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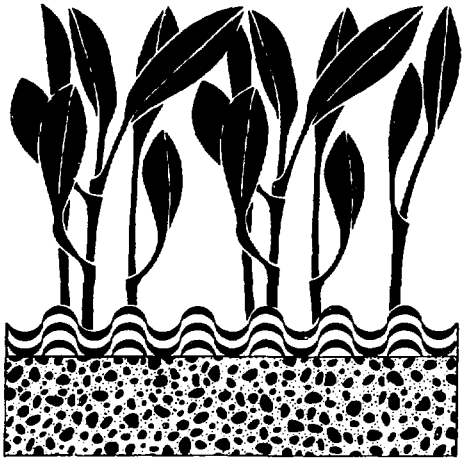

Soils Newsletter

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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CONTENTS

1. TO OUR READERS

As anyone who has written a regular Newsletter will know, the deadlines come around with great regularity. So here we are, the end of another year and the start of a new year. The staff of the Soil Fertility, Irrigation and Crop Production Section and the Soils Unit, Agricultural Laboratory, IAEA Seibersdorf Laboratory, send you greetings and all best wishes for 1989.

The main new developments in 1988 included the conduct of a training course focussing on roots and how to study them (reported in our July Newsletter), the further consolidation of a strong African regional network on biological nitrogen fixation (including a regional training course in Ghana in August) and the initiation of a new Co-ordinated Research Project in Africa focussing on the identification of genotypes of crops and of tree species with high efficiency in the uptake and use of water and phosphate. This programme was indicated in our July issue and is being funded by the Swedish International Development Authority. We are calling for submissions at present. Although this co-ordinated research programme is focussed on Africa I would welcome indications of similar interests from workers in other areas; perhaps we can form a type of network to keep each other informed. The rationale behind the programme is that large differences have been demonstrated between genotypes of most species examined for water uptake and use, and nutrient uptake and use. It is especially appropriate for developing countries aiming for a low input, sustainable agriculture to have genotypes responding well to low (or nil) inputs.

The Seibersdorf research activities in nitrogen fixation by tree species is going extremely well. With particular involvement of Drs Sanginga, Hardarson and Zápata at Seibersdorf (with valuable back up from Helga Axmann and her analytical services group) and with some involvement of Seth Danso, Cevat Kirda, Saliya Kumarasinghe and myself, strong group is developing. Some indications of this work are given in this newsletter.

Recently, we held a small consultants meeting to define and discuss possible roles of the group in molecular biology/molecular ecology. We were pleased to have Dr. Bill Broughton (University of Geneva), Dr. Claudine Elmerich (Pasteur Institut), Dr. Fergal O'Gara (University College, Cork) and Dr. Erik Stomberg (Virginia Polytechnic Institute) assist us in our thinking. It would be impracticable for us to become involved in aspects such as genetic engineering in nitrogen fixation, but a number of areas were identified, especially on molecular ecology of symbiotic organisms, which would be relevant to developing country problems and which would be practicable for us to develop, as and when opportunity arises. This area will receive attention also in our training courses.

Again, our very best wishes to all for 1989.

Glynn Bowen

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3. CO-ORDINATED RESEARCH PROGRAMMES

A. Isotopic studies of nitrogen fixation and nitrogen cycling by blue-green algae and Azolla

(Project Officer: David L. Eskew)

The final set of experiments in this programme are now in progress. The ^{15}N balance for Azolla *versus* urea in the rice and soil will be measured, and the effect of a cover of Azolla on N losses from urea by ammonia volatilization will be examined. The ^{15}N isotope dilution technique will also be used to measure nitrogen fixation by several strains of Azolla. The final co-ordination meeting is planned for September 25-29, 1989, in Vienna, Austria.

B. The use of isotopes to improve yield and N_2 fixation of grain legumes in Latin America.

(Project Officer: Gudni Hardarson)

Our previous Newsletter (July 1988) gave detailed information on the first Research Coordination Meeting of the programme. Participants have continued their research projects and initiated efforts to enhance nitrogen fixation in this very important food crop in Latin America. In August 1988 a progress report was written which contains results from experiments of all participants. This report is available upon request from Gudni Hardarson at the IAEA Seibersdorf Laboratory. Dr. J. Peña Cabriales has kindly offered to host the next Research Coordination Meeting at the Centro de Investigacion de Estudios, Irapuato, Mexico and it is tentatively being planned for 10-14 April 1989.

C. The use of nuclear and isotopic techniques to improve crop production on salt-affected soils.

(Project Officer: Cevat Kirda)

The main objective of this programme is biological amelioration of salt-affected soils. The participants in programme have selected genotypes of salt-tolerant crop species which will be tested in field experiments. The second research co-ordination meeting was held 10-14 October 1988 at the IAEA Headquarters, Vienna, Austria. A more detailed report of the meeting is given later in the Newsletter.

D. Evaluation and calibration of nuclear techniques compared with traditional methods.

(Project officer: Cevat Kirda)

Field research work pertaining to this programme is progressing well. The soil samples sent to the Nuclear Research Center of Cadarache, France, are being analyzed for thermal neutron absorption and diffusion cross sections which will be used for theoretical calibration of neutron water gauges, and compared with field calibration. The second and final research co-ordination meeting of this programme is proposed to be held in July 1989, Vienna, Austria.

E. The use of isotopes in studies to improve yield and nitrogen fixation of grain legumes in Asia.

(Project officer: Seth Danso)

This CRP, examining genetic variation in important grain legumes, was suspended for almost a year when the one-year sub-contract funding expired.

The efforts initiated to obtain renewed funding seem promising, and the chances are good that even before these funds become available, funds from IAEA regular budget would be used to renew contracts for 1989. This is a piece of good news for the participants of this important programme.

4. REPORTS OF MEETINGS

The second research co-ordination meeting on "Nuclear techniques to improve crop production on salt-affected soils", 10-14, October 1988, IAEA Headquarters, Vienna Austria.

During the meeting, first the results of screening for salt tolerant genotypes of crop species which would be used in the subsequent field trials were presented. Each participant identified specific crop species and a salt tolerant genotype which would be tested for biological amelioration of salt-affected soils. Methods to assess progress of soil amelioration, through measurements of physical and chemical soil properties, plant analysis and root studies were discussed. During the remaining time of the meeting, individual field experiment designs adopted by each contractor were presented and, if needed, modifications were suggested. Excerpts from presented reports:

S. M. Rahman, Institute of Nuclear Agriculture, Mymensingh, Bangladesh. Nuclear techniques to improve crop production in salt-affected soils

Experiments were conducted in the grey floodplain saline soil of Satkhira of Bangladesh to study the water requirement and N utilization by wheat and lentil using isotopic techniques. Results indicated that yield of wheat increased due to irrigation with both lake water (stored saline water) and tube-well water. Lentil yield decreased with irrigation. ^{15}N isotope aided studies showed that total and fertilizer N uptake, by both wheat and lentil were lower in the salt-affected soils. Biological nitrogen fixation by lentil increased considerably (25 - 27 kg ha^{-1}) due to the use of rhizobium inoculum.

Results of screening for salt tolerance in glasshouse experiments indicated that the three plant species, wheat, barley and lentil, can withstand varying degrees of salinity and can be successfully grown in the salt-affected soils. The wheat cultivars 'Akbar' and 'Kanchan', the barley cultivar 'L-1' and the lentil cultivar 'V-81149' produced higher dry matter yield in soils with high salinity levels. There were considerable changes in the salinity levels (EC values) and soluble ions in the soils after cropping due probably to continuous watering of the experimental plots with normal water having low EC values.

R. Hartmann, State University of Ghent, Faculty of Agriculture Sciences, Soil Science Department, Ghent, Belgium. Salinization hazard in polder soil of Belgium

Hydrogeological surveys carried out in the polder area of North-East Flanders of Belgium showed the presence of saline ground-water, at varying depths deposited during Holocene transgressions. Mostly this saline water occurs too deep to have a direct influence on agriculture. At some places, however, brackish water is present much closer to the soil surface.

A field experiment was set-up: (1) to investigate the salt distribution and evaluation in the unsaturated zone of a polder soil having undeep

brackish ground water, (2) to analyze the salinization hazard for crop growth. A maximum electrical conductivity of 2 mS/cm was found at N 80 cm in April and N 50 cm in August. However, the EC at 105 cm depth was 9 mS/cm throughout. In the upper 1 m depth of the soil, salinization was caused mainly by net unsaturated upward water flux. However, the salinization in the deeper zones may be attributed more to drying than to upward movement of brackish water. Rather high chloride contents - possibly at toxic levels were measured in grass grown, towards the end of the growing season. Older leaves displayed especially chlorosis and necrosis. Results obtained with the computer model SWATRER, simulating root water uptake, suggest that metabolic disturbances in grass may be due to high chloride content and to increase of the osmotic pressure of the soil water. Pasture is the most suitable land use for this soil if shallow rooted, chloride resistant grass species could be used.

P.I. Orphanos, Agricultural Research Institute, Ministry of Agriculture and Natural Resources, Nicosia, Cyprus. Effects of salinity (NaCl) and nitrogen fertilizing on yield of haricot beans (Phaseolus vulgaris L.)

Four successive crops of haricot beans (Phaseolus vulgaris L.) planted in spring and autumn, each spanning about 100 days, were grown in a clay soil containing 50% $CaCO_3$ and saturated with gypsum. The plant rows were 50 cm apart and were irrigated by tricklers spaced at 30 cm on the line in crops 1 and 2 and at 15 cm in crops 3 and 4. One irrigation line served two plant rows. Three salinity levels (chloride contents) in the irrigation water were tested. In crop 1 the chloride levels were 1.4, 8.5 or 17.0 meq Cl/l, and in crops 2 and 3, 1.4, 17.0 or 34.0 meq Cl/l, added to the irrigation water (containing originally 1.4 meq Cl/l) as NaCl. In crop 4, water containing 1.4 meq Cl/l was used and three N levels were tested, i.e. 0, 50 or 100 kg N/ha.

With the low-salinity water yield was virtually identical in crops 1, 2 and 3, even though by the end of the crop 2 gypsum was leached from the soil volume immediately below the drippers. This indicates that, with the frequent (weekly) irrigation applied, the presence of gypsum in the soil (ECe = 3 dS/m) was not harmful. Sodium chloride at 17.0 meq/l in the irrigation water did not reduce yield in crop 1 but reduced yield by 30% in crop 2 and 60% in crop 3. This was a direct effect of the chloride accumulated in the soil. After accumulated chloride was leached by the high rainfall (410 mm) in the winter following crop 3, yield of crop 4 was lower by 9% and 21% in plots irrigated with water containing 17.0 and 34.0 meq/l NaCl respectively. Such reductions were due to increased ESP (up to 25% of CEC) associated with the Na^+ accumulation. Since the amount of water applied just matched evapotranspiration, the shorter dripper spacing on the irrigation line after crop 2 reduced the leaching of salts below the dripper, which was occurring when the same amount of water was applied through half as many drippers, hence the more severe yield reduction due to salinity.

M. Popp, Westfälische Wilhelms-Universität, Münster, Federal Republic of Germany
The function of acyclic and cyclic polyols as stress metabolites in higher plants

It is well established that higher plants accumulate low molecular weight organic solutes under various stress conditions (e.g., salinity, drought, heat, chilling). These solutes belong to two chemical groups: (1) polyols and close derivatives and (2) zwitterionic solutes like amino acids, betaines and their sulfur analogues. Previous reports have shown an increase of sorbitol with increasing salt stress in Plantago maritima. The research

undertaken here also showed a relation between the mannitol content of leaves from the mangrove Aegiceras corniculata and the substrate salinity. In case of cyclitols, it has been reported by others that an increase of pinitol content was observed by salt treatment of Sesbania aculeata.

Results discussed here showed that pinitol may also serve as a cryoprotectant in the cold season. The future research work will aim to compare the different compatible solutes produced by higher plants under stressed conditions.

S. Ramani, Bhabha Atomic Research Center, Nuclear Agriculture Division, Bombay, India
Physiological response of ^{22}Na and ^{36}Cl uptake in mungbean cultivars and Sesbania species

The physiology of NaCl induced stress was studied in six cultivars of mungbean and three species of Sesbania. Physiological response to the presence of graded doses of NaCl in solution were studied for plant growth, uptake and translocation of nutrients and percent nitrogen. None of the mungbean cultivars studied tolerated 100 mM NaCl in the nutrient medium when transferred directly from low NaCl medium. However, the salinity tolerance in these varieties was enhanced with the gradual increase of NaCl in the growth medium from 25 to 100 mM. The presence of 5 mM NaCl in the medium decreased the uptake and transport of Rb significantly both in mungbean and S. aculeata. The transport of Na to stem and leaf was much less than the rate of absorption in S. rostrata and S. aculeata. Though the ^{22}Na uptake was more than ^{36}Cl in two Sesbania species, a greater proportion of the absorbed Cl was transported to shoot compared to Na. The salinity tolerance of Sesbania is due to retention of the absorbed Na in the roots. Nitrogen content in root and stem of mungbean and Sesbania was affected by NaCl.

O. Folorunso, University of Maiduguri, Dept. of Soil Sci., Maiduguri, Borno State, Nigeria.
Salinity tolerance of selected sorghum and millet varieties

Greenhouse experiments were conducted to screen Sorghum and Millet varieties for salt-tolerance in potted soil. For each of Sorghum and Millet, five levels of salinity ranging from ECe of 1.7 to 22.5 dS/m were established with three replications. Five different genotypes of each crop species were planted using a completely randomized design. Parameters measured included relative germination percentage, relative plant height and the dry matter yields of tops and roots.

The Sorghum genotypes screened were Yar-Washa, Cide-rijimba, War-Ware bashi, KSV and BES. In germination, shoot and root dry matter yields, the Yar Washa was superior to the other genotypes. It also appeared to be the most efficient accumulator of sodium and chloride of all the varieties tested. The genotypes BES and KSV exhibited the least tolerance to salinity. The Millet genotypes tested were Ex-Borno, Maiwa, SE-13, Local Mubi and Boduma. Early growth, shoot and dry matter yields Maiwa exhibited the highest level of tolerance to salinity.

M. Haq, Nuclear Institute for Agric. and Biology, Soil Biology, Division, Faisalabad, Pakistan.
Biological control of salinity in relation to use of saline ground water for irrigation

Growing of highly tolerant cultivars of Barley PK 30130 and PK 30136 led to significant lowering of soluble toxic salts from salt-affected profiles.

Roots of barley solubilized native $CaCO_3$ present in the soil. This soluble calcium increased leaching of exchangeable sodium from the exchange complex. Significant lowering of the sodium adsorption ratio and electrical conductivity was found in spite of the fact that saline sodic underground water with high residual carbonates was used. Following conclusions were drawn:

(a) Two varieties of oats namely PD 22653 and SAWN showed similar amelioration of the soil but to a lesser degree than barley.
(b) Significant amelioration of the soil was observed by growing Sesbania aculeata.
(c) The order of amelioration of the saline-sodic soil was Kallar grass > Sesbania aculeata > Barley > Oats-rice- Brassica napus > Wheat and vegetables

S. Sadio, Inst. Sénégalais de Recherches en Agriculture, Departement de recherches Forestières, Dakar, Sénégal.
Soil salinity impact on water and nitrogen uptake by Casuarina equisetifolia and Albiza lebbek

Experiments for screening salt tolerant, forest tree species have been carried out in both laboratory and greenhouses. Six-month old seedlings of Casuarina equisetifolia, Melaleuca leucadendron and Prosopis juliflora showed good growth when they were watered with saline solution, with EC as high as 30 mS/cm. It was observed that these species could survive even at 40 mS/cm - a salinity equal to that of sea water however their growth was somewhat hindered. Other screened species such as Eucalyptus camaldulensis, Albizia lebbek showed less tolerance and their growth was hindered at 20 mS/cm.

Germination response to salinity was also studied. The number of germinated seeds per g of seed was recorded under 3 salinity treatments: watering with (1) fresh water (EC < 0.02 mS/cm), (2) medium saline water (EC = 2 mS/cm) and (3) highly saline water (EC = 5 mS/cm). Germination test was carried out in cotton medium and soil. In cotton Casuarina equisetifolia and Eucalyptus microtheca gave better germination rate in medium salinity than in fresh water. Melaleuca viridiflora and M. acacioroles both germinated well even at high salinity in medium. However germination rates decreased with increased salinity in soil. Germination tests made in cotton medium may therefore be quite misleading.

Future work

Participants of the programme will continue the screening work for salt tolerance, using at least 20 genotypes of each crop species tested. Field work however should start without further delay since most of the participants had already selected the potential ameliorating crops to be tested under salt-affected soil conditions. In addition to soil and plant analysis to assess the progress of soil amelioration, an objective crop which the farmer would eventually like to grow, after the soil is ameliorated will be planted. Experimental plots will be divided in 4 sub-plots. At the end of first year, the objective crop will be planted in the first sub-plot, the remaining sub-plots (2, 3 and 4) will still be planted to ameliorating crop. In the second year, the objective crop will also extend to the 2and sub-plot, and the remaining 2 plots (3 and 4) will have the ameliorating crop. This way, the objective crop will progressively be replacing the ameliorating crop. The yield data of the objective crop will be an additional indicator of and biological soil amelioration.

5. TECHNICAL CO-OPERATION PROGRAMMES

The number of Technical Co-operation Programmes handled by our section is presently 69. In this issue, highlights of Technical Co-operation Programmes in Middle East and Europe Region are given. The programmes in Africa and Latin America Region will be highlighted in future issues.

Greece
Isotope-aided Crop Studies (GRE/5/014)
Department of Soil Science and Plant Nutrition, Nuclear Research Center, Athens Counterpart: Dr. E. Papanicolaou

This project is concerned with improving nitrogen and phosphorus fertilizer use efficiency in vegetable crops, such as tomatoes, and tree crops, primarily citrus trees. A mass spectrometer has been set up to increase the number of samples which can be analysed.

Greece
Nuclear Techniques in Agriculture (GRE/5/015)
Sub-tropical Plant and Olive Tree Institute, Laboratory of Irrigation, Hania, Crete. Counterparts: Dr. N. Michelakis

This project is near to completion. The institute was provided a neutron moisture gauge and services of the Agency expert, Dr. E.L. Greacen to assist their research effort to optimize the use of limited water resources in irrigation of citrus orchards, avocado and new olive tree plantations.

Jordan
Nuclear Techniques in Agriculture (JOR/5/003)
Faculty of Agriculture, University of Jordan, Amman. Counterpart: Dr. Khattari

The project aims at increasing and stabilizing crop yields in rainfed agricultural areas through different tillage and agronomic practices which will improve water conservation and fertilizer use efficiency. The institute has been provided with ^{15}N labelled fertilizer, a neutron moisture gauge and some laboratory equipment.

Syria
Soil nitrogen studies (SYR/5/009)
Syrian Atomic Energy Commission, Department of Agricultural Applications, Damascus. Counterpart: Dr.K.H. Khalif

This project was initiated in 1985, and has been studying the efficiency of N fertilizer uptake in crops, and the fate of applied N fertilizer in soil. Different forms of fertilizer are being compared, as well as the interaction between water and phosphorus fertilizer on the fate of N in soil and uptake by crops.

6. GOOD-BYE TO A COLLEAGUE

Dr. Douglas Nethsinghe retires

After 22 years of service at the IAEA Dr. Douglas A. Nethsinghe retired in September 1988. After doing his D.Phil at the Univ. of Oxford in 1958, Douglas who started his illustrious career as a soil scientist at the Coconut Research Institute in Sri Lanka first joined the Soils Section of the IAEA Laboratory at Seibersdorf in 1966. Together with the then Head of the Agriculture Section at Seibersdorf Dr. Hans Broeshart, Douglas contributed immensely to the development of isotopic techniques in studies of root activity with particular emphasis on tree crops.

From the Laboratory he moved to the Headquarters in 1968 as technical officer in the Soil Fertility, Irrigation and Crop Production Section of the Joint FAO/IAEA Division where he worked until he joined the Department of Technical Cooperation in 1977 as the Head of the Asia and Pacific Section. His dedication and continued interest in soils research and in the activities of the soil section was evident from the many seminars and scientific meetings he attended over the years in spite of the heavy workload in his own office. Throughout his successful career he has worked with much distinction and to the admiration of the many in the developing world, particularly those in the Asia and Pacific region. His unassuming nature and charming ways always made him an unforgettable personality. Douglas and his wife Audrey have now returned to Sri Lanka to spend their retirement near the palm fringed beach in Mount Lavinia. We and his many friends and colleagues in both developed and developing countries wish Douglas and Audrey and their family all the very best.

7. THE IAEA FELLOWS RESEARCH AT THE SOILS UNIT OF THE SEIBERSDORF LABORTORY

This new section will include selected short communications from IAEA fellows who have been conducted research at the Soils Unit at the IAEA Laboratory Seibersdorf. It will be a summary of their research projects listing their main findings.

Every year approximately ten IAEA fellowships are awarded to fellows from the developing countries to conduct research or learn analytical methods at the Soils Unit Seibersdorf Laboratory. The length of fellowships is normally between three and twelve months.

There are two types of fellowships in the Soils Unit, i.e. (1) analytical fellowships which are for short-term periods of 2-4 months for the purpose of learning specific analytical techniques, e.g. N-15 assay techniques by emission spectrometry, and (2) research fellowships, which are awarded for 6-12 months. In the latter case the fellow works on a research question within the Laboratory's programme and receives guidance on the use of isotope techniques, experimental strategies and other methods relevant to a particular area of research, which he/she will pursue upon return to his/her own country.

The applicant must have a suitable academic background and be currently working in the area in which further training is requested. Completed application forms must be endorsed by and returned through the official channels established (The Ministry of Foreign Affairs, the National Atomic

Energy Authority or the Ministry of Agriculture). Applications sent directly by individuals or by private institutions cannot be considered.

Effect of nodule position on biological nitrogen fixation by common bean (Phaseolus vulgaris). K. Manrique Klinge, IAEA fellow, presently at the University of La Molina, Lima, Peru.
G. Hardarson and S.K. A. Danso, Scientific Supervisors, Joint FAO/IAEA, Vienna.

Common bean (Phaseolus vulgaris L.) is a grain legume of great dietary importance in Latin America and in many other areas of the world. Research has revealed a great genetic diversity in nitrogen fixation in common bean and in the effect of environmental conditions on nitrogen fixed. Earlier work had demonstrated that the method of inoculation affects the location of nodules on the root system, and that this in turn influences the amount of nitrogen fixed. A similar study was therefore carried out in common bean grown in the greenhouse to assess the possible impact of different inoculation procedures on nodule location and N_2 fixation in common bean. Two cultivars of common bean cv. Ikinimba (indeterminate) from Rwanda and cv. Extender (local determinate type) were used. The seeds, soil (whole soil or at seed level, 5 or 10 cm depth) were inoculated with a mixture of two effective strains, and harvested at physiological maturity. Root nodules on the 0-5, 5-10, 10-15 and > 15 cm segments were counted and N_2 fixed was measured using the isotope dilution technique.

There was greater downward movement of Rhizobium along the root than we previously observed with Bradyrhizobium inoculation resulting in substantial nodulation on the lower segments of the root. For Ikinimba which nodulated more (mean nodule number 257 vs 178) than Extender, the most profuse nodulation (mean 39% of nodules formed) occured on the 10-15 cm root segment while for Extender, this occured on the 5-10 cm segment (mean 40%). Treatments did not significantly influence N_2 fixation on either cultivar. However, N_2 fixation in Extender (54 mg/plant or 48% N_2 fixed) was greater than in Ikinimba (28 mg/plant or 35% N_2 fixed).

8. RESEARCH WORK ON NITROGEN FIXING TREES AT SEIBERSDORF

An advisory group meeting held in Vienna from November 24-28, 1986 examined the roles of trees in restoring soil fertility (soil nitrogen and organic matter), in contributing to a stable agricultural system on fragile soils and to combating erosion and desertification as well as providing fuelwood. Several important matters emerged very clearly from this meeting:

(i) Despite world recognition of the potential of nitrogen fixing trees in agroforestry systems and silvo-pastoral systems, there is a great lack of knowledge on the the measurement and management of nitrogen fixation by trees in such systems.

(ii) Very few studies have been performed identifying potentially high N fixing tree species and genotypes.

(iii) No critical studies have been made to determine the amounts of N_2 fixed compared with N taken from soil, nutritional constraints to nitrogen fixation and in particular the effect of management procedures e.g. time and severity of cutting, on N_2 fixed and on transfer of

nitrogen to associated crops or on changes in soil characteristics due to the trees.

With these problems in mind and from its considerable experience in nitrogen fixation by grain and pasture legumes, the Soils Unit at the Agricultural Laboratory, Seibersdorf initiated a research programme on different aspects of nitrogen fixation by trees.

The objectives are: (i) to develop ^{15}N methodologies for measuring N_2 fixation by trees, (ii) to select combinations of plant genotype and microsymbiont with high nitrogen fixing ability, (iii) to study the effect of some environmental (soil and climatic) constraints to nitrogen fixation, (iv) to determine the effects of management practices on nitrogen fixation.

In these studies emphasis is on species already used in agroforestry systems such as Leucaena leucocephala and Gliricidia sepium in the humid tropics, Acacia albida in the arid and semi arid ecosystems and Casuarina and Allocasuarina species for soil conservation.

Experiments have examined genetic variation in symbiotic nitrogen fixation and in tolerance to low phosphorus of diverse provenances of G. sepium (25) A. albida (12) L. leucocephala (12), Casuarina species (23) and Allocasuarina species (13). Considerable inter- and intra-specific genetic variation in nitrogen fixation has been found. The percentage of N_2 derived from fixation (Ndfa) ranged between 15 to 44% for A. albida; 37-74% L. leucocephala; 15-68% G. sepium. N_2 fixation estimates by Casuarina and Allocasuarina species using N-15 are being processed. Large plant to plant variation in nodulation occurs in both plants of Allocasuarina species.

There is a mounting evidence from experiments aimed to study tolerance of these tree genotypes to low P, of large intra-specific variation to adaptation to low P soil conditions. A few genotypes tolerant to low P have been identified and are being tested for their response to different levels of phosphorus. Soil phosphorus is a serious constraint to nitrogen fixation in most soils in tropical conditions. Several authors have suggested application of large amounts of P to improve N_2-fixed by nitrogen fixing trees. Our recent results with C. equisetifolia have demonstrated that growth of plants dependent on symbiotically fixed nitrogen was more sensitive to low levels of P than that of plants supplied with fertilizer N. Further investigations are envisaged to study the role of mycorrhizas in P nutrition and nitrogen fixation.

The effects of management practices e.g. time and frequency of cutting on nitrogen fixation is being studied on L. leucocephala and G. sepium. Preliminary results have indicated an increase in plant biomass with 3 successive cutting while Ndfa remains constant. Nodule senescence and decay occurs at 3 weeks after each cutting and thereafter new ones start forming and are able to sustain N_2 fixation during the next growing period. N determination in the different plant parts have shown that roots contain a significant fraction of total N i.e. almost 50%. Estimates of nitrogen fixed based only on above ground parts can therefore be greatly in error.

9. TRAINING COURSES

1. African Regional Training Course held in Ghana, August/ September 1988.

A FAO/IAEA Regional Training Course in Africa on the use of isotope and radiation techniques in studies of isotope and radiation techniques in studies of biological nitrogen fixation and soil/plant nutrition was held at the University of Ghana, in collaboration with the Ghana Atomic Energy Commission, from 22 August - 16 September, 1988. Twenty-three participants from sixteen countries (Cameroon, Egypt, Ghana, Kenya, Mauritius, Morocco, Niger, Nigeria, Senegal, Sierra Leone, Somalia, Tunisia, Uganda, Zaire, Zambia and Zimbabwe) received training. The course covered a wide range of aspects of nuclear techniques in studies of biological nitrogen fixation of grain legumes and N-fixing trees, fertilizer uptake and fertilizer use efficiency, and soil moisture studies. Techniques were thought through intensive classroom lectures, discussions, laboratory sessions, and field experiments. Emphasis was placed on the application of these techniques to solve agricultural problems of practical importance in the African region. A final course evaluation revealed that the training course was a great success, and many participants sought the assistance of the IAEA to hold similar training courses in their own countries.

2. FAO/IAEA Training course on the use of isotope and radiation techniques in studies on soil/plant relationships in 1989

Next year's inter-regional training course will be held from 23 May to 30 June 1989 at the Agency's Laboratories, Seibersdorf (near Vienna), Austria.

The objective of this course is to train scientists from developing Member States in all aspects of the use of relevant nuclear techniques in soil-plant relationships research. Emphasis will be placed on the use of isotope and related techniques in the management of symbiotic nitrogen fixation in integrated plant nutrition systems for increasing soil fertility and plant productivity, and on nitrogen relations of plants.

Participants must have a university degree and preferably advanced academic degree with specialization in the fields of soil fertility and plant nutrition. Preference will be given to those who are actively involved in FAO/IAEA Co-ordinated Research and/or Technical Co-operation Programmes on the above topics with particular reference to nitrogen fixation. They will be expected to have an active, personal involvement in research as chief counterparts or members of a team.

Lectures are delivered in English and it is thus essential that applicants should have no difficulty in following lectures and expressing themselves in English.

The official announcement of the course will be issued to the relevant government authorities (in each country) in November 1988. Nominations should be submitted in duplicate on the standard IAEA nomination form for training courses. Completed forms must be endorsed by and returned through the official channels established (the Ministry of Foreign Affairs, the National Atomic Energy Authority, the Office of the United Nations Development Programme or the Ministry of Agriculture). They must be received by the International Atomic Energy Agency, P. O. Box 100, A-1400 Vienna, Austria, not later than 24 February 1989. Nominations received after that date or applications sent directly by individuals or by private institutions cannot be considered.

For additional enquiries, please write to Dr. G. Bowen, Head, Soil Fertility, Irrigation and Crop Production Section, Joint FAO/IAEA Division, Wagramerstr. 5, P.O. Box 100, A-1400 Vienna or Dr. F. Zapata, Head, Soil Science Unit, Agency's Laboratories, A-2444 Seibersdorf, Austria.

It is anticipated an Asian Regional Training Course will be held in Malaysia in December 1989. As well as giving general training in the use of isotopes/nuclear techniques in soil/plant relations, there will be particular emphasis on trees. The same general conditions of application hold for this course as for the inter-regional course above. More information can be obtained from Glynn Bowen (address above).

10. ANNOUNCEMENTS

1. Symposium on "The use of stable isotopes in plant nutrition, soil fertility and environmental studies"

This symposium was originally scheduled for 1989 but later, due to budget constraints, it was postponed to 1990. The exact date has yet to be decided. We hope to provide you with more information in our next issue.

2. Symposium on "Advances in the use of isotopes in soil fertility and plant nutrition"

The symposium is to be organized during the 14th International Congress of Soil Science, Kyoto, Japan, 12-18 August 1990. The Agency is co-operating in organization of the symposium through its Joint FAO/IAEA Division. The Agency will award a limited number of travel grants to the participants from developing countries. The respective forms will soon be dispatched with a circular letter to the National Atomic Authorities or the Ministry of Foreign Affairs.

3. International Symposium on "Climatic risk in crop production: Models and management for the semi-arid tropics and sub-tropics"

This symposium will be held in Brisbane, Queensland, Australia, 2-6 July 1990. For further information write to:

Mr. Victor Catchpoole
Symposium Secretary
CSIRO Division of Tropical Crops and Pastures
Cunningham Laboratory
306 Carmody Road, St. Lucia, Qld. 4067, Australia

11. FROM OUR READERS

Phosphate uptake of rice under daily temperature fluctuations using ^{32}P technique

Le Xuam Than, Pham Ba Than, Dalat Institute of Nuclear Research, Vietnam.

Significant differences were observed in P-uptake of rice (var. KS82 from IRRI) in response to different night time temperatures of 22, 25 and 35°C. Low night time temperature of 22±2°C - from 17:30 to 08:00hrs - caused significant increase in P uptake of 7 days old rice seedlings when compared with the treatment of 25±2°C. It was shown that the higher temperature treatment (35°C) inhibits the P-uptake.

Results suggest that efficiency in uptake and use of phosphate by rice are influenced significantly by daily temperature fluctuations prevailing in North and South Vietnam.

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