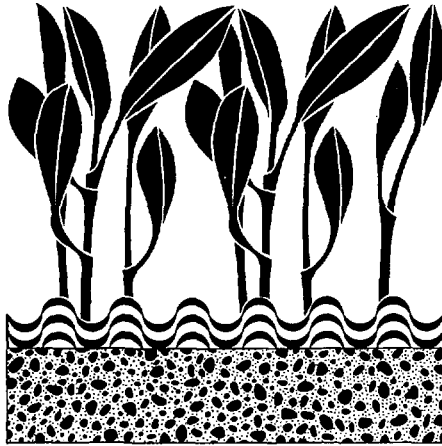




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Soils Newsletter

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

INTERNATIONAL
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TO OUR READERS

The past years have witnessed a growing impact of the application of nuclear tools in agricultural research of which soil-water-plant relations research forms a major component. This development has coincided with an increasing awareness on the part of atomic energy commissions and agricultural research organizations, especially in the developing countries, of the potential of isotope and radiation techniques in research aimed at enhancing crop production and improving the quality of crops in the most economic way. The Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture, which has as its main activity the assistance to developing Member States of FAO and IAEA in the applications of nuclear energy to food and agriculture, considers it timely to initiate the publication of a Soils Newsletter.

The objectives of the Joint FAO/IAEA Division are to contribute to increasing and stabilizing agricultural production, improving food and feed quality, protecting agricultural products in the field and post-harvest, and minimizing pollution of food and agricultural environment through sound problem-oriented research with the aid of isotope and radiation techniques. These objectives are achieved through three major activities, namely, coordinated research contract programmes*, technical assistance projects*, and organization of international symposia and seminars. The Joint Division ensures collaboration with international, regional, and national organizations to integrate its activities with more conventional approaches.

The purpose of the Newsletter is to facilitate rapid pooling and dissemination of information arising out of international cooperative efforts in the use of nuclear techniques for research into soil fertility, fertilizer usage, plant nutrition, soil moisture and irrigation. We shall endeavour, at as regular intervals as possible, to inform the scientists working in these fields about the programme, progress and development of the activities of the Soil Fertility, Irrigation and Crop Production Section of the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture. Results of the coordinated research programmes under the purview of the Section will be published. The progress and major accomplishments of the technical assistance projects currently operating in nearly twenty-five Member States in Asia, Africa, Europe and Latin America will be reported.

We would also like to use the Newsletter as a forum for dissemination of information on the latest developments in isotope and radiation-aided research into soil-water-plant relations in Member States and would greatly welcome contributions in this regard from our readers. We request you to kindly supply such material.

We shall also highly appreciate receiving your valued comments and suggestions for the improvement of the Newsletter.

We thank you in advance for your collaboration in this endeavour and wish you every success in your activities for 1978 and the years to come.

SOIL FERTILITY, IRRIGATION
AND CROP PRODUCTION SECTION

* For further details on the nature of these activities, the reader may refer to the publication "IAEA Services and Assistance, IAEA, Vienna, pp. 76 (1974)"

STAFF OF THE SOIL FERTILITY, IRRIGATION AND CROP PRODUCTION SECTION
OF THE JOINT FAO/IAEA DIVISION OF ATOMIC ENERGY IN FOOD AND AGRICULTURE
AND THE STAFF OF THE AGRICULTURE SECTION OF THE IAEA LABORATORY
AT SEIBERSDORF

The Soil Fertility, Irrigation and Crop Production Section is one of the six Sections of the Joint Division, headed by Dr. M. Fried, Director. Together with two other Divisions, the Joint Division belongs to the Department of Research and Isotopes, headed by Dr. H. Kakihana, Deputy Director General, IAEA. The Joint Division is also part of FAO (Division: AGE) belonging to its Agriculture Department, headed by Dr. D.F.R. Bommer, Assistant Director General, FAO.

The present Staff of the Soil Fertility, Irrigation and Crop Production Section consists of the following:

- Dr. Y. Barrada (Egypt), Senior Officer, Head of the Section
(since: 1964)
- Dr. F.E. Broadbent (U.S.A.), SSA (Sabb. Leave)
(since: 1977)
- Dr. V. Ladonin (U.S.S.R.), First Officer
(since: 1977)
- Dr. K.B. Mistry (India), First Officer
(since: 1977)
- Dr. M.F. L'Annunziata (U.S.A.), Associate Officer
(since: 1977)
- Ms. Charlotte Fiscus (U.S.A.), Secretary
(since: 1975)
- Ms. Marina Kneissl (Austria), Secretary
(since: 1976)

The Agricultural Section of the IAEA Laboratory at Seibersdorf is mainly concerned with the analytical services, and implementing research at the Laboratory which complements the programmes of the Joint FAO/IAEA Division. The following Staff of the Agricultural Section are at present contributing to the activities of the Soil Fertility, Irrigation and Crop Production Section of the Joint Division:

- Dr. H. Broeshart (Netherlands), Senior Officer, Head, Agriculture
(since: 1961) Section
- Dr. R.J. Rennie (Canada), Associate Officer
(since: 1976)
- Ms. H. Axmann (Austria), Senior Technician
(since: 1963)
- Mr. G. Proksch (Austria), Senior Technician
(since: 1963)

- Mr. S. Borovits (Austria), Laboratory Technician
(since: 1970)
- Ms. M. Kelemer (Federal Republic of Germany), Laboratory Technician
(since: 1971)
- Mr. L. Mayr (Austria), Laboratory Technician
(since: 1975)
- Mr. F. Stöckl (Austria), Laboratory Technician
(since: 1973)
- Mr. P. Wolfik (Austria), Laboratory Technician
(since: 1975)
- Ms. E. Pereira (Austria), Secretary
(since: 1976)

The Section enjoys the benefit of close association with Dr. M. Fried, Director, Joint Division, who is an internationally renowned authority on soil fertility, soil-plant relationships and fertilizer usage and has pioneered the use of nuclear techniques in these and cognate fields. Dr. C. Lamm, Deputy Director, Joint Division, who is a leading soil chemist with long experience in isotopic tracer methodology is also associated with the activities of the Section, especially the large-scale technical assistance projects.

WORK PROGRAMME OF THE SOIL FERTILITY, IRRIGATION AND CROP
PRODUCTION SECTION OF THE JOINT FAO/IAEA DIVISION OF ATOMIC
ENERGY IN FOOD AND AGRICULTURE

The objective of the Soil Fertility, Irrigation and Crop Production Section is to advise and assist Member States of FAO and IAEA in connection with the application of isotopes and radiation techniques in problem-oriented research on soil fertility, plant nutrition, irrigation and other soil and water management practices with a view to improving the quality of crops and increasing crop production in the most economic way.

The objective is achieved through coordinated research programmes with assistance as required by the IAEA Laboratory in Seibersdorf, technical assistance projects and training programmes. Coordination, dissemination of results and reviews are ensured through meetings and publications.

The coordinated research programmes currently under the purview of the Soil Fertility, Irrigation and Crop Production Section are described here. The technical assistance projects, training courses, symposia, seminars and meetings for which the Section has technical responsibility as well as soils research activities at the Seibersdorf Laboratory are described elsewhere in this Newsletter.

COORDINATED RESEARCH PROGRAMMES

The coordinated research programmes are designed to solve very practical agricultural problems of relevance at the national as well as regional levels. The objectives of each programme are discussed and drawn up by specially convened panels of experts. Competent research institutes are then contacted and invited to take part in the programme, which is normally of the duration of approximately five years. Institutes in developing Member States are normally awarded research contracts with nominal financial support, while institutes in the developed Member States usually participate under cost-free research agreements. The participants in the coordinated programmes meet periodically to review the results achieved, and to discuss and decide on the future activities.

I. Coordinated Research Programme on the Use of Isotopes in Fertilizer Efficiency Studies on Grain Legumes (1973-1978)

Participating Countries: Australia, Brazil, Egypt, Ghana, Greece, Hungary, India, Peru, Romania, Senegal, Sri Lanka, U.K., U.S.A.

Objectives: The programme, which has involved the use of ^{15}N -, ^{32}P -, and ^{33}P -labelled fertilizer materials, has been aimed at evaluating: (i) the influence of method, time and source of fertilizer application, with particular reference to nitrogeous and phosphatic fertilizers, on the efficiency of fertilizer utilization and crop yields; (ii) the impact of fertilizer application on the symbiotic fixation of atmospheric nitrogen; and (iii) the influence of other agronomic practices such as irrigation, the liming of acid soils, and mulching with straw on the efficiency of fertilizer utilization, nitrogen fixation, and crop yields.

Brief Summary of Results: The final meeting of the participants of this Coordinated Research programme was held during November 1977, and a technical publication incorporating the major findings obtained by all cooperators of this programme is currently under preparation. A report of the meeting which *inter alia* summarizes the important results of the programme is included elsewhere in this issue of the Newsletter.

II. Coordinated Research Programme on Isotope-Aided Micronutrient Studies in Rice Production with Special Reference to Zinc Deficiency (initiated in 1974)

Participating Countries: Australia, Bangladesh, Egypt, India, Indonesia, Korea, Pakistan, Philippines, Thailand, U.S.A.

Objectives: To develop diagnostic methods and remedial measures for zinc deficiency in flooded rice soils.

Brief Summary of Results to Date: Following the analyses of grain, plants, and soils collected from rice fields representative of major rice growing regions in the countries participating in the programme, zinc deficiency was confirmed in Egypt, India, Korea, Pakistan, Philippines, Thailand, and the U.S.A. Indications of copper deficiency were reported in Thailand, Korea, and Pakistan. A significant result of the programme is that for the first time in many participating countries, analytical data are now at hand on available zinc and other micronutrients in soils and in plants from representative rice growing tracts. In the study of soil analytical methods for identifying zinc deficiency, DTPA and HCl were found to be the

more promising soil extractants for predicting the zinc status of flooded rice soils; zinc in these extracts correlated well with plant zinc. Using ^{65}Zn it was found that application of zinc sulphate on the soil surface and in the water was more effective than mixing in the soil in Thailand and Egypt, whereas in Pakistan and India, soil-mixed application was the most efficient. Results have also indicated that ZnSO_4 was superior to ZnEDTA as a source of zinc for flooded rice. Current project activities are directed to field experiments on the comparative efficiency of various methods and sources of zinc fertilizer application to flooded rice grown on zinc deficient soils using ^{65}Zn -labelled fertilizers. Residual effects of the applied zinc will also be studied.

III. Coordinated Research Programme on Isotope Techniques in Studies of Biological Dinitrogen Fixation for the Dual Purpose of Increasing Crop Production and Decreasing Nitrogen Fertilizer Use to Conserve the Environment (initiated in 1978)

Objectives: To obtain more effective symbiotic and associative dinitrogen fixation to reduce the need for nitrogenous fertilizer application in developing countries.

The programme objectives will be met through approximately twelve research contracts to institutes in developing Member States and six to eight cost-free research agreements. The programme is partially financed by the Government of Sweden.

The supported research will employ isotopic techniques aimed at the field optimization of N_2 fixation on a short-term basis. A major problem to be attacked is the quantitative measurement of the amount of N_2 fixed by crops grown in the field. Nitrogen-15 will be used to make and improve the methodology of this quantitative measurement under field conditions. The stable isotope of nitrogen will also be applied to the solution of such important problems as: (i) the development and field testing of viable, effective, and competitive N_2 fixing bacteria adapted to the soil and climatic conditions of particular localities, which can compete with indigenous and ineffective strains; (ii) the determination of the conditions needed so that the effective host plant-bacterial symbiotic combinations thrive in the field whereby all or most of the nitrogen requirements of the plant are satisfied; (iii) the improvement of inoculation technology so as to insure the survival of the inoculant under various field conditions; (iv) the optimization of crop utilization of N_2 fixed by algae and algal-fern associations in the field; and (v) the improvement of plant-microbial symbioses for grasses and cereals.

IV. Coordinated Research Programme on the Use of Radiation and Isotope Techniques in Studies on Soil Water Regimes (1972-1978)

Participating Countries: Belgium, Brazil, Chile, Cyprus, France, Israel, Japan, Madagascar, Nigeria, Syria, Thailand.

Objectives: To contribute to a better understanding of water movement in unsaturated soils through the development of techniques which will make it possible to obtain a reliable estimate of the drainage percolation of soil profiles in the field. The information gained through this programme would lead to appreciable savings in water, to the development of adequate soil and water conservation practices, to more efficient use of fertilizer by crops, and to the control of possible pollution.

Brief Summary of Results to Date: Soil moisture changes in representative soil profiles in Member States have been followed with neutron moisture meters and hydraulic conductivity determined as a function of soil moisture content for different soil types. The spatial variability of soil hydraulic conductivity in fields having an area of 10 to 20 hectares was thoroughly investigated. The drainage component has been estimated and water balances have been established. The results obtained have served as a basis for the development of practices aimed at increasing crop yields, reducing water losses and avoiding accumulation of salt near the soil surface.

V. Coordinated Research Programme on Isotope and Radiation Techniques for Efficient Water and Fertilizer Use in Semi-Arid Regions (initiated in 1978)

Objectives: This isotope and radiation techniques-aided research programme is aimed at developing practices for: (i) increasing effective soil-water storage, through increasing water infiltration, reducing evaporation, and organic matter application; (ii) harvesting water for subsequent use; (iii) enhancing efficiency of water and fertilizer use by crop plants; and (iv) controlling wind and water erosion.

The programme implementation will involve the award of eight to twelve research contracts to institutes in developing Member States and two to three cost-free agreements.

VI. Coordinated Programme of Research on Agricultural Nitrogen Residues with Particular Reference to their Conservation as Fertilizers and Behaviour as Potential Pollutants (in collaboration with the Chemical Residues and Pollution Section of the Joint FAO/IAEA Division and supported by the Government of the Federal Republic of Germany, initiated in 1975)

Participating Countries: Brazil, Canada, Chile, Denmark, Egypt, India, Israel, Japan, Mauritius, Netherlands, New Zealand, Pakistan, Peru, Romania, Trinidad, U.S.A., Yugoslavia.

Objectives: To contribute to the control of the pollutant potential of fertilizer nitrogen residues as undesirable nitrate in food, feed, or water and to improve their conservation in soil as useful plant nutrients.

Brief Summary of Results to Date: Work has been directed towards understanding the long-term fate of fertilizer nitrogen in the soil-air-water-plant ecosystem. Specifically, the ^{15}N isotope-aided experiments in progress involve the measurement of the uptake of both the soil and fertilizer nitrogen by crops, the residual value of fertilizer nitrogen for subsequent crops, the quantities of inorganic and organic forms of residual fertilizer nitrogen within the rooting zone, losses of gaseous nitrogen to the atmosphere and losses of nitrogen through leaching below the rooting zone. Results for at least five years are required for arriving at meaningful conclusions on the fate of fertilizer nitrogen residues in the terrestrial foodchain.

TECHNICAL ASSISTANCE PROJECTS

The Soil Fertility, Irrigation and Crop Production Section has the technical responsibility for a number of assistance projects funded out of the regular budget of the Agency in the developing Member States. The assistance provided for these projects, which is on a relatively modest scale, takes the form of experts and specialized equipment, often together with fellowship training for the counterpart staff in the recipient Member State. Currently the Section has the technical responsibility for the implementation of twenty-two technical assistance projects dealing with the application of isotope and radiation techniques to solve specific and urgent problems of soil fertility, fertilizer usage, plant nutrition, soil moisture and water management in twenty Member States in Africa, Asia, Europe and Latin America. In addition, the Section is also concerned with the soils component of the large-scale multi-disciplinary projects on nuclear techniques in agriculture which are being executed by the Agency in Bangladesh and Brazil, as well as a small-scale project in Syria financed by the United Nations Development Programme (UNDP) or the Swedish International Development Authority (SIDA). A brief account of the technical programme of regular-budget-funded projects and the nature of assistance provided by the Agency is presented here.

I. AFRICA1. Egypt

Assistance will be provided, subject to availability of funds, to the Department of Agriculture for Soils and Water Research, Atomic Energy Establishment, Cairo, for establishing a central facility for ^{15}N analyses of plant and soil samples and initiating a programme of ^{15}N -aided studies on efficient nitrogen fertilization of major cereal crops of the country including transformation and losses of applied nitrogen. The provision of an emission spectrometer for ^{15}N analysis, labelled fertilizers, expert services for six man-months, and awards of training fellowships and travel grants for scientific visits is envisaged.

2. Ivory Coast

In continuation of the aid provided by the Agency over the past three years to the Institut des Savanes, Bouake, the Institute will receive four man-months of expert services, a liquid scintillation counting system which is being gifted by the Government of the USA, and radioisotopes. The current assistance would help to foster the isotope-aided research programmes on development of techniques for rooting pattern studies on upland rice and on the transport of photosynthates in rice plants under drought conditions.

3. Kenya

Assistance is being provided to the Radioisotope Laboratory, Coffee Research Station, Ruiru, for a research programme aimed at studying the problems of soil moisture, root activity and timing and placement of nitrogen and phosphate fertilizers associated with newly introduced close-spaced planting of coffee through isotope and radiation techniques. This programme would help to rationalize the soil water and fertilizer management practices for coffee which is the most important cash crop of the country. A neutron moisture meter, labelled fertilizers and twelve man-months of expert services are being provided for this project through a grant from the Government of the USA.

4. Morocco

In continuation with the aid provided over the past year to the Central Radioisotopes Station, Tangiers, the Agency will, subject to the availability of funds, assist in a new research programme aimed at establishing the optimum source, method and time of application of nitrogen and phosphate fertilizers for sugarcane cultivation in Morocco. This project would be implemented largely through isotope-aided field experiments, and the Agency assistance would be in the form of expert services, awards of training fellowships and labelled fertilizer materials.

5. Niger

The Agency is providing the services of a consultant for the establishment of a radioisotope laboratory at the Institut National de Recherches Agronomiques (INRAN), Niamey, and advice on application of nuclear techniques in specific programmes of soil-plant relations and water-use research, requirements of equipment and assessment of future needs for expert services and training facilities for successful implementation of such research programmes.

6. Senegal

The Agency is continuing its assistance to the National Agronomic Research Centre, Bambey. During 1978 the Centre will receive aid for implementation of new projects on (a) soil fertility and root system studies on cereals and grain legumes with special reference to amelioration of phosphate deficiency, liming and screening for drought resistance; and (b) studies on the effects of utilization of sodium-rich underground waters for irrigation on soil properties. The Agency's assistance is in the form of expert services, neutron moisture and density probes, beta-gamma counting assembly and ancillary equipment as well as labelled fertilizers. Aid would also be provided to the National Centre of Forestry Research, Dakar, for isotope-aided studies aimed at minimizing the cost of correction of phosphate deficiency in plantations of casaurina, Eucalyptus and other wood forming species.

7. Tanzania

The Faculty of Agriculture, University of Dar-es-Salam is being assisted in the establishment of a radioisotope laboratory for training and research in the use of nuclear techniques in agriculture. Following an earlier consultancy mission by a Staff Member of the Agency, basic radiation detection and measuring equipment for the isotopic-tracer laboratory including neutron moisture meters and two man-months of expert services are being provided by the Agency. The assistance would help to plan and initiate a sound research programme aimed at efficient water management practices under dry farming, as well as irrigated cultivation in Tanzania. The services of an expert in soil fertility and plant nutrition will also be made available for the duration of three months. The expert will cooperate in planning and initiating applied research with labelled fertilizers aimed at increasing the efficiency of fertilizer use.

8. Zambia

The Agency is providing the services of a consultant to the Central Agricultural Research Station, Makalu, to advise in the planning of isotope and radiation techniques-aided research programmes aimed at increasing crop

production, indicate the equipment and facilities required and assess future needs for expert services and training of local scientists for successful implementation of such research programmes.

II. ASIA AND THE PACIFIC

1. Pakistan

The Agency is assisting the Division of Plant Physiology, Atomic Energy Agricultural Research Centre, Tandojam, to carry out research on salt tolerance in crops and in the management of saline soils using isotope techniques. Since nearly 25 per cent of the total cultivable area in Pakistan is affected by water logging and salinity to varying extent, development of practices for efficient utilization and amelioration of salt-affected soils is a high priority area of research in the country. A walk-in type controlled environment growth chamber is being provided to complement the facilities already available for the project.

2. Philippines

Subject to the availability of funds, the Agency will provide three man-months of expert services, an emission spectrometer and accessories for N-15 analysis and N-15 labelled fertilizers for initiating a programme of research on dinitrogen fixation by soybean varieties under tropical conditions. This project is linked to the high-priority national programme on development of high yielding varieties of soybeans which is important as feed, food and raw material for general industries in the Philippines.

3. Sri Lanka

Assistance is being provided to the Central Agricultural Research Institute, Peradeniya for a new research programme aimed at delineating the micronutrient status of the soils of Sri Lanka through soil and tissue analysis, studying the uptake of zinc and iron compounds using radioisotope labelled fertilizers and selecting rice varieties tolerant to zinc deficiency and iron toxicity. This research is linked to a programme of breeding and selection of rice varieties sponsored by the International Rice Research Institute. Since micronutrient deficiencies and imbalance are suspected to limit crop growth for lowland rice, as well as upland grain legumes, the programme is of immense practical value to the country's food production drive. An atomic absorption spectrophotometer with accessories for micronutrient analysis, four man-months of expert services and an award of a training fellowship will be provided for this programme.

4. Thailand

The Agency is assisting the Isotope Laboratory, Division of Agricultural Chemistry, Department of Agriculture, Bangkok, in implementing a new isotope-aided research programme aimed at comparing the effectiveness of ammonium chloride and ammonium sulphate as sources of nitrogen for lowland rice and assessing the possible adverse effects of long-term usage of ammonium chloride fertilizer, which is the cheapest nitrogen source in Thailand, on root activity of rice and the quality of subsequent upland crops grown in rotation with rice. Assistance is also being provided for the continuation of the Agency-sponsored research programme of isotope-aided studies on micronutrient problems related to rice production with special reference to zinc deficiencies. The two programmes are considered to be of significant and economic importance to agricultural production in

the country. Six man-months of expert services, labelled fertilizers, as well as equipment such as an automatic multi-element analyzer, atomic absorption spectrophotometer with accessories for micronutrient analysis, soil coring and sampling machine, which are being procured out of a grant from the Government of the USA, will be provided for these programmes.

III. EUROPE AND THE MIDDLE EAST

1. Bulgaria

The Agency is assisting in the development of rapid methods of soil, soil solution, and plant analysis with the aid of neutron activation techniques at the N. Poushkarov Institute of Soil Science, Sofia. These methods would enable the assay of a very large number of soil samples collected from experimental fields all over the country. The results obtained would form the basis for the development of adequate soil and water management practices leading to enhanced agricultural production. The assistance being provided include the services of an expert for one man-month, a programmable multichannel analyser system with Ge (Li) detector and an award of training fellowship.

2. Greece

The Agency is assisting the project aimed at development of optimal fertilizer practices including application of green manures, farm residues and lime amendments for wheat, cotton, sugarbeets and legumes which are the major economy crops of the country. The work involves field, greenhouse and laboratory studies using a variety of stable and radioactive isotopes at the Department of Soils and Plant Nutrition, N.R.C. Democritos, Athens. Assistance which is being provided through a grant from the Government of the USA is in the form of a liquid scintillation counter which is essential for the assay of radioisotopes in plant and soil samples.

3. Iceland

Assistance is being provided to the Agriculture Research Institute of Iceland in isotope-aided studies on the role of mineral nutrients in raising the production of winter feed of livestock. One man-month of expert services, as well as related equipment will be made available under this project.

4. Romania

The Agency will provide, subject to the availability of funds, assistance to the ICCPT-Fundulea, Ilfov, for tracer-aided studies on the development of efficient fertilizer practices for the newly introduced hybrid sunflower crop which is expected to cover the entire area under sunflower cultivation in the country. The assistance will be in the form of a liquid scintillation counting system, ancillary equipment, expert services and awards for training fellowships and scientific visits for senior scientists.

IV. LATIN AMERICA

1. Chile

Assistance is being provided to the Soils Department, Agronomy Faculty, Catholic University of Chile and the Agriculture Department,

Chilean Nuclear Energy Commission at Santiago for implementing isotope-aided research programmes aimed establishing the optimum source and time of application of nitrogenous and phosphatic fertilizers for cereal crops including Triticale on principal soil types of the country. The programme is expected to result in the development of efficient fertilizer practices for food grain cultivation in Chile. The Agency is providing some radiation detection and measuring equipment, expendable supplies, and training fellowships to complement the facilities already available for the project.

2. Ecuador

The Agency is assisting the Ecuadorian Atomic Energy Commission (CEEAA) in organizing a training course at the national level to enable agricultural specialists to become familiar with the application of isotope and radiation techniques in agricultural research programmes. This project is expected to lead to a country-wide programme on use of nuclear techniques for agricultural development. Assistance provided includes equipment, radioisotopes and two man-months of expert services.

3. Peru

As a follow-up of the aid provided by the Agency over the past two years to the National Agrarian University, Lima, the Agency is assisting in the implementation of a national training centre for the use of isotope and radiation techniques in agriculture and development of sound research programmes in different disciplines of agricultural science. Expert services for the duration of six man-months in the fields of soil fertility, fertilizer usage and soil microbiology, related equipment, labelled fertilizers and awards of training fellowships are being provided.

4. Uruguay

As a follow-up of the earlier Agency-sponsored project of photosynthesis studies in grape vines at the Institute of Viticulture, Canalones, assistance is being provided to the Institute for developing a programme of isotope-aided studies on photosynthetic efficiency of sugarcane, sugarbeet, potato, and sweet potato crops and assessment of the country's potential for production of carbohydrates from these sacchariferous species as an energy source. Four man-months of expert services and an award of a training fellowship have been allocated for this project.

SOILS RESEARCH AT AGRICULTURAL SECTION,

SEIBERSDORF LABORATORY

Research employing isotopes in soils at the IAEA Laboratory, Seibersdorf has been, in the main, related to agricultural nitrogen residues and soil microbiology.

I. Nitrogen Residues

Serious pollution of ground water may occur by application of fertilizer nitrogen. A two-year study to follow the fate of ^{15}N -labelled urea nitrogen applied to spring and winter wheat showed that nitrate nitrogen reached a depth of 150 cm in the soil profile by approximately 100 days. After this time it disappeared, presumably into the ground water.

Experimentation concluded that in the coarse, stoney Seibersdorf soil, sampling of the soil solution by suction probes was not possible and that only destructive analysis of the soil profile to at least 2 meters would yield a quantitative estimate of the fate of applied fertilizer nitrogen.

One means of preventing this loss of fertilizer nitrogen, either by leaching into the ground water, or by denitrification, is to retard the rate of appearance of nitrate nitrogen in soil. Experiments where winter wheat received ^{15}N -labelled urea either as sulfur-coated urea (SCU) or para-benzylquinone-treated urea (PBQ), both of which theoretically reduce hydrolysis of urea, showed that neither would decrease potential pollution of ground waters in the Seibersdorf soil. PBQ was not an effective inhibitor of urea hydrolysis in this soil; sulfur coating did prevent urea hydrolysis but to such an extent that this nitrogen was not plant available and thus remained in the soil to be leached into the groundwater. The application of normal unamended urea resulted in an increased uptake of soil and fertilizer nitrogen thus effectively reducing the nitrate pollution potential.

II. Soil Microbiology

1. Dinitrogen Fixation

Due to the increasing cost of fertilizer nitrogen, more emphasis is being placed on legumes capable of reducing atmospheric dinitrogen. In order to improve the amount of dinitrogen fixation, it is necessary to know how much dinitrogen is fixed. Present methods are either short-term assays (e.g., acetylene reduction) or are subject to substantial errors (e.g., the difference method). Labelling a soil with ^{15}N enables the determination of the amount of fertilizer, soil and atmospheric nitrogen in a legume if an appropriate non-fixing control plant is available. Experiments with soybeans showed that the best non-fixing control was the nodulating isoline infected with an ineffective Rhizobium japonicum (i.e., nodulation occurred but no dinitrogen fixation) in contrast to using the non-nodulating isoline as a control. In a soil where no indigenous rhizobia are present, a non-inoculated fixing plant supplied with sufficient nitrogen is an appropriate control.

Present experiments involve laboratory and phytotron studies on dinitrogen fixing organisms and legumes to contrast measurements of dinitrogen fixation as determined by $^{15}\text{N}_2$, C_2H_2 reduction and ^{15}N -isotope dilution techniques.

2. Denitrification

Although fertilizer nitrogen may be lost through leaching to pollute ground waters, extensive losses by reduction of nitrogen to gases also occur. Procedures are being developed to employ gas chromatograph-mass spectrometric analysis of nitrogenous gases emitted from soil to evaluate the actual extent of losses of applied fertilizer nitrogen through denitrification.

Report on the
FAO/IAEA RESEARCH COORDINATION MEETING ON THE USE OF ISOTOPES IN
FERTILIZER EFFICIENCY STUDIES ON GRAIN LEGUMES

Vienna, Austria

14 - 18 November 1977

The final meeting of participants in the Joint FAO/IAEA Coordinated Research Programme on the Use of Isotopes in Fertilizer Efficiency Studies in Grain Legumes was held during 14-18 November 1977 at the IAEA Headquarters in Vienna. The meeting was devoted to presentation and discussion of results of the 1976-77 experiments and to summaries of the overall programme, which was initiated in 1973.

In general terms, the objectives of the programme were to evaluate the influence of various fertilizer and management factors on yield, plant composition, efficiency of fertilizer utilization, and on nitrogen fixation by grain legumes. These factors included time of application of ammonium sulfate, method of placement of superphosphate, rate and time of application of urea, irrigation management and split application of high rates of urea, and effects of application of a foliar spray solution containing nitrogen, phosphorus, potassium and sulfur. The studies employed fertilizer materials labelled with ^{15}N , ^{32}P , or ^{33}P .

The following grain legume crops were grown in the Coordinated Research Programme:

- (1) Soybean, with experiments in Greece, Hungary, India, Romania, Sri Lanka, and the U.S.A.;
- (2) Common Bean, with experiments in Brazil, Greece, Peru, and Romania;
- (3) Broad Bean, with experiments in Egypt;
- (4) Groundnut, with experiments in Ghana and Senegal;
- (5) Cowpea, with experiments in Ghana.

Related work, but not the standard experiments, was performed by Research Agreement holders in Australia and the United Kingdom.

The experiments were conducted under a wide diversity of soil and climatic conditions, so that a concise summary of the results is very difficult to make. However, a few general statements can be made. Yield efficiency of phosphorus uptake, and in some instances, nitrogen fixation were improved by band placement of phosphate fertilizer. Phosphorus uptake was improved by a starter dose of nitrogen. Soybean was more responsive to fertilizer application of nitrogen than the other legumes. Broad bean and groundnut showed very little effect of nitrogen fertilizer. In some cases higher nitrogen uptake efficiency was achieved by means of the Hanway foliar spray, but in general, yield and total nitrogen uptake by the crop were not significantly improved. In a few instances the spray caused defoliation of the crop.

The experiments demonstrated the feasibility of the A-value method for measuring N_2 fixation in field trials where ^{15}N -labelled fertilizers are utilized, but emphasized the importance of having a suitable control crop

to use as a reference baseline. The experience gained in the Grain Legume Programme should be very useful as a guide in planning for the projected programme on N_2 fixation.

Participants in the November meeting in addition to representatives of the Joint Division included Mr. H. Braun, FAO, Rome; Mr. C. Atkins, Australia; Mr. A.M.L. Neptune, Brazil; Mr. M.R. Hamissa, Egypt; Mr. P. Kwakye, Ghana; Mr. E. Papanicolaou, Greece; Mr. J. Dombovari, Hungary; Mr. C. Hera, Romania; Mr. M.F. Ganry, Senegal; Mr. S.L. Amarasiri, Sri Lanka; and Mr. J. Day, United Kingdom. Project Officer for the programme was Mr. D. Nethsinghe, formerly of the Soil Fertility, Irrigation and Crop Production Section.

Report on the

FAO/IAEA ADVISORY GROUP MEETING ON THE POTENTIAL USE OF ISOTOPES IN THE STUDY OF BIOLOGICAL DINITROGEN FIXATION

Vienna, Austria

21 - 25 November 1977

The Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture sponsored an Advisory Group Meeting on the Potential Use of Biological Dinitrogen Fixation in Vienna during 21-25 November 1977. **Drs. R. Rennie, L. Mellado, M. Fried, and Y. Barrada** served as secretariat to the meeting. The meeting was attended by 33 participants from Australia, Belgium, Brazil, Canada, France, India, Nigeria, Romania, Spain, Sweden, United Kingdom, and the USA. A member of the Land and Water Division of the FAO, as well as representatives of IITA, and ICRISAT also participated.

The participants presented experimental results and review papers on the following aspects of biological dinitrogen fixation: (i) the biochemistry, genetics and energetics of N_2 fixation; (ii) asymbiotic N_2 fixation; (iii) the use of isotopes of nitrogen for the assay of dinitrogen fixation; (iv) the effect of management practices on dinitrogen fixation; and (v) international and national programmes on N_2 fixation.

The principal objectives of the meeting were to apply isotope and radiation techniques where appropriate for solution of the major problems associated with the improvement of dinitrogen fixation in the field in order to reduce the need for nitrogenous fertilizer application in developing countries and to avoid pollution due to the excessive use of fertilizer nitrogen. The employment of isotopic techniques were planned for the development of management practices which would insure conditions favorable for dinitrogen fixation in the field. It was decided that a major effort should be concerned with establishing the methodology for field determinations of dinitrogen fixation.

The Advisory Group recommended the initiation of a coordinated research programme dealing with the employment of isotopic techniques in the study of the following aspects of dinitrogen fixation:

- 1) Testing and comparing current methods of assaying dinitrogen fixation and developing more reliable techniques for in situ quantitative determinations of dinitrogen fixation;

- 2) Comparing various species of leguminous crops in symbiosis with different rhizobium strains with respect to their ability to fix atmospheric nitrogen under well-defined conditions;
- 3) The development of adequate management practices which would insure the prevailing of conditions most favorable for symbiotic dinitrogen fixation;
- 4) The residual effect of dinitrogen fixation on subsequent crops;
- 5) The development of field techniques which would improve associative symbiosis in addition to algal fixation of nitrogen with special emphasis on algal-Azolla associations.

Research was recommended to be undertaken principally with the employment of the stable isotope ^{15}N . This research would be implemented for the most part in institutes in developing countries through research contracts. Leading scientists in the field of dinitrogen fixation in developed countries would also be associated with the programme through cost-free research agreements. Due consideration is also given to the use of the radiotracer ^{15}N in these studies.

It is anticipated that the Proceedings of the Advisory Group Meeting will be published in June 1978.

TRAINING COURSES

The Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture organizes every year inter-regional training courses on the use of isotopes and radiation techniques in soil-water-plant relations research. The training courses are designed to give soil scientists the basic terms and principles necessary for understanding ionizing radiation, its detection and measurement, its associated hazards and most of the more common applications. Due consideration is also given to the detection of stable isotopes and providing a clear understanding of the possibilities of their use in research on soils and crops. Such understanding is essential in order to gain the maximum information from the use of isotopes and to design research experiments for the greatest effectiveness.

During 1978, two training courses will be held, viz., a five-week Interregional Training Course on the Use of N-15 in Soil Science and Plant Nutrition at Leipzig, German Democratic Republic, and a seven-week Interregional Training Course on the Use of Isotope and Radiation Techniques in Studies on Soil/Plant Relationships at the IAEA Laboratory at Seibersdorf. Details of these training courses are given below.

Interregional Training Course on the Use of N-15 in Soil Science and Plant Nutrition

Place: Zentralinstitut für Isotopen- und Strahlenforschung,
Leipzig, German Democratic Republic

Time: 3 May - 2 June 1978

Organizers: The International Atomic Energy Agency and the
Food and Agriculture Organization of the United

Nations, in cooperation with the Government of the German Democratic Republic.

Language: English

Purpose: The object of the course is to train scientists from developing countries in all aspects of the use of N-15 enriched and depleted compounds in soils and plant nutrition studies. Particular emphasis will be placed on laboratory exercises and studies directed towards improving the techniques of N-15 determination and the efficiency of the use of nitrogenous fertilizers.

Nature of the Course:

The syllabus of the course will include lectures, discussion periods, laboratory exercises with soils and plants, and scientific visits. The subject matter of the lectures will include the properties of isotopes of nitrogen, availability of stable isotopes N-15 and N-14 and principles of their separation, determination of N-15/N-14 ratios by mass- and emission-spectrometry, N-15 density-labelling experiments, isotope effects, tracer kinetics, N-balance studies in the soil-plant system, use of N-15 in research into atmospheric nitrogen fixation, nitrogen transformation, and management practices aimed at improving the efficiency of nitrogen fertilizer use.

The laboratory work will include determination of total N and N-containing fractions in soils and plants, preparation of samples for isotope-ratio analysis, sources of error, isotope dilution chemistry, isotope-ratio determination by mass- and emission-spectrometry, N-15 density labelling and positional N-15 isotope analysis by H nuclear magnetic resonance. Short-term applications of tracer methods, e.g., plant uptake of labelled fertilizer nitrogen, recovery of N-15 labelled ammoniacal nitrogen following incubation with soil, losses of nitrogen by leaching and volatilization will be undertaken. Design of field experiments, plant, soil, and soil-water sampling from field experiments and factors influencing the N-15 enrichment required for field experiments will be included.

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

Place: IAEA Laboratory, Seibersdorf, Austria

Time: 17 April to 6 June 1978

Organizers: International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations. Financed by the Swedish International Development Authority (SIDA).

Language: English

Purpose: The objective of the course is to provide intensive training on the use of both stable and radioactive isotopes and radiation equipment to scientists in developing countries who are actively engaged in research in soil science including plant nutrition, fixation of atmospheric nitrogen and fertilizer and water management practices. The course, which will deal with the basic principles and practical aspects of the subject, will help developing countries to build up adequately trained personnel who would be able to effectively utilize isotope and radiation techniques in sound applied research aiming at increasing crop production.

Nature of the Course: The course will deal with the principles involved in the use of both stable and radioactive isotopes and radiation equipment in research in soil chemistry, soil physics, plant nutrition, and fertilizer and water management practices. Through lectures, laboratory, greenhouse and field experiments, films and discussion groups, the course will provide information and practical experience to participants on how nuclear methods can be effectively used for increasing crop production economically through a better understanding of the soil-water-plant system.

The first three weeks of the course will be devoted to training in the basic principles of isotope and radiation methodology. Greater emphasis will be placed on those topics of direct relevance to the practical application of isotope and radiation techniques. Laboratory exercises will be designed to familiarize the participants with the principles involved, use of equipment, and laboratory discipline pertaining to the safe handling of radioactive materials and minimizing contamination risks.

During the latter four weeks, emphasis will be placed on the application of nuclear methods to research on soil science and plant nutrition problems of practical importance to developing countries. The practical exercises will be designed to allow the students to carry through to completion short-term research type projects. This would include planning, execution, sample preparation, analysis, interpretation and presentation of results.

ANNOUNCEMENT OF SYMPOSIUM

FAO/IAEA International Symposium on the Use of Isotopes and Radiation in Research on Soil-Plant Relationships

Colombo, Sri Lanka

11 - 15 December 1978

The Symposium will provide a forum for the dissemination of knowledge and exchange of information on recent progress in the understanding of soil-plant relationships through the use of isotope and radiation techniques.

The last symposium on this subject was held in Vienna in 1971. In the present symposium, attention will be focused on research on soil physical and chemical factors influencing plant growth, the uptake and translocation of nutrients by plants, fertilizer usage and other soil management practices, including irrigation, for increased and more efficient crop production. Special sessions of the Symposium will be devoted to problems associated with trees and micronutrients, legumes and nitrogen fixation, pastures and fertilizer efficiency. The meeting will be of interest to soil scientists, plant physiologists, agronomists and horticulturists interested generally in the field of soil-water-plant relationships, whether they are using isotopes in their research or not. The Proceedings of the Symposium are planned to be published within six months of the Symposium. The list of topics involving nuclear techniques are:

- (a) Soil physics (e.g., soil moisture and movement of water through soil and into plant, soil density, soil atmosphere).
- (b) Soil chemistry and analytical methods (e.g., dissolution, exchange, diffusion, mass flow, fixation, and losses of ions, transformation of organic matter, salinity).
- (c) Ion uptake and translocation in plants (e.g., uptake, losses, accumulation and translocation of ions absorbed through roots and leaves, root activity and root coalescence, mycorrhiza).
- (d) Fertilizer usage (e.g., sources, methods, times and rates of application).
- (e) Soil fertility and nutrient availability.
- (f) Other soil management practices (e.g., irrigation, soil and moisture conservation).
- (g) Mineral cycling.

Deadlines for
Submission
of Papers:

Form for Submission of a Paper with six copies of an extended synopsis	-	<u>31 March 1978</u>
Four copies of full text papers accepted for the Symposium	-	<u>10 October 1978</u>

Secretariat:

Scientific Secretary: 1. Dr. Y. Barrada*
Joint FAO/IAEA Division of Atomic Energy
in Food and Agriculture
International Atomic Energy Agency
P.O. Box 590, Kärntner Ring 11
A-1011 Vienna, Austria

* Further details on the Symposium may be obtained from Dr. Y. Barrada

2. Dr. H. Matsuo
 Land and Water Development Division
 Food and Agriculture Organization
 of the United Nations
 Via delle Terme Caracalla
 00100-Rome, Italy

Administrative Secretary: Ms. C. de Mol van Otterloo
 Conference Service Section
 Division of External Relations
 International Atomic Energy Agency
 P.O. Box 590, Kärntner Ring 11
 A-1011 Vienna, Austria

COMING EVENTS

FAO/IAEA Research Coordination Meeting on the Use of Radiation and Isotope
 Techniques in Studies of Soil-Water Regimes

Ghent, Belgium
 11-16 September 1978 (provisional)

FAO/IAEA Research Coordination Meeting on Isotope-Aided Micronutrient
 Studies in Rice Production with Special Reference to Zinc Deficiency

Jakarta, Indonesia
 11-15 September 1978 (provisional)

FAO/IAEA International Symposium on the Use of Isotopes and Radiation
 in Research on Soil-Plant Relationships

Colombo, Sri Lanka
 11-15 December 1978

FORTHCOMING PUBLICATIONS

"Isotope Studies on Rice Fertilization"
 (Results of a Five-Year Coordinated Research Programme of Experiments
 Using Nitrogen-15 Labelled Fertilizer Carried out in Ten Countries
 and Sponsored by the Joint FAO/IAEA Division of Atomic Energy in Food
 and Agriculture).

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 A-1011 Vienna, Austria

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