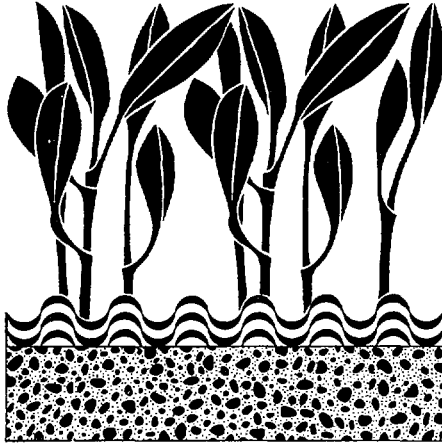




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Soils Newsletter



JOINT FAO/IAEA DIVISION
OF ISOTOPE AND RADIATION APPLICATIONS
OF ATOMIC ENERGY
FOR FOOD AND AGRICULTURAL DEVELOPMENT
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA

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TO OUR READERS.

This issue of the Soils Newsletter is to highlight some of the important activities and developments that have taken place in the Soil Fertility, Irrigation and Crop Production Section of the Joint FAO/IAEA Division, mainly during the second half of 1983. We are grateful for the increased requests we have received for the supply of our Newsletter, which we hope reflect on its value to our many readers and to those who happen to have known about it lately.

After a long and outstanding career as Head of the Agriculture Section of the IAEA Seibersdorf Laboratory, Dr. Hans Broeshart retired at the end of November, 1983. Hans, as he is popularly called, I am sure is known by many of our numerous readers, who will agree that the contribution he has made in the use of isotopes, in particular, in soil-plant nutrition studies will not end with his retirement. Hans plans to undertake various missions in Agency Technical Cooperation Projects, thereby continuing the good work he has always been involved in. Hans' place has been taken by an enthusiastic and young capable scientist, Dr. Klaus Reichardt. Klaus is also not a new comer in the field of nuclear techniques in agriculture and should be familiar in person or by name to many of our readers. Klaus is leaving for the Seibersdorf Laboratory after a rather short tenure as Head of the Soils Section in the Headquarters of the Joint FAO/IAEA Division of the Agency. Thus the headquarters will definitely miss the good services and friendliness of Klaus, but we believe the Seibersdorf task is so important as to justify such a move. To both Hans and Klaus, the staff of both the Headquarters and the Seibersdorf Laboratory, and I believe our keen readers wish you the best of luck in your new endeavours. In the mean time, Dr. S.K.A. Danso will be Acting as Head of the Soils Section in the Headquarters until further notice.

The Agriculture Section of the Seibersdorf Laboratory has expanded its activities to give increased attention to research and training in relevant biotechnology. As a result, the laboratory is now known as the FAO/IAEA Agricultural Biotechnology Laboratory.

This issue seems also to be the most appropriate place and time to thank our readers for the many encouraging letters and interest shown in our activities. We wish you all a very successful New Year.

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ONGOING COORDINATED RESEARCH PROGRAMMES.

(a) FAO/IAEA Coordinated Research Programme on Development of Fertilizer and Water Management Practices for Multiple Cropping

During the last Coordination Meeting it was agreed that all contractors would carry out two seasons of experiments involving legumes and cereals, with the aim of studying fertilizer use efficiencies, water balance and possible nitrogen "transfer" from the legume to the cereal. The main purpose of the first season's experiment is to evaluate amounts of nitrogen fixed by legume plants. In the second season the residual effect of fertilizers will be studied by comparing nitrogen and phosphorous A-values of the soil when the preceding crop was either a legume or a cereal. The third Research Coordination Meeting will be held in Indonesia, from 5-9 March 1984.

(b) FAO/IAEA Coordinated Research Programme on Isotope and Radiation Techniques for Efficient Water and Fertilizer Use in Semi-Arid Regions

The Programme is formally closed. The Final Research Coordination Meeting will be held in Vienna, from 6-10 February 1984 and will review the five years of the programme, make recommendations and draw conclusions based on the research carried out. A final publication is planned for the end of 1984.

(c) FAO/IAEA/IG Coordinated Research Programme on Use of Nuclear Techniques in Improving Pasture Management

The initial phase of this programme is concentrating on measuring nitrogen fixation in mixed legume-grass pastures as affected by legume species or variety, level of N and P fertilization, or inoculation with Rhizobium and/or mycorrhizal fungi. The First Research Coordination Meeting was held in Vienna, from 7-11 November 1983. Results presented showed that the proportion of a legume's total N that came from atmospheric N-fixation was higher when in a mixture with grass, than when grown as a sole crop. It was also shown that the enrichment of ¹⁵N in grass grown alone was not similar to grass grown in a mixture with legumes. The implication of this on the selection of a reference crop

needs to be investigated. Immediately following the RCM, a one-week workshop on the concepts and use of ^{15}N in plant nutrition was offered to the participants, from 14-18 November.

(d) FAO/IAEA/SIDA Coordinated Research Programme on Studies of Biological Dinitrogen Fixation for the Dual Purpose of Increasing Crop Production and Decreasing Nitrogen Fertilizer Use to Conserve the Environment.

The Final Research Coordination Meeting was held in Vienna, from 22-26 August 1983. The programme covered methodological and practical aspects of atmospheric nitrogen fixation by annual grain legume crops. The Final Research Coordination Meeting reviewed the achievements of the programme over the five-year duration. A final publication containing the results and conclusions of this programme is planned for the beginning of 1984.

(e) FAO/IAEA Coordinated Research Programme on Isotopic Studies of nitrogen fixation and nitrogen cycling in Azolla and blue-green algae

This programme started during the second half of 1983 although some preliminary work had been carried out earlier at the IAEA Biotechnology Laboratory and under Technical Contract with Sri Lanka. Several Research Contract Proposals were received and are now being technically evaluated.

The primary objective of this programme will be to quantify nitrogen fixation using ^{15}N techniques under field conditions, and to evaluate the availability of the N in Azolla and BGA to crops, primarily flooded rice.

PLANNED COORDINATED RESEARCH PROGRAMMES

Based on the recommendations of a consultants meeting held by the Joint FAO/IAEA Division in 1981, there are plans to initiate a Coordinated Research Programme in 1984 to study nutrient requirement and water management practices in Tree Crops. Special emphasis will be put on fertilizer use efficiency studies, nitrogen fixation from the atmosphere, cultivation practices and water balances.

An FAO/IAEA Advisory Group Meeting was held in Aix-en-Provence, France 18-22 April 1983, on Nuclear Techniques in Studies of the Effect of Irrigation Water Quality and Crop Water Requirements, with Specific reference to saline and salt affected soils on Crop Production. Participants recommended to the Joint FAO/IAEA Division, the initiation of a Coordinated Research Programme on the above subject. The specific recommendations of the Advisory Group are being published in the proceedings of a Symposium (see item 8 of this Newsletter) held simultaneously in Aix-en-Provence, France.

A Consultant's Meeting on Breeding for Improved Nitrogen Fixation in Grain Legumes held in September 1983 recommended the initiation of a Coordinated Research Programme on the subject. This will be a joint programme between the Soils and Genetics Sections of the Joint FAO/IAEA Division and will have the objective to increase grain legume yields by utilizing nitrogen derived from the atmosphere rather than fertilizer nitrogen. In the later stages of screening genotypes with this ability, the ¹⁵N methodology to evaluate atmospheric nitrogen fixation will be used.

Persons interested in participating in the above research programmes should contact the Head, Soil Fertility, Irrigation and Crop Production Section for further information and contract application forms. From the applications received, 10-15 participants will be selected to constitute the Coordinated Research Programme. The contract programme provides limited funds to Institutes from developing Member States of the IAEA for the supply of isotopes and purchase of small equipment necessary for conducting the research. Participants meet occasionally to review the progress of their research and to plan future studies.

TECHNICAL COOPERATION PROGRAMMES.

In our Newsletter Vol 5, No 2. the Agency's Technical Cooperation Programme was described and information was given on how to apply. The Soils Section has, during 1983, had technical responsibility for Technical Cooperation Projects in the following countries: Bangladesh, Bolivia, Brazil, Chile, Colombia, Egypt, Ghana, Guatemala, Greece, Ivory Coast, Kenya, Madagascar, Malaysia, Mali, Mauritius, Morocco, Niger, Pakistan, Panama, Philippines, Republic of Korea, Romania, Senegal, Sri-Lanka, Sudan, Thailand, Tunisia, United Republic of Tanzania, Uruguay, Venezuela, Zaire, and Zambia. Several requests for assistance in 1984 were evaluated by the Soils Section. Requests for financial support in 1985 must be received by the IAEA late in 1983 or very early in 1984.

SOILS RESEARCH IN THE FAO/IAEA AGRICULTURAL BIOTECHNOLOGY LABORATORY.

(a) Multiple Cropping

Two field experiments using ^{15}N methodology were carried out at the IAEA Biotechnology Laboratory in 1983 to study the benefit of including a legume in a crop rotation. These experiments were performed in support of the Coordinated Research Programme on Multiple Cropping systems.

(b) Azolla and Blue-Green Algae

Several greenhouse and field experiments have been carried out using ^{15}N to study N_2 fixation by the Azolla-Anabaena symbiosis and the use of Azolla as biofertilizer. It has been found that Azolla-Anabaena is able to derive most of its N from the atmosphere, when the concentration of N in the growth medium is low. The use of Azolla as biofertilizer is still being investigated and results of these field experiments carried out in Hungary will be reported in the next issue of this Newsletter.

Messrs S.A. Kulasooriya and S. Kumarasinghe from Sri-Lanka collaborated in the above projects on Azolla.

(c) Pasture Management

Two field experiments on the use of ^{15}N methodology to study N_2 fixation in perennial pastures were performed in the Seibersdorf Laboratory during 1982-83. In the first experiment, N_2 fixation in pure and mixed sward of alfalfa-ryegrass as well as N supply from alfalfa to ryegrass was investigated. Preliminary results showed that 70-90% of the N in alfalfa was derived from the atmosphere and that the amount fixed was approximately 140 and 250 kg N/ha $^{-1}$.year $^{-1}$ for the first and second year, respectively. No direct transfer of N from alfalfa to ryegrass was observed in the present experiment but some nitrogen (less than 15% of the N in ryegrass) was being supplied from alfalfa to ryegrass after cutting, probably due to senescence of roots and nodules.

In the second experiment various methods of applying ^{15}N labelled fertilizer were evaluated. N_2 fixation was measured in treatments which received ^{15}N i) after every cutting; ii) once every year; and iii) once for the duration of the experiment. Preliminary results showed that when 5 kg N/ha of 50% ^{15}N atom excess fertilizer was applied, N_2 fixation measurements could only be reliably performed for three consecutive cuttings due to the % ^{15}N a.e. of plant materials approaching the limit of detection.

The results of both experiments were reported at the First Research Coordination Meeting of the Pasture Management Programme 7-11 November 1983 and these provided preliminary results for designing future experiments to be carried out in the above programme.

(d) Rock Phosphates

During the spring and summer of 1983 greenhouse and field experiments were carried out in Seibersdorf using ^{32}P labelled superphosphate as a standard to evaluate the availability of phosphorus in rock phosphates of different origin. The method is based on the measurement of the fraction of P in plants derived from fertilizer, which is calculated from the ratio of specific activity of ^{32}P in plant and fertilizer. In the presence of phosphorus from rockphosphate, the specific activity of ^{32}P in plant samples decreases. From the magnitude of decrease in specific activity the available amount of

phosphorus in the rock phosphate can be calculated in terms of superphosphate equivalents.

(e) Fellowships

A number of fellowships are awarded each year to research workers from developing Member States, to allow recipients to undergo specialized training in various advanced laboratories in the use and applications of stable and radioactive isotopes in soil-plant research. This forms a part of the regular Fellowships Programme of the Department of Technical Cooperation and the IAEA's Seibersdorf Laboratory has trained several of such Fellows.

A Fellow in Seibersdorf usually begins the training as a participant in the Annual FAO/IAEA Interregional Training Course on the Use of Isotopes and Radiation Techniques in Studies of Soil-Plant Relationships in Seibersdorf. Continuation of the training may then be arranged in the fields of research in which the laboratory and the Fellow are active. The period of training may vary depending on the requirements of each fellow.

In 1983, ten scientists successfully completed fellowship training at the Seibersdorf Laboratory.

REPORT ON THE FAO/IAEA CONSULTANTS MEETING ON BREEDING
FOR IMPROVED NITROGEN FIXATION IN GRAIN LEGUMES

A Consultants Meeting on Breeding for Improved Nitrogen Fixation in Grain Legumes was held by the Joint FAO/IAEA Division of Isotope and Radiation Applications of Atomic Energy for Food and Agricultural Development during the period 26 to 30 September 1983 at the Vienna International Centre, Austria.

The cost and restricted availability of nitrogen fertilizer pose serious problems for agricultural production, especially of developing countries. Biological nitrogen fixation, resulting from symbiosis between legume crops and Rhizobium can ameliorate this problem by adding atmospheric nitrogen to the N input from soil and fertilizers. Research has demonstrated that genetic variability exists within both the plant (macrosymbiont) and the bacterium (microsymbiont) regarding N₂ fixing capability. Furthermore, it has been possible to breed forage legumes for increased nitrogen fixation. A similar variability exists among grain legume species and varieties and it is hoped that the existing variability and plant breeding techniques can be exploited to increase nitrogen fixed. If the desired genotypes cannot be found among existing germplasm, mutation induction to create greater variability will have to be employed. Of particular importance would be the use of mutation induction to eliminate the regulatory system that blocks further nitrogen fixation, once nitrogen from soil is available for plant uptake.

Guidelines for scientists regarding approach and methods to be used in breeding grain legumes with better capability to support symbiotic nitrogen fixation were formed during the above mentioned meeting. Increasing the yield as well as the nitrogen fixation capacity in grain legumes will require breeding for improvement of the host - Rhizobium symbiosis in addition to the improvement of agronomic characteristics and of resistance to pests and diseases. The complex relationships between these factors suggest that the problems will be best tackled by research teams, which should include a plant breeder, a microbiologist, and preferably a plant physiologist, in addition to experts in agronomy and plant protection. It was also recommended that N₂ fixation breeding programmes must be built up within established plant breeding programmes,

where the expertise in dealing with inter-related breeding objectives exist. To verify the improved N-fixation capacity of new lines, ¹⁵N techniques would be appropriately applied to quantify amounts of fixed nitrogen.

The possibility of initiating a Coordinated Research Programme with the objective to increase grain legume yields by utilizing nitrogen derived from atmosphere rather than fertilizer nitrogen was recommended to the Joint FAO/IAEA Division.

COMING EVENTS

(a) FINAL RCM ON WATER AND FERTILIZER EFFICIENCY STUDIES

The Final Research Coordination Meeting of the FAO/IAEA Research Coordinated Programme on Isotope and Radiation Techniques for Efficient Water and Fertilizer Use in Semi-Arid Regions, will be held in Vienna from 6-10 February 1984.

(b) THIRD RCM ON MULTIPLE CROPPING

The Third Research Coordination Meeting of the FAO/IAEA Coordinated Research Programme on Development of Fertilizer and Water Management Practices for Multiple Cropping Systems, will be held in Jakarta, Indonesia from 5-9 March 1984.

(c) FAO/IAEA INTERREGIONAL TRAINING COURSE ON THE USE OF ISOTOPES AND RADIATION TECHNIQUES IN STUDIES OF SOIL/PLANT RELATIONSHIPS

The seventh annual Interregional Training Course on the Use of Isotopes and Radiation Techniques in Studies of Soil/Plant Relationships will be hosted by the Seibersdorf Laboratory, Vienna, Austria, from 22 May to 6 July 1984. The course will provide training on the use of both stable and radioactive isotopes to scientists in developing countries who are actively engaged in research in Soil Science and Plant Nutrition, Atmospheric Nitrogen Fixation, and Fertilizer and Water Management Practices. Application forms may be obtained from the official channels in Member States responsible for Atomic Energy matters, or from the Training Course Section, IAEA, Wagramerstrasse 5, P.O.Box 100, A-1400 Vienna, Austria. Enquiries should be directed to Dr. F. Zapata, FAO/IAEA Agricultural Biotechnology Laboratory A-2444 Seibersdorf, Austria.

(d) FAO/IAEA GOVERNMENT OF BELGIUM INTERREGIONAL TRAINING COURSE IN SOIL PHYSICS

The second Interregional Training Course on the Use of Nuclear Techniques in Soil Physics is planned to be offered in the second half of 1984, in Ghent, Belgium. The course will provide training on the calibration and use of neutron and gamma probes in soil physical studies

to scientists in developing countries who are actively engaged in Soil Physics, Irrigation and Water Management Practices. More details will be given in the next Soils Newsletter. Invitation letters will soon be extended to Member States to nominate candidates for the course which will be offered in English. Enquiries may be addressed to the Head, Soil Fertility, Irrigation and Crop Production Section, Joint FAO/IAEA Division, Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria.

(e) FAO/IAEA INTERREGIONAL SEMINAR ON THE USE OF ISOTOPES IN STUDIES OF BIOLOGICAL NITROGEN FIXATION

The Soil Fertility, Irrigation and Crop Production Section of the Joint FAO/IAEA Division in collaboration with the Government of Turkey will host an Interregional Seminar on the above topic in Ankara from 12-16 November 1984. An announcement through official channels of Member States of the FAO and IAEA will be sent out soon. The purpose of the Seminar is to critically review the state of the art, regarding the capabilities of isotopic techniques, relative to other available methods for detecting and/or measuring nitrogen fixed in various biological systems. Interested participants from Member States of both developed and developing nations are encouraged to apply for participation. Please send all enquiries to Dr. S.K.A. Dasno, Soil Fertility, Irrigation and Crop Production Section, Joint FAO/IAEA Division, Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria.

(f) ADVISORY GROUP MEETING ON MINIMUM TILLAGE

The Advisory Group Meeting on Agricultural Nitrogen Residues which was planned to be held during May 1983, has been postponed to 1985.

STAFF DUTY TRAVEL

G. Hardarson and D. Eskew attended the 5th International Symposium on Nitrogen Fixation (August 28 - September 1983) at the International Agricultural Centre, Noordwijkerhout, Holland.

F. Zapata served as an expert for a Technical Cooperation Project in Colombia, from 19 to 30 September 1983. He was involved in the initial planning of an isotope aided programme to study rice and potato crop fertilization.

D. Eskew served as expert for a Technical Cooperation Project in Madagascar, from 2-11 December 1983 to discuss isotope aided research programme on Pasture Management.

H. Axmann was in Albania from 14 September to 6 October 1983, to assist in the installation and use of an NOI-5 emission spectrometer to measure ¹⁵N.

F. Zapata attended the 3rd International Congress on Phosphate Compounds, in Brussels, Belgium from 4-7 October 1983.

F. Zapata and H. Axmann visited the Azolla/rice experiments which was carried out in cooperation with Hungary, at Szarvas, 13-15 July 1983, and 12-14 September 1983.

K. Kalinin attended the XIV Annual Meeting of the European Society of Nuclear Methods in Agriculture (ESNA), Madrid Spain, from 5-9 September 1983.

K. Kalinin took part in the Agency's Advisory Mission to Libya upon the request of the Libyan Government. They explored potential areas of Technical Assistance in Tripoli, Libya, from 31 October to 4 November 1983.

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