varying effects on grain yields and zinc uptake depending on local practice and source of material used. Residual effect of zinc fertilizer was obtained on a wide range of soils at the application of 5 kg Zn/ha. Average per cent utilization of zinc fertilizer at the 5 kg Zn/ha rate by the first residual rice crop was approximately 1%; this value was about 50% lower than the corresponding value of per cent utilization of zinc fertilizer by the rice crop to which zinc fertilizer was applied. The effects of 10 kg Zn/ha rate for the first residual crop were not always significantly

greater than that of the 5 kg Zn/ha rate. In addition to the main experimental programme, some participants investigated factors affecting zinc fertilizer practice of special relevance to their region, e.g. liming, alternative local zinc sources and management practices.

2. A prerequisite of the programme was to investigate methods of assessment of micronutrient deficiencies and to delineate areas in which response to zinc fertilization is likely. This aspect of the programme had to take into account the variation between participant countries with respect to the "state of the art." In some, micronutrient problems had been long recognized and studied, and in others, not. The approach was to investigate soil test procedures already commonly in use, viz, DTPA and dilute HCl and to attempt validation in relation to plant uptake, dry matter yield and isotope methods. This brought into consideration the problem of critical soil and plant values in relation to regional and plant variations. Participants are moving towards the aim of achieving generalized maps indicating areas of rice production likely to respond to zinc fertilization. Some have already produced useful preliminary maps.

3. Inter-laboratory comparison of reference samples was periodically undertaken at the participating institutions to evaluate the analytical procedures for estimation of small quantities of zinc and other micronutrients in rice plants and soils. The standard of analytical methods was generally very good, but problems in some laboratories were identified.

4. The meeting stressed several specific areas where continuing research is required using isotope techniques where appropriate. These include;

i) Refinement of diagnostic techniques to assess the status of zinc and other micronutrients by soil and plant tissue tests;

ii) identification of interactions between zinc and other plant nutrients under flooded conditions;

iii) evaluation of various zinc rates and sources including N-Zn P-Zn combined fertilizers and locally available products;

iv) identification of rice cultivars which are most efficient in utilization of zinc.

5. The meeting recommended that a summary of the major findings obtained under the coordinated programme be published by the Agency in the form of a technical report. The meeting also made detailed recommendations on the format and contents of the technical report.

TECHNICAL ASSISTANCE ADVISORY MISSIONS

An Agricultural Advisory Mission was executed by Dr. M.F. L'Annunziata of the Soil Fertility, Irrigation and Crop Production Section on behalf of the Division of Technical Assistance to Colombia and Guatemala during May/June 1979.

TECHNICAL ASSISTANCE PROJECTS

I. AFRICA

1. Ivory Coast

Project:	IVC/5/07
Institution:	Institute of Agronomic Research, Bouake
Expert:	Mr. P.A. Lespinat
Duration of Assignment:	March - May 1979

Mr. Lespinat executed an assignment related to project IVC/5/07 at the Institute of Agronomic Research, Bouake, during 29 March - 13 April 1979 and 30 April - 22 May 1979. Mr. Lespinat's assignment was to apply a ^{14}C-labelling technique to rice plants as a method permitting a study of the effect of water stress on the migration of photosynthate in the plant. The objective of these studies is to devise a technique which would assist in the screening of plant varieties for drought resistance.

The production of upland rice in the Ivory Coast is very irregular owing to the effect of dry spells commonly encountered on yields. Certain new varieties developed by IRAT, such as IRAT 13, proved to be more resistant to drought, and therefore the areas on which they are grown are gradually increasing.

Studies aimed at a better understanding of the observed drought tolerance are underway. Preliminary experiments indicate that drought resistant varieties have the ability to draw carbon from their apex (growing tips) starting from the stems in case the leaves are not playing their role as a normal reservoir as a result of the lack of water. To prove this hypothesis, it was necessary to use ^{14}C to follow the transfer of carbon between the different parts of the same plant.

This type of study necessitates the labelling of a large number of plants for short periods of time. The expert accomplished his assignment in two visits. During his first visit (29 March to 13 April 1979) the expert developed a simple technique for labelling and carried out two preliminary experiments to follow the migration of carbon in upland rice plants of variety IRAT 13. During the intermediate period the plant samples were analysed at the Cadarache Centre in France with the aid of Mr. Katinan Camara, an Agency fellow from the Ivory Coast. During the expert's second assignment (30 April to 22 May 1979), 512 plants of rice (varieties IRAT 13 and 63-68) were labelled with $^{14}CO_2$ under very adequate conditions.

Technique (experimental method)

Eight rice plants were grown in each pot containing about 20 kg of soil. The pots were kept in a greenhouse provided with a cooling system to avoid the effect of extremely high temperatures. The labelling was performed while covering each pot with a supple plastic cloth to form an isolated chamber having a volume of about 100 liters. Two microventilators suspended in the interior of the plastic chamber were used to ensure adequate circulation of the atmosphere. The temperature within the plastic chamber was kept within a reasonable range (32 to 37°C), through the passage of a

cool air current coming from the greenhouse and continuous spraying of the plastic chamber with water. The labelling took place around noon-time to benefit of optimal conditions for photosynthesis.

A bottle of compressed gas containing one liter of CO_2 having an activity of 2.5 mCi of ^{14}C was prepared in Cadarache. With the aid of precise release-manometers and gas syringes exact amounts of gas were injected in the chambers.

At the beginning of the experiment the inactive CO_2 content in the interior of the chambers was increased to approximately 1000 ppm through the action of N HCl on a certain quantity of $NaHCO_2$.

The absorption of radioactivity was followed by taking samples from the chamber's atmosphere throughout the labelling period. The samples taken were immediately analysed with the aid of a Packard liquid scintillation counter.

The time of labelling was kept at one hour for the experiments, and a dose of 25 microcuries per pot was used.

At the end of the labelling two plants were taken, cut into different parts, grinded, and counted in powder form as an infinitly thick sample with a Geiger-Müller counter.

The absolute activity was measured in Cadarache using a combustion apparatus of the type Oxymat Intertechnique. A good correllation was observed between the activities measured with the Geiger-Müller counter and those determined with the aid of the combustion apparatus.

Mr. Reyniers will start this year to collect precise data on the migration of carbon from the stems to the tip of the plants on two upland rice varieties, 63-83, and IRAT 13. The effect of exposing the plants to a period of water stress during the crucial stage of grain filling will be investigated. In this perspective, about 600 plants labelled with ^{14}C were grown and marked as described above at various stages of stem development.

After 105 days from the date of planting, half of the plants were normally supplied with water, while the other half was exposed to water stress through reducing the irrigation dose by 50% during 15 days.

Plant samples were taken to determine the distribution of ^{14}C among the different plant parts at:

i) the time of labelling,

ii) at the beginning of the dry spell,

iii) at the end of the mentioned period, and

iv) at maturity (130 days from sowing).

The experiment was terminated early in July 1979, and it is anticipated that the complete results will become available towards the end of the year.

The labelling technique followed during the expert's assignment could be easily used later on rice or other plants.

The training which Mr. Katinan Camara enjoyed and the experience he gained will ensure the continuation of similar successful studies in the future.

2. Mauritius

Project:	MAR/5B/02
Institution:	Mauritius Sugar Industry Research Institute
Expert:	Y. Barrada
Duration of Assignment:	2-16 March 1979

Dr. Y. Barrada, Head of the Section, executed an assignment related to project MAR/5B/02 at the Mauritius Sugar Industry Research Institute during 2-16 March 1979. During this assignment the current and planned research programmes of the Institute in soils, plant nutrition and irrigation were thoroughly discussed with Messrs. P.J. Deville, C. Cavalot, K.F. Ng Kee Kwong, and P.Y. Chan. As a result of the mentioned discussions, the following recommendations (listed in their order of priority) are made for the further implementation of the technical assistance project MAR/5B/02:

1. In view of the great difficulties associated with taking soil samples of known volume at various depths from rocky soils in connection with establishing a reliable calibration curve for measuring moisture content with a neutron probe, it is recommended to send about 16 soil samples from 4 different soils (locations) to Cadarache for establishing 4 semi-imperical calibration curves for the Wallingford neutron moisture meter now in use at the Institute.

2. A total of 48 mercury tensiometers with all necessary accessories should also be provided for taking readings at $\frac{1}{2}$, 1, 2, 3, 4, and 5 feet (8 for each depth). These tensiometers are badly needed to replace the less sensitive dial-type tensiometers now available at the Institute in water research. For example, studies aiming at determining the hydraulic conductivity as a function of moisture content below the rooting zone will be initiated in the near future. These studies would benefit from using more sensitive tensiometers and are essential for establishing a reliable water balance as well as for estimating nitrogen losses by leaching.

3. A hydraulic soil coring machine (Gidding) should be supplied without a power source. The machine will be very helpful in taking soil samples at various depths and in making bore holes (2" diameter) for placing access tubes for taking readings with the neutron moisture meter now available at the Institute (Wallingford type).

4. The services of an expert are recommended for the duration of three weeks. The expert's assignment should begin shortly after the receipt of the equipment indicated under Items 2. and 3. The expert should cooperate with his counterparts in comparing methods of soil solution sampling, demonstrate the use of the portable instrument developed in Braunschweig, Federal Republic of Germany for this purpose, and help in evaluating data obtained from soil solution samples in comparison with the information gained from soil sampling. The expert is also expected to help his counterparts in installing tensiometers.

5. In connection with the implementation of the project, a study tour is recommended for a scientific officer to visit institutes carrying out research on water and ion movement, irrigation, and water use efficiency with the aid of nuclear techniques. The duration of the proposed study tour should be 4 to 6 weeks.

The expert cooperated with his counterpart in preparing a technical assistance request aiming at improving the efficiency of the use of nitrogenous fertilizer by sugar cane. The request is being considered by the Agency for implementation in 1980.

Recommendations for the Institute

Very often recommendations, such as the introduction of irrigation or the use of a certain irrigation system, the application of a given fertilizer or soil amendment, growing of a food crop between the rows of sugar cane, the choice of a certain plant population density, the introduction of a drainage system in high rainfall areas, the mechanization of various activities, etc. have to take into consideration important economic considerations which vary with time, in addition to the information gained from implemented research. Therefore, it is often difficult for technical officers to recommend specific management practices based on their research data alone.

For the above reason, the recruitment of an economist, to start with, is recommended for the consideration of the Institute. The economist's task would be to undertake a careful economic evaluation before a certain recommendation based on results of research is made. The economist would at a later stage also make an economic evaluation of the benefits which the cane producers made as a result of following the Institute's recommendations. Such an evaluation would make it easier for the Institute to get more support from cane producers, international organizations and other donor countries.

The Institute's sound research programme aimed at improving the efficiency of water use, requires the services of another technician (in addition to the one now being trained by the Agency in Davis, California). Due favourable consideration should be given to the recruitment of a qualified technician and training him on the proper use and handling of radiation equipment. This would then justify the purchase and ensure the proper use of additional equipment for soil moisture measurements necessary for the implementation of the Institute's water research programmes. The Soils and Plant Nutrition Division also needs the services of an additional technician so that the isotope-aided research programmes planned to improve the efficiency of nitrogenous fertilizer use could be properly implemented.

To ensure fruitful future cooperation with the Agency and to benefit from the use of nuclear techniques in the Institute's research programmes, it is essential to train some of the Institute's staff (professionals and technicians) on the use of these powerful research tools through the Agency's training programme (fellowships and training courses).

Though rainfall is being adequately measured in most of the Institute's experimental farms, the recording of net radiation and the evaporation from open pans deserves more attention. Due consideration should be given to the protection of evaporation pans against possible water consumption by birds.

It is understood that high priority will be given to animal nutrition studies aiming at making efficient use of residues of sugar cane and by-products of the sugar industry. In fact, new additional facilities will be constructed soon. As only one biochemist is involved in these very important studies, the recruitment of at least two technicians is badly needed. The animal nutrition studies would benefit a great deal from the use of isotopes, and Agency technical assistance in this field may be requested in the future.

Regional Training Centre

It was indicated by the UNDP Resident Representative and the Institute's Director that the Institute will, in the very near future, become a Regional Training Centre. It is believed that due favourable consideration will be given to including nuclear techniques in some of the Centre's training programmes. The Agency's support to the Centre's training activities is highly recommended as this will be beneficial to a number of Member States.

II. ASIA

1. Philippines

Project:	PHI/5B/13
Institution:	Agricultural Research Division Philippine Atomic Energy Commission Quezon City
Expert:	Dr. J. Witty
Duration of Assignment:	2 January - 26 March 1979

Dr. J. Witty executed an assignment in connection with project PHI/5B/13 at the Agricultural Research Division of the Philippine Atomic Energy Commission, Quezon City from 2 January - 26 March 1979. His assignment was twofold,: i) to install and calibrate an NOI-5 Emission Spectrometer supplied by the IAEA for the analysis of the isotope nitrogen-15, and ii) to cooperate with counterpart scientists in the planning and implementation of an N-15-aided research project aimed at evaluating the nitrogen fixing capacity of a number of soybean/*Rhizobium* symbiotic combinations, estimating the contribution of symbiotically fixed nitrogen to soybean yield under diverse soil conditions and moisture regimes, and establishing nitrogen balance for soybeans grown in contrasting soil types.

The Isotope Laboratory of the Agricultural Research Division, Philippine Atomic Energy Commission has planned a programme of anticipated three-year duration with the objective of yielding results of direct application for optimizing nitrogen fertilizer use for soybean and improving soybean yields in the Philippines. As a first step in the implementation of this programme, the IAEA expert initiated two greenhouse experiments and a field trial during his assignment. The greenhouse experiments were designed with the use of N-15-labelled ammonium sulfate to i) examine rhizobium cultivar interactions in Novaliches soil and to evaluate various non-fixing controls, and ii) examine the depletion of fertilizer and soil N with time. The field experiment was designed to i) evaluate the number

and effectiveness of native Rhizobium japonicum at the P.A.E.C. site, and ii) evaluate the suitability of a non-nodulating soybean (Clark Rj1) and inoculation with an ineffective rhizobium strain as controls for measuring dinitrogen fixation with N-15-labelled ammonium sulfate, and iii) check the lateral movement of this fertilizer in the soil.

2. Thailand

Project:	THA/5B/19
Institution:	Isotope Laboratory Division of Agricultural Chemistry Department of Agriculture Bangkok
Expert:	Dr. D.A. Rennie
Duration of Assignment:	January - February 1979

This mission was a follow-up to the assignment implemented by Dr. D.A. Rennie from 15 September - 15 October 1975 and Dr. J.R. Bettany from 3 October 1975 - 12 April 1976. The objective of the assignment was to assist the Isotope Laboratory personnel in the planning and implementation of an isotope-aided project to assess the possible adverse effects on long-term usage of ammonium chloride fertilizer on root activity of rice and the quality of subsequent upland crops grown in rotation with rice.

Detailed plans were drafted for the following experiments:

i) A field experiment with applications of urea and ammonium chloride at rates of 50 and 100 kg N/ha applied on a split basis with 40% applied at three weeks prior to transplanting and 60% applied at the primordial initiation growth stage. Treatments and control are to be replicated four times.

Microplots consisting of 25 cm diameter and 50 cm long plastic tubing will be established on each of the NH_4Cl "main plots" and the ^{36}Cl-labelled ammonium chloride will be applied to each so that the fate of the early- and late-applied ammonium chloride in a rice-soybean cropping sequence can be assessed. Total chlorine and chlorine-36 will be assayed in rice and soybean grain, straw, and surface roots, and root core samples down to a 1.5 meter depth. The data obtained from the rice-soybean multiple cropping sequence will enable a chlorine balance to be calculated.

ii) A soil column study with treatments similar to the field experiment described above. This will permit an accurate chlorine-36 balance study as leachate will be collected and assayed for chlorine-36 which would have passed the root depth.

iii) A preliminary experiment involving only one crop but four microplots as described in i) above. The objective of this preliminary experiment is to provide the staff at the Isotope Laboratory with an opportunity to become familiar with the use of chlorine-36 in field experiments prior to the initiation of the main field experiment. The preliminary experiment will also provide urgently required information on the amount of chlorine which leaches below the root depth or that which laterally disperses during the growth of the rice crop.

UNDP PROJECTS

In addition to technical assistance projects financed by the IAEA, the Section is also concerned with soil-water-crop production aspects of larger scale multi-disciplinary projects financed by the United Nations Development Programme (UNDP). Reports on the activities and progress of the soils component of a UNDP project in Syria are given here.

The project SYR/72/018/A/01/18 was signed in August and became operative in October 1974.

Based on the information gained through isotope-aided applied research, the project aimed at the following:

i) increasing yields in the irrigated area benefiting from the Euphrates Dam Project through improving the efficiency of both water and fertilizer use;

ii) reducing the hazzards of crop failures and increasing crop production under dry farming conditions through the development of adequate management practices;

iii) Training of Syrian scientists on the use of isotopes and radiation techniques in studies of soil-water-plant relationships.

To achieve the objectives of the project a simple radioisotopes laboratory was established within the premises of the Faculty of Agriculture. The laboratory was attached to the Department of Soil and is now functioning under the supervision of the Department's Head, Dr. N. Zein El-Abidien.

The achievements of the last two experts, Dr. F. Amer and Dr. Y. Barrada are summarized below:

Expert: Dr. F. Amer

Duration of Assignment: February - March 1979

Prof. F. Amer carried out an assignment in connection with the project SYR/72/018 at the Faculty of Agriculture, University of Aleppo, from 6 February to 5 March 1979. His task was mainly to cooperate in planning and initiating isotope-aided laboratory, greenhouse, and field research aiming at increasing yields through improving the efficiency of fertilizer use, in addition to on-the-job training of his counterparts.

Except for the irrigated land of the Euphrates Dam Project, agriculture is mainly rain-fed with supplementary irrigation in some places. Euphrates soils contain 15 to 30% caloium carbonate, and there are extensive areas of gypsiferous soils. There is a need to evaluate to what extent the soil productivity is influenced by the gypsum content, and to search for means to correct its adverse effects. To this effect, the following studies were initiated:

1. Gypsum Effect on Phosphorus Solubility

The effect of gypsum on the solubilities of treble superphosphate (TSP) and diammonium phosphate (DAP) was tested through several wetting and

drying cycles. A clay soil extremely low in calcium carbonate content was used. Soil mixtures containing 10, 25, and 50% gypsum were also prepared. Samples of 50 g were placed in 150 ml beakers after mixing with TSP or DAP at the rate of 2%. After wetting the soil or soil gypsum mixture to near saturation, they were dried in the incubator at 30°C, and the process was repeated for several cycles. Water soluble P was then determined using a soil to water ratio of 1:5 and 2 hours shaking.

In the absence of added gypsum DAP increased soluble P to considerably greater extents than TSP, almost in correspondence to their P content. Gypsum, however, resulted in a drastic reduction in DAP soluble P compared with that of TSP. There were relatively little changes in soluble P with gypsum varying between 10 and 50% suggesting that the gypsum solubility product may be the determining factor.

2. Gypsum Effect on Phosphorus Mobility

Soil was packed in cylindrical wax blocks having cavities 38 mm in diameter and 100 mm deep. Columns of soil containing 50% gypsum were similarly prepared. TSP or DAP equivalent to 80 g P were placed uniformly on the top of the soil columns. Destilled water was then added to raise the moisture content of the soil to field capacity. After several days the columns were sliced at 5 mm intervals and soil samples were analyzed for water soluble P.

Preliminary results were in general agreement with those obtained in the previous experiment. After 12 days P from TSP reached a depth of 40 mm. Gypsum decreased the P solubility as well as the overall mobility.

3. Effect of Gypsum on Phosphorus Uptake by Wheat

A simplified pot experiment was initiated to acquaint counterparts with the techniques involving the use of radioactive labelled fertilizers as well as to explore the effect of gypsum on phosphorus uptake by wheat from TSP and DAP. Wheat would be harvested after 6 weeks, and Cerenkov counting would be used for measuring the ^{32}P activity with the Beckman LS-230 liquid scintillation counter.

The following studies were also planned:

1. Optimizing Fertility and Water Management for Gypsiferous Soils

Laboratory investigations would be conducted to investigate the changes in the chemical and physical properties of the soil with gypsum content, followed by greenhouse and field experiments. The depressing effect of gypsum on potassium may be tested in the laboratory by determining the reduced ratio of potassium to calcium $(K/\sqrt{Ca})$ in the soil solution. A DTPA soil test may serve as a laboratory index for predicting availability of the metal micronutrients in gypsiferous soils. Based on the laboratory findings greenhouse experiments would be conducted to evaluate the treatments that are presumed to correct the adverse effects of gypsum. The recommended fertility treatments would finally be tested in the field under optimum water management.

2. Fertilization Effects on Alfalfa Yield, Residual P and N_2 Fixation

Residual value of the phosphorus applied the first year would be determined by using ^{33}P-labelled superphosphate in the second year to measure "A" value both in the soil which received no fertilization and in the soil that received fertilization the first year. The N_2 fixation by alfalfa may be estimated by using the "A_N" concept.

The study would allow for a quantitative estimate of the residual P and whether it is more beneficial to apply phosphorus the second year as indicated by the results of a study performed by Drs. Zein El-Abedien and Saffaf. In addition, valuable information would be gained on the effect of nitrogen application on alfalfa yield and N_2 fixation.

3. Relative Efficiency of Urea and Ammonium Nitrate and the Effect of Time of Application

With the aid of ^{15}N-enriched fertilizers the efficiency of the use of urea and ammonium nitrate by wheat will be compared under local conditions.

The general practice in Syria seems to be adding half the nitrogen dose before planting the crop. In case of heavy rains, such practice may lead to heavy nitrogen losses through leaching and denitrification. There is a need to optimize the time of application of nitrogenous fertilizers applied to wheat and other crops in order to improve the efficiency of their use.

Expert: Dr. Y. Barrada

Duration of Assignment: April - May 1979

1. Current Research

The expert discussed with his counterparts the isotope-aided research performed since the initiation of the project, exchanged views, and made comments and suggestions concerning the current and future research programs of the Department of Soils.

The Department of Soils of the Faculty of Agriculture of the University of Aleppo initiated in October 1977 a post-graduate one-year course. The diploma obtained after completion of this course is a pre-requisite for registration for M.Sc. degree which started late in 1978. Three post-graduate students are now carrying out isotope-aided studies, and this number is likely to reach a total of seven or eight in October 1979. Two of the post-graduate students are carrying out their field experiments at the farm of ICARDA while the third is making use of the Faculty's experimental farm at Muslimiah. The research being implemented is briefly indicated below:

i) Under dry-farming conditions a comparison of conventional and improved management practices is being carried out on a crop rotation involving wheat, barley, vetch and water melon.

ii) The response of two different varieties of lentils to phosphatic fertilizer application and the effect of phosphorus on dinitorgen fixation and water use are being studied.

iii) The effect of including a period of fallow in a crop rotation on crop production and water conservation is being investigated.

2. Future Research Programmes

Based on the recommendations made by Dr. D. Nielsen and Dr. R. Rauschkolb during their assignments as experts to this project, and as a result of the discussions with Dr. Y. Barrada, the following isotope-aided studies should be given highest priority when planning the laboratory's future research programmes:

i) Effect of source and method of placement on the efficiency of phosphatic fertilizer use by the main field crops, with special emphasis on grain legumes.

ii) Magnitude of ammonia losses resulting from various methods of urea application to initially dry and wet calcareous soils.

iii) Magnitude of ammonia loss through volitalization as a function of N source and depth of placement on gypsiferous and calcareous soils.

iv) Effects of time of application and method of placement on the efficiency of nitrogenous fertilizer use by the main field crops.

v) The effect of salinity on yields, water requirements and the efficiency of fertilizer use.

vi) Effects of amounts and frequency of applied irrigation water on yields and efficiency of fertilizers use, in selected geographic areas.

vii) Water management and conservation for optimum crop production in rain-fed areas. This study will be partially implemented according to Research Contract No. 2378/RB awarded to the Faculty of Agriculture, University of Aleppo as part of the coordinated research programme on "Efficiency of Water and Fertilizer Use in Semi-Arid Regions."

viii) The use of radiation techniques in the in situ characterization of the physical properties of soil profiles. This study was partially implemented at Muslanriah Experimental Farm according to an Agency Research Contract awarded as part of the terminated coordinated research programme on "The Use of Isotope and Radiation Techniques in Studies of Soil Water Regimes." The study should be performed in the near future in pilot project areas of the Euphrates Basin.

ix) Estimating the amount of water and its dissolved salts moving annually below the root zone of crops irrigated in the Euphrates Basin.

x) Diagnosis and remedy of micronutrients (mainly Mn, Fe, and Zn) deficiency on Pistachio and other tree crops, especially on calcareous and gypsiferous soils.

3. Expert's Recommendations

The expert made the following recommendations:

1) Awarding five fellowships to assistants and staff members of the Department of Soils to acquire the necessary experience in the following fields:

i) Dinitrogen fixation studies. Techniques used for sample preparation and $^{15}N/^{14}N$ ratio determination.

ii) Ion and water movement in soils. The use of radiation equipment for soil moisture studies.

iii) Soil fertility and plant nutrition studies (mainly ^{35}S, ^{32}P, and ^{33}P aided studies).

iv) Micronutrients. Isotope-aided studies for the diagnosis and remedy of their deficiency.

v) Detecting contamination, decontamination, waste disposal, and measuring radiation exposure.

(in all cases training programmes and host institutes were suggested)

2) Training courses:

The Radioisotope Laboratory established as part of the project is a very adequate facility for training scientists and technicians on the use of isotope and radiation techniques in soils research. The following courses were recommended:

i) A six-week local training course to be held in 1980 on the use of isotope and radiation techniques in studies of soil-plant relationships. Fourteen soil scientists will benefit from the course.

ii) A regional training course similar to that mentioned above under i) is recommended for 1981. The course should be organized in cooperation with the FAO-managed regional project on land and water use for the Near East and North Africa.

iii) Starting in 1982 specialized intensive training courses of short duration are recommended for technicians and soil scientists. Examples for such courses are:

- A three-week course on the use of radiation equipment for soil moisture and bulk density measurements.
- A four-week course to train technicians on the methods of sample preparation and the proper handling of counting systems.
- A four-week course for soil physicists emphasizing isotope-aided studies of ion and water movement in soil profiles.

3) Cooperation with other research-oriented organizations & institutes:

Establishing and furthering cooperation with various institutes and organizations involved in applied research is essential for ensuring the continuity of the appropriate utilization of the isotope laboratory established within the premises of the Department of Soils of the Faculty of Agriculture of the University of Aleppo, and is therefore highly recommended. In fact, contacts were established and cooperation is either being discussed or planned or was already initiated between the Isotope Laboratory and the Euphrates Dam Project, ICARDA, ACSAD, the Soils Directorate of the Ministry of Agriculture, and the Soils Department of the Faculty of Agriculture of the University of Damascus.

REPRESENTATION OF THE IAEA IN THE FAO REGIONAL SEMINAR ON RAIN-FED AGRICULTURE IN THE NEAR EAST

An FAO Regional Seminar on Rain-Fed Agriculture in the Near East was held in Amman, Jordan during 5-10 May 1979. Dr. Y. Barrada, Head of the Soil Fertility, Irrigation and Crop Production Section attended the meeting and presented a paper entitled "Research Techniques in Soil Moisture Regimes Under Rain-Fed Agriculture," presented the FAO/IAEA Joint Division's new coordinated research programme entitled "The Use of Isotope and Radiation Techniques for Efficient Water and Fertilizer Use in Semi-Arid Regions," and also chaired a session of the meeting.

The very successful Seminar was attended by 84 participants from 19 countries including 13 from the FAO Near East Region and representatives of 6 international and regional organizations. Forty technical papers of a high level were presented, covering a wide range of subjects, such as crop production, farming systems, soil and water conservation, tillage, methods of soil moisture measurements, range management and socio-economics.

As a result of the presentation of the various papers and the extensive discussion that they generated, the following points are among the most relevant findings and conclusions:

i) Further research work is needed to determine whether the inclusion of periods of fallow and/or short-cycle legumes in crop rotations would be advantageous or not under well-defined weather conditions.

ii) To obtain good yields of cereals under rain-fed agriculture, the application of nitrogen and eventually other macro- and micro-nutrients is essential.

iii) As plant roots differ in their ability to extract water at different moisture tensions and vary in their patterns of development, the importance of studying the root system development of various crops and the possibility of using the mentioned criteria as a technique for selecting plant varieties more resistant to drought were pointed out.

iv) The importance of recording the soil and climate characteristics of the sites at which field experiments are carried out, cannot be over-emphasized.

Within the activities of the FAO/IAEA Joint Division item i) above is one of the major points to be dealt with in the Joint Divison's new Coordinated Research Programme on the Use of Isotope and Radiation Techniques for Efficient Water and Fertilizer Use in Semi-Arid Regions. Also, isotopes would serve as very useful tools in studies related to the above-indicated itmes ii) and iii).

Among the recommendations of the Seminar the following important ones are of interest to the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture:

i) Advantage should be taken of the assistance provided by international and regional organizations and financing institutions to combat desertification and develop land

use systems based on land use capability (rain-fed crop land, range land, forest) in association with soil and water conservation measures, and optimum utilization of land and water resources, and that governments should be encouraged to invest in such activities in an integrated manner.

ii) Since range lands constitute the largest natural renewable resource providing the bulk of feed, and since they are degrading at a rapid rate, efforts should be made to improve and achieve optimum use of these resources by developing national and regional programmes.(The Joint Divison is planning to initiate an isotope-aided coordinated research programme in 1982 aiming at increasing the carrying capacity of range land as a result of the development of appropriate management practices.)

iii) It is believed that it would be very useful to plan long-term studies, under a variety of well-defined soil, climatic conditions and crop rotations to investigate the different aspects of fallowing (this is along the lines of research planned for the recently initiated coordinated research programme entitled "The Use of Isotope and Radiation Techniques for Efficient Water and Fertilizer Use in Semi-Arid Regions".)

iv) Due consideration should be given to the use of isotopes (mainly ^{32}P and ^{33}P) in root system development studies.

v) Owing to the need for using neutron moisture meters in various studies aiming at the development of appropriate water conservation practices, it would be useful to organize a regional training course for the duration of two weeks to train scientists and technicians on the use of radiation equipment. Such a training course may be planned by the Near East Regional Project for Land and Water Use in cooperation with the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture.

SOILS RESEARCH AT AGRICULTURE SECTION SEIBERSDORF LABORATORY

Symbiotic nitrogen fixation by legume crops under field conditions

A series of field experiments were started with a view to analyzing the sources of variation in the determination of symbiotically fixed nitrogen by *Vicia faba* and soya (*Glycine max.*).

Various methods of application of small quantities of highly enriched nitrogen fertilizers are being compared, including band placement, surface broadcasting, incorporation with organic matter and spraying as a liquid.

Barley, non-nodulating soybeans and sudangrass are being tested as non-nitrogen-fixing standards. Various types of experimental design have been laid out, including adjacent planting and alternate rows of legume and standard crop.

In one experiment 20 *Vicia faba* mutant lines were compared with their mother variety in respect to symbiotic N fixation.

A soybean experiment compared the effectiveness of 20 different rhizobia strains. Two experiments received applications of ^{35}S-labelled solutions to see whether sulphur could be used as an internal check for the assumption that both standard crop and legume crop are confronted with the same soil nitrogen supply.

Mass-spectrometer facilities in the Seibersdorf Laboratory

The Japanese Hitachi spectrometer which served for the analyses of ^{15}N in more than 150,000 plant samples provided by cooperators of coordinated research and technical assistance programmes since 1965 has been replaced by a Micromass 602D double collector mass-spectrometer. The new instrument will enable the Laboratory to carry out mass-spectrometric analyses with greater precision which is required for the current programmes on symbiotic nitrogen fixation and fertilizer nitrogen residues.

TRAINING COURSES

Report on the FAO/IAEA Interregional Training Course on the Use of Isotope and Radiation Techniques in Studies on Soil/Plant Relationships

Seibersdorf, Austria

23 April - 8 June 1979

The FAO/IAEA Interregional Training Course on the Use of Isotope and Radiation Techniques in Studies on Soil/Plant Relationships was held during 23 April - 8 June 1979 at the Agriculture Section of the IAEA Laboratory, Seibersdorf.

Twenty-one participants coming from Brazil, China, Cuba, Egypt, India, Malaysia, Morocco, Oman, Pakistan, Sudan, Tanzania, Turkey, Thailand, Tunisia, Venezuela, Yemen, and Zaire worked together during seven weeks, carrying out field, greenhouse, and laboratory work in Seibersdorf.

During the course emphasis was put on the planning and execution of experiments dealing with practical problems encountered in developing countries.

The group carried out a field experiment on fertilizer placement using ^{32}P-labelled superphosphate as well as another field experiment using ^{15}N-labelled urea to determine symbiotic nitrogen fixation by Vicia faba, using barley as a standard.

The active root distribution pattern of trees was determined by injecting ^{32}P and ^{33}P-labelled phosphate solutions at different depths around the base of the trees. Leaf samples were taken for the analysis of the isotopes three weeks after injection into the soil.

A greenhouse experiment was carried out to determine the availability of a few natural rock phosphates on different soil types using ^{32}P-labelled superphosphate as a standard.

The participants were acquainted with the preparation and assay of radioactive isotopes by means of G.M. counting, solid scintillation and liquid scintillation counting techniques as well as the determination of the stable isotope ^{15}N in plant material. Experiments in liquid scintillation counting included the preparation of channels ratio quench correction curves, Cherenkov counting, and double-label counting.

Several days were devoted to the use of the neutron- and gamma-density probes for the determination of soil moisture changes in field plots.

During the course, all participants had an opportunity to report on related research in their home country and to discuss the future development of their programmes with staff of the Joint Division and the Laboratory. In addition to Laboratory and Joint Division staff, Prof. H. Faust from the G.D.R., Prof. K. Reichardt from Brazil, and Prof. R. Soper from Canada gave lectures to the participants and were involved in the field and laboratory exercises.

Report on the FAO/IAEA Interregional Training Course on the Use of ^{15}N in Soil Science and Plant Nutrition

Leipzig, German Democratic Republic

21 May - 17 June 1979

The Interregional Training Course on the Use of ^{15}N in Soil Science and Plant Nutrition was held during 21 May to 17 June 1979 at the Zentralinstitut für Isotopen- und Strahlenforschung, Leipzig, German Democratic Republic.

The purpose of the course was to train scientists from developing countries in all aspects of the use of nitrogen-15-enriched and depleted compounds in soil and plant nutrition studies. Particular attention was placed on laboratory experiments and studies directed towards improving the techniques of ^{15}N determination in soil and plant samples and the efficiency of the use of nitrogenous fertilizers in agricultural practices.

Nineteen participants were selected from Afganistan, Argentina, Benin, Bulgaria, Czechoslovakia, Costa Rica, Egypt, India, Indonesia, Jordan, Pakistan, Philippines, Sri Lanka, Syria, Tanzania, Thailand, Turkey, Yemen (P.D.R.), and Zambia. The course programme included lectures on different aspects of the basic use of ^{15}N methodology in soil and plant nutrition research, time for discussion of the participants' work in their home countries, laboratory experiments with soil and plant samples, scientific visits to the different agriculture research institutes of the G.D.R. and excursions.

Drs. H. Broeshart and V. Ladonin, Agency staff members, Dr. H. Faust, Director of the course, and staff members of the Host Institute delivered lectures according to the programme of the course.

The basic part of the course dealt with the determination of the total N and N-containing fractions from soil and plants, sample preparation for

isotope ratio analysis, isotope ratio determination by mass- and emission-spectrometry, plant uptake of labelled fertilizer nitrogen and losses of nitrogen by leaching and volatilization. Six groups were formed and each group had one instructor from the staff members of the Host Institute to supervise their work.

During the course the participants visited the Institute of Mineral Fertilizer in Leipzig and the Experimental Station of this Institute, the Institute of Plant Biochemistry in Halle, the Institute of Plant Nutrition in Jena, the Isotope Laboratory of the Central Institute of Crop Research in Gatersleben and the Agricultural Exhibition "Agra" in Leipzig.

Announcement of the

FAO/IAEA Training Course on the Use of Radiation Equipment for Soil Moisture Studies

Place:	Centre d'Etudes Nucléaires de Cadarache, Saint-Paul-lez-Durance, France
Time:	23 June - 12 July 1980
Organizers:	International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations in cooperation with the Commissariat a l'Energie Atomique (CEA), France
Language:	French
Purpose:	The objective of the course is to provide intensive training in the use of radiation equipment used for measuring soil moisture and bulk density to French speaking technicians in developing countries. Through the course, technicians will gain experience in using radiation equipment in applied research aimed at improving the efficiency of water use on irrigated land and the development of adequate water management practices under rain-fed agriculture. It is intended that the course assist in filling a gap of trained technicians in this field, which presently prevents many Member States from utilizing the above-mentioned powerful research tools.
Nature of the Course:	The course would emphasize the calibration, proper handling and maintenance of the various types of radiation equipment. The advantages and limitations of the equipment would also be thoroughly discussed. In addition, due consideration would be given to the interpretation of results and to reducing or eliminating possible sources of error, for example through proper placement of access tubes and avoiding soil compaction. It is planned that the first

week of the course would provide the basic information essential for explaining the theories involved and the precautions necessary to avoid radiation hazards while the remaining two weeks would concentrate on the practical applications of the equipment in the field.

VISITS TO THE SECTION

- Dr. D.F.R. Bommer, Assistant Director General, FAO, Rome, Italy, visited the Section on 27 August 1979. He dicussed current FAO/IAEA programmes and plans for the implementation of new programmes with the staff of the Section.

- Mr. Drevon of the Ministère de l'Agriculture, Laboratoire de Recherche sur les Symbiotes des Racines, Institut National de la Recherche Agronomique, Montpellier, France, visited the Section for discussions on current research in the field of dinitrogen fixation. Mr. Drevon was on a stop-over visit while travelling to Africa as an FAO consultant on legume inoculation technology.

- Dr. Fausto Muñoz Ribadeneira, Secretary General of the Atomic Energy Commission of Ecuador visited the Section on 18 May 1979 to discuss present activities in agricultural applications of nuclear energy in Ecuador and the present construction of the nuclear center near Quito.

- Mr. Grière, Director of Research, World Phosphate Institute, Paris, France, visited the Soils Section on 30 and 31 July 1979.

  This Institute was founded in 1973 and is being financed by important phosphate mines in various parts of the world. Those mines are mainly: Office Sherifièn des Phosphates (Morocco); International Mines Corp. (IMC, U.S.A.); Jordan Mines (Governmental Organization); Gafsa Mines (Tunisia); Sonarem (Algeria); Taïba (Senegal); Comp. des Mines du Benin (Togo); Union of Brazilian Mines linked in an association called IBRAPHOS; Gardinier (phosphate mines owned by a French group in the U.S.A.).

  The objectives of the World Phosphate Institute are essentially scientific, mainly to contribute to increasing agricultural production through promoting the proper use of phosphorus as fertilizer. The Institute also tries to promote other possible uses of phosphorus compounds, for example, in detergents, paints, and pesticides.

  Mr. Grière showed great interest in the activities of the Soils Section. He indicated that the Institute would be willing to consider supporting research programmes or technical assistance projects aimed at increasing yields through improving the efficiency of phosphatic fertilizer use in addition to the development of other more adequate management practices.

- Dr. H. Wachtel, Director of the Donau Reno Hyperphosphate Society visited the Section on 21 September 1979. He provided interesting information about his concern's current investigations in Austria and the important role played by Hyperphosphate (a natural phosphorus source having at least 55% of its total P in a form soluble in formic acid) in western Europe.

COMING EVENTS

FAO/IAEA Regional Seminar on the Use of Isotope and Radiation Techniques in Soil and Water Conservation Studies for Developing Countries in the African Region

Khartoum, Sudan
12-17 November, 1979

FAO/IAEA Research Coordination Meeting on Isotope Techniques in Studies of Biological Dinitrogen Fixation

Vienna, Austria
25-29 February, 1980

FORTHCOMING PUBLICATIONS

"Use of Isotopes and Radiation in Research on Soil-Plant Relationships" (Proceedings of the FAO/IAEA International Symposium on the Use of Isotopes and Radiation in Research on Soil-Plant Relationships held in Colombo, Sri Lanka during 11 - 15 December 1978).

"Soil Nitrogen as Fertilizer or Pollutant" (Report and Proceedings of a Fourth Research Coordination Meeting of the FAO/IAEA/GSF Coordinated Programme of Research on Agricultural Nitrogen Residues held in Brazil, 3-7 July, 1978).

"Grain Legumes: Management for Optimum N-Fixation and Fertilizer Utilization" (Results of a Five-Year Coordinated Research Programme of Experiments Using Isotopically Labelled Fertilizers Executed in Eleven Countries and Sponsored by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture).

"Radiation and Isotope Techniques in Studies of Soil-Water Regimes" (Results of a Five-Year Coordinated Research Programme of Experiments carried out in ten countries designed to develop techniques for studying water movement in different unsaturated soils and obtain reliable estimates of drainage percolation of representative soil profiles in Member States).

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