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CADI AYYAD UNIVERSITY
MARRAKECH, MOROCCO

INTERNATIONAL CENTRE
FOR GENETIC ENGINEERING
AND BIOTECHNOLOGY
TRIESTE, ITALY

FINAL REPORT

THEORETICAL COURSE

BIOTECHNOLOGY AND AGRICULTURE IMPROVEMENT IN DEVELOPING COUNTRIES

22 MAY-3 JUNE, 1994

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THE COURSE PROGRAMME AND ABSTRACTS

COURSE PROGRAMME

Saturday 22 May, 1994

Participants arrival

Monday 23 May, 1994

08 : 30-10 : 00	Welcome session and registration
10 : 00-12 : 00	Applications of Biotechnology in Agriculture Dr. ZAID A.
14 : 00-15 : 30	Plant pathology and Bioengineering Dr. LEPOIVRE P.
15 : 30-15 : 45	Coffee break
15 : 45-18 : 00	Impact of Biotechnologies on Plant Pathology Dr. LEPOIVRE P.

Tuesday 24 May, 1994

08 : 30-10 : 00	Special cases of Biotechnology Applications Dr. LEPOIVRE P.
10 : 00-10 : 15	Coffee break
10 : 15-12 : 00	Introduction to Mycorrhizae Dr. OIHABI A.
14 : 00-15 : 30	Importance of Mycorrhizae Dr. OIHABI A.
15 : 30-15 : 45	Coffee break
15 : 45-18 : 00	Conference Biotechnology and Agriculture : Impact and Perspectives Dr. LEPOIVRE P.

Wednesday 25 May, 1994

08 : 30-10 : 00	Micropropagation Techniques : Organogenesis and Asexual Embryogenesis Dr. AAOUINE M.
10 : 00-10 : 15	Coffee break
10 : 15-12 : 00	Establishment of a Commercial Mass-Propagation Unit (Organization, basic equipments, follow-up, ...) Dr. AAOUINE M.

14 : 00-16 : 00	Monoclonal antibodies : Applications and diagnosis of viral diseases in plants Dr. ZEMZAMI M.
16 : 00-16 : 15	Coffee break
16 : 15-18 : 00	Conference A case study : Morocco and Biotechnology Drs. ZAID A. and AAOUINE M.

Thursday 26 May, 1994

08 : 30-10 : 00	Introduction to Molecular Biology Dr. SIMONEAU P.
10 : 00-10 : 15	Coffee break
10: 15-12 : 00	Genitical transformation techniques in higher plants : Techniques and uses Dr. CASSEDELBART F.
15 : 45-18 : 00	Transgenic plants : Resistance to herbicides, diseases and insects Dr. CASSEDELBART F.

FRIDAY 27 MAy, 1994

08 : 30-10 : 00	Mycorrhizae : Towards standards for biotechnolgy applications Dr. SIMONEAU P.
10 : 00-10 : 15	Coffee break
10 : 15-12 : 00	Continue of Dr. SIMONEAU's course
15 : 00-16 : 30	Visit to the plant Physiology Laboratory National Institute of Agronomic Research, Marrakech (Research on micropropagation of date palm)
16 : 30-16 : 45	Coffee break
16 : 45-18 : 00	Conference Modification of Protein biosynthesis during the mycorhizas formation in tissue culture derived plants Dr. SIMONEAU P.

Saturday 28 May, 1994

06 : 00	Departure to Meknes City
15 : 00	Visit to a commercial tissue culture Unit (Domain of ouilane, Meknes)

Sunday 29 May, 1994 visite to Fes and Meknes Cities

Monday 30 May, 1994

06 : 00	Departure from Meknes to Rabat
10 : 00-12 : 00	Visit to Dar Essalam Laboratory (Monoclonal Antibodies production)

15 : 00-18 : 00	Visit to several laboratories of SODEA (Temara)

Tuesday 31 May, 1994

06 : 00	Return back to Marrakech
16 : 00-18 : 00	Visit to Various Laboratories of the Faculty of Sciences-Marrakech. (Biochemistry, plant physiology, molecular biology, Computer Sciences and food technology units)

Wednesday 01 June, 1994

08 : 30- 10 : 00	Molecular markers (isoenzymes, RFLP, RAPD) used in plant breeding Dr. BAAZIZ M.
10 : 00-10 : 15	Coffee break
10 : 15-12 : 00	Continue of Dr. BAAZIZ 's course
14 : 00-15 : 30	In vitro propagation of woody species Dr. WALLALI L.
15 : 30-15 : 45	Coffee break
15 : 45-18 : 00	In vitro acclimatization Dr. ZAID A.

Thursday 02 June, 1994

08 : 30-10 : 00	Organogenesis and Somatic embryogenesis : Techniques and perspectives Dr. LETOUZE R.
10 : 00-10 : 15	Coffee break
10 : 15-12 : 00	Shoot tip culture and obtention of disease free plants Dr. LETOUSE R.
14 : 00-16 : 00	Cell biology of plant transgenesis Dr. MARTY F.
16 : 00-16 : 15	Coffee break
16 : 15-17 : 45	Biotechnology = An additional tool to plant breeding Dr. AMRI A.
18 : 00	<u>Conference</u> In vitro Plant regeneration techniques with special focus on woody species Dr. LETOUZE R.

Friday 3 June, 1994

08 : 30-10 : 00	Objectives and principles of controlled Mycorrhization Dr. PLENCHETTE C.

10 : 00-10 : 15	coffee break
10 : 15-12 : 00	Continue of Dr. PLENCHETTE's Course
15 : 00	Closing session; distribution of course certificates
19 : 00	Official diner in honor of participants.

APPLICATIONS OF TECHNOLOGY IN AGRICULTURE

Dr. ZAID A.

ABSTRACT

Biotechnology cover all the processes and techniques using living organisms (microorganisms, plant or animal cells) in the agricultural or industrial production as well in human health. The following examples of biotechnology applications in Agriculture were presented :

- Micropropagation of various plant species
- Plant tissue culture techniques
- Biological nitrogen fixation
- Molecular biology and genetic engineering
- Artificial insemination and embryo transfer
- Valorization of Agricultural and industrial by-products
- Enzymatic and fermentation engineering
- Biodiversity

The popularizatiobiotechnological inovations as well as the adequate transfer of biotechnology to developping countries were presented.

MOLECULAR TECHNIQUES FOR THE DIAGNOSIS OF PLANT PATHOGENS

Dr. LEPOIVRE P.

ABSTRACT :

The current evolution of agricultural and horticultural production systems requires simple, rapid and sensitive techniques for the diagnosis of plant pathogens.

Among serological methods, the enzyme-linked immunosorbent assay (ELISA) is the most commonly used technique nowadays, for virus and bacteria detection and identification. It meets the desired requirements for generalised use and can be easily automatized.

Recently, molecular hybridiazation techniques for the testing of plant pathogens have gained world-wide acceptance. They involve the use of labelled complementary DNA or RNA (cDNA, cRNA) prepared from the nucleic acid of the pathogen, as a probe. Nucleic acid hybridization is generally done by blotting test samples onto a nylon or nitro-cellulose membrane, and then incubating the membrane with the probe.

One drawback for the use of probes, as commonly applied, was linked to radioactive labelling, which involves problems for the development of "user's friendly" kits. While radioactive probes are reliable and safe in well equipped laboratories, they are not suitable for wide use. Non radioactive labelling, either direct (peroxydase) or indirect (biotin-streptavidin, and diagoxigenin systems), is being increasingly used. Combined with the detection of being molecules by chemoluminescence, they allow the use of crude sap extracts of infected plant as samples.

A further significant advance in molecular biology is the advent of the polymerase chain reaction (PCR (R)) which involves the enzymatic amplification of a specific target DNA sequence. Once the DNA is amplified, it can be detected by electrophoresis or nucleic acid hybridization. The potential increase in sensitivity provied by the PCR technique has resulted in considerable interest, either for direct detection of organisms or for the development of probes from cloned PCR products.

For its use in practice, any method of diagnosis should be evaluated in term of sensitivity, specificity, reliability and cost, according to the encountered problem. Whereas technical performance in terms of sensitivity or specificity is not a goal by itself, sensitivity is becoming a priority in the frame of certification procedures which require the detection of low levels of pathogens in asymptomatic tissues.

On the other hand, less sensitive, but more specific tests, are generally required for classification and taxonomical studies, to manage genetic resources, or to detect strains of pathogens resistant to pesticides.

The PCR procedure using a battery of group-specific primers allows the detection of any members of the different group of virus by a relatively rapid and simple, yet sensitive, preliminary work of separation or purification of the components of viral complexes, and is therefore particumarly useful for quarantine or certification purposes where the primary objective is to identify pathogen-infected samples whatever the identity of the pathogen involved.

In further works, the amplified fragments obtained could be cloned into a vector and sequenced by routine procedures for subsequent classification and taxonomical studies, or to develop virus-specific nucleic acid hybridization tests.

CONFERENCE

BIOTECHNOLOGY AND AGRICULTURE : IMPACT AND PERSPECTIVRES

Dr. LEPOIVRE Philippe

ABSTRACT

Application to agriculture of the new discoveries in the field of manipulating living organisms certainly opens interesting perspectives, but also raises potential problems. The most recent steps in the development of agricultural biotechnology are discussed.

In microbiology, progress was mainly in the field of biopesticides and biostimulants. On the other hand, plant and animal sciences benefitted from major advancements in the techniques of genetic manipulation, reproduction control, disease diagnosis and therapeutics, thus paving the way to the introduction of revolutionary methods in corp and animal husbandry .

Beside the successes already obtained and the perspectives of even more sensational discoveries, there is a less bright side of the question, namely the limitations, either scientifical or sociological, of possible applications.

The potentials of plant biotechnology are found on two main objectives : increase the yield of a given genotype by sanitation or transgenesis; and modify the available genomes by speeding up genetic improvement programs, overcoming incompatibility factors, or creating additional genetic variability.

Whatever the methods used, the improved organisms should be submitted to extensive field testing in order to ascertain their values in terms of genetic conformity and stability, sustainable health through successive cropping, yield, and product quality.

The sociological and economical implications of biotechnology applications in agriculture should not be understimated, notably in developing countries. In this respect, such issues as patentability of living microorganisms, gene ownership, genetic diversity, or farmer's rights, should be raised and adequately delt with.

The explosive development of biotechnology in agriculture raises mixed feelings of admiration and fear, which need to be managed adequately by taking into account the social, economical, scientific and ecological environnent, In industrialized countries, the scientific and legislative background allows a suitable control of biotechnology applications in industry, crop production, and animal husbandry. Biotechnology innovations could lead there to an increasing use of transgenic plants and animals, to produce specific molecules intended for bioindustries, fine chemicals, or pharmaceuticals. In developping countries, where production of food and of renewable energy are essential, together with cash corps, biotechnologies have many potential applications. Benefitting from them, however, requires a progressive and adapted development, based on legal and physical infrastructures, as the human skill to perform on-site control. Attention should be paid also to ensure the various programs correspond to the needs of the relevant populations and to their global environment.

MYCORRHIZAE : INTRODUCTION AND AGRICULTURAL IMPORTANCE

Dr. OIHABI A.

ABSTRACT :

Mycorrhizae are a symbiotic association between soil-born fungi and plant roots. Three groups of mycorrhizae could be distinguished.

- Ectomycorrhizae : concerns essentially ascomycetes and basidiomycetes fungi and forest trees. The fungus surround the roots of the host and does not colonise cells.

- Endomycorrhizae : They are vesicular arbuscular Mycorrhizae and are the most important. It concerns cultivated plants (more than 80% of cultivated plants could by mycorrhized) and zygomycetes. In this type, the fungus colonize host cells.

- Ectoendomycorrhizae : which present both characteristics of Ecto and Endomycorrhizae.

The mycorrhizal association increases plant nutritient and the phosphorous is the most concerned mineral element. Infact, it also increases plant growth and development and consequently improves yield.

MICROPROPAGATION TECHNIQUES : ORGANOGENESIS AND ASEXUAL EMBRYOGENESIS

Dr. AAOUINE M.

ABSTRACT

The two basic techniques used in plant tissue culture, organogenesis and embryogenesis were defined and presented. A literature review on various steps with some plant species examples was also discussed. Futur prospects of both techniques with the key variables such as explants, culture media, growth regulators, incubation conditions and genetic stability were deeply analyzed. Experimental protocols for both techniques, using examples of Daucus carota (somatic embryogenesis) and Phoenix dactylifera L. (organogenisis) were also presented and illustrated to participants.

ESTABLISHMENT OF A COMMERCIAL MASS-PROPAGATION UNIT

Dr. AAOUINE M.

ABSTRACT

During this course, the lecturer presented the main components of a commercial tissue culture laboratory including detail of the conception of the unit, its construction and equipment. Problems encountered when suitching from a reserch laboratory to a commercial one were also discussed. As a general manager of a large commercial unit, the lecturer shared with participants his daily experience in management and activities planning. Difficulties encountered with some plant species (such as date palm) were also presented.

MONOCLONAL ANTIBODIES USE IN PLANT DISEASE DIAGNOSTICS

Dr. ZEMZAMI M.

ABSTRACT

Monoclonal antibodies (McAb) are immuno-reagents used for plant pathogens detection and identification. Their high specificity as compared with the conventional antisera has made the serodiagnosis very sensitive and more reliable.

Hybridomas secreting McAb's are obtained by fusing a myelloma cell with a B-Lymphocyte producing antibodies specific to a desired antigene. The resulting hybridoma inherits the ability to grow indefinitly in artificial medium from the myolloma parent and the capability to produce a single type of antibodies (McAb's) from the B-Lymphocyte parent.

The technique of cell-fusion, the hybridomas selection, Hybridomas Cryoconservation and reviving as well as several diagnostic techniques utilizing McAb's are described.

CONFERENCE

A CASE STUDY : MOROCCO AND BIOTECHNOLOGY

Dr. ZAID A. & Dr. AAOUINE M.

ABSTRACT :

During this conference, the two speakers presented the situation of biotechnology in Morocco. The following points were discussed :

- Advantages of biotechnology compared to classical techniques
- Situation of Biotechnology in Developped/ Developping countries
- Moroccan main economic activities
- Moroccan view and perspectives on biotechnology
- Biotechnology programme
- Public and private research base
- Human ressources and extent of Government findings
- Intellectual property laws and biosafety regulations.
- Main constraints and proposed solutions.

Following this presentation, an around table discussion was held and participants shared with the assistance the case of their respective countries and also discussed similarities and differences with the case study presented in this conference.

MYCORHIZAS : TOWARDS STANDARDS FOR BIOTECHNOLOGY

Dr. SIMONEAU P.

ABSTRACT

Numerouse publications regarding the in vitro culture and physiology of mycorrhizas have now been gathered. This lesson presents the following points :

- synthesis of ectomycorrhizal associations;
- physiology of phosphorus;
- gene expression during ectomycorrhiza formation;
- in vitro cultue of VAM fungi;
- synthesis of vesicular-arbuscular mycorrhizas;
- encapsulation in alginate beads;
- SR protein in endomycorrhizas.

Two groupe of mycorrhizas present the most important economical objectives : ectomycorrhizas for sylviculture and production of edible mushroom, vesicular-arbuscular endomycorrhizas for agriculture and horticulture. The creation of new products for the utilisaation of mycorrhizas in sustainable agriculture is limeted by several problems. our team endeavours to remove three of these; (1) the cloning of host-plants; if this cloning is not controlled, in the symbioses created the plant material displays genetic variability; (2) the in vitro culture of the endophytes, a limitating factor, particularly as regards Endogonacease forming endomycrrhizas; (3) the molecular basis of the relationship between the partners?

MODIFICATIONS OF PROTEINE BIOSYNTHESIS DURING MYCORRHIZAE FORMATION IN TISSUE CULTURE-DERIVED PLANTS

Dr. SIMONEAU P.

ABSTRACT

Birch (Beetula pendula Roth) micropropagated plantlets were inoculated with 7 different isolates of the mycorrhizal fungus Paxillus involutus Batsch. Based on the level of fungal ergosterol neaasured in roots at the end of the "mycorrhiza formation stage", strain PO was chosen as the reference strain. Electrophoretic analysis of in vivo labeled proteins extracted from mycorrhizal roots 96 h post-inculation with this strain, non-inoculated roots, and free-living myelium, revealed that specific polypeptides were synthesized during ectomycorrhiza formation. To examine hypothetical similarity between some of these polypeptides and defense proteins, parts of corresponding putative genes of birch wer isolated. Partial sequencing of one clone have showne that it contained a portion of gene for phenylalanine ammonia-lyase

GENETIC TRANSFORMATION OF HIGHER PLANTS: TECHNIQUES AND USES

Dr. CASSE-DELBART FRANCINE

ABSTRACT

Agreobacteria are soil bacteria possessing high molecular weight plasmids, part of which can be transferred to the nuclear plant cell genome. Integration and expression of T-DNA are responsible for the phenotypical modifications of transformed cells. Knowledge of the molecular mechanisms implied in this natural gene transfer from the bacterium to the plant cell is used to obtain transgenic plants. Thus, cointegrative intermediate vectors and binary vector systems have been developed. Other transformation systems, such as direct DNA transfer, allow to obtain transgenic monocots. Plant genetic transformation is a powerful tool in basic research, since it allows to study the regulatory gene sequences. It also offers the possibility to introduce genes of agronomical interest into cultivated plant.

GENETICAL TRANSFORMATION TECHNIQUES IN HIGHER PLANTS : TECHNIQUES AND USES (Continue)

Dr. CASSE - DELBART F.

ABSTRACT :

The different methods used to introduce foreign DNA into plant nuclear genome are described : use of vectors derived from Agrobacterium Ti or Ri plasmids (cointegrating intermediate vectors as well as binary vector systems); technics of direct DNA transfer (microinjection, electroporation, particle gun, cells or tissues choosen as target for DNA intergration and subsequent regeneration).

The structure needed for a gene to be efficiently in plants is rapidly explained, as well as the fundamental informations on regulation of plant gene expression that can be learned from the in vitro construction of chimeric genes, their introduction in to plant nuclear DNA and the study of their expression in transgenic plants.

TRANSGENIC PLANTS : RESISTANCE TO HERBICIDES, DISEASES AND INSECTS

Dr. CASSE - DELBART F.

With genetic engineering, the availability of genes of interest is no more limited to the same or closely related species as it for sexual crosses or even cell fusions, but on the contrary to the whole living kingdom (including every plant species, animals, fungi, bacteria, viruses, ...) and also to the synthesis of newly designed sequences. Plant genetic engineering is therefore become a new powerful tool in plant breeding. A review as wide as possible presents the published examples of introduction of transgenes determining changes in nutritional value, male sterility and fertility restauration, control of flower pigmentation, control of tomato ripening, resistance to bacteria and viruses. Using data from scientific literature, more extensive details are given on genes conferring resistance to the major herbicides which act as inhibitors of either photosynthesis, or essential amino acid biosynthesis, by either overexpression of the target protein, or production of a mutated (resistant active) target protein, or degradation of the herbicide molecules into inactive derivatives. Detailed data concerning the design of genes conferring insect tolerance *(Bacillus thuringiensis* toxin, protease inhibitors, lectin) are also discussed. Published results of field trials with the corresponding transgenic plants are shown.

MOLECULAR MARKERS USED IN PLANT BREEDING

Dr. BAAZIZ M.

ABSTRACT

The use of morphological markers in plant breeding is resstricted, since their number is limited. One promising approach for integrationg biotechnoiogy with traditional plant breeding is marker-assisted selection. Molecular markers used derived form isoenzyme aand DNA polymorphisms. Isoenzyme markers were obtained, after electrophoresis, by incubating gels with enzyme substrates. It results a colored stain at each separated isoenzyme. Isoenzyme markers exhibit codominant inheritance and could be scored in different stages of plant development. However, their use is restricted by their limited number. Markers of DNA, such as RFLPs (restriction fragment length polymorphisms) have become more important during recent years, because they are mostly expressed codominantly and can be investigated in all stages of development. Recently, the use of random amplified polymorphic DNAs (RAPDs), as additional from of molecular markers, exhibited many advantages of this technique over RFLPs. Thus, faster data production, less DNA and no radioactivity requirement, characteerize this technique. Problems concerning reliability can be eliminated by optimizing the experimental conditions.

MARKER-ASSISTED SELECTION IN DATE PALM. CASE OF ISOENZYMES

The date palm (Phoenix dactylifera L.), a perennial Monocothyledon, is notuitable to detailed genetic studies based on morphological characters. Among 9 enzymes, 3 polymorphic systems; endopeptidases (ENP), glutamate oxaloacetate transaminase (GOT) and esterases (EST) were used to identify Moroccan date palm cultivars. When used to assess genetic conformity of date palm vitro-plants produced by tissue culture, the enzymatic systems showed a great stability of the parental electrophoretic phenotypes, with specific reactions of cultivars. The presence of loci; ENP, GOT-2 and EST-1, exhibiting 7 alleles with Mendelian segregation, allowed the identification of F1 populations of seedings derived from date palm cultivars resistant to Bayoud disease (fusariosis). In almost all cases, the most frequent electroretic phenotypes scored for each enzyme in different F1 populations, were similar to those of the corresponding parent cultivars.

IN VITRO PROPAGATION OF WOODY SPECIES

Dr. WALLALI LOUDYI. D.M.

ABSTRACT

Areas of in vitro tissue culture applications have evolved these last two decades including various aspects from the fundamental research to applied implications for the improvement and mass propagation of fruit and forest trees.

The technical innovations have given new insights into fundamental aspects of plants differenciation and development. New approaches have opened the way to the mastering of some woody plant manipulation in vitro. The aim of review is to emphasize some research areas which have been advanced by tissue culture technology and try to report the state of the art with the applications to trees.

IN VITRO ACCLIMATIZATION

Dr. ZAID A.

ABSTRACT

The ability of plants to adjust to a new environment is called "acclimation". Both acclimation and acclimatization are terms which describe the process of adaptation of an organism to an environmental change. Acclimation is a process regulated by nature, while acclimatization is regulated by man.

Problems of low survival rates and reduced growth for in vitro cultured plantlets transferred to soil occur for both woody and herbaceous species. Considerable effort has been made to document the changes that occur in plantlets as a result of in vitro incubation conditions. The generally low light and high humidity of the tissue culture environment have been shown to affect both plantlet morphology and physiology with a corresponding low survival rate due to desiccation after transfer.

From a commercial nurseries perspective, acclimatization of tree species has proved problematic. Procedures that have been described, may not be applicable on a commercial scale. Fortunately, progress is being made as more workers are turning their attention to this crucial area. Most scientists are interested in what happens during acclimatization to cause such water stress in tissue- cultured plantlets, how tissue-cultured plantlets are re-established in vivo and how transplants acclimatize to soil environments. Evaluation of physiological and structural changes taking place during acclimatization is prerequisite to comprehension of this process and necessary to the development of more efficient transplant protocols.

Plants of various species produced in vitro often show morphological, structural, physiological and biochemical differences from those produced conventionally e.g. : reduced epicuticular wax formation, altered leaf anatomy, excessive water loss and stomatal abnormalities compared to greenhouse acclimated plants, smaller palisade cells, large intercellular spaces and lower stomatal frequency, reduced trichome numbers in conjuction with abnormal trichome and stomatal distribution, and poor vascular connections between the root and shoot are also observed.

Biotechnology = An additional tool to plant breeding

Dr. AMRI Ahmed

ABSTRACT

An over-view of the traditional breeding techniques and factors that affect the genetic gain were discussed. Transfer of desired genetic factors, the use of variability in the secondary and tertiary gene pools and the development of new mutants are the objectives of any genetic manipulation of plants. Techniques used to achieve such objectives were presented. The use of genetic markers and the detail of some of the techniques used were discussed. All these techniques were presented as additional tools to increase the efficieacy of the existing breeding programs. Field evaluation and integrated selection are still required steps in any breeding program.

OBJECTIVES AND PRINCIPLES OF CONTROLLED MYCORRHIZATION

Dr. PLENCHETTE C.

ABSTRACT:

VA mycorrhizae present a great potential for plant growth and protection against pathogens in agricultural systems of developping contries. Concerns of modern agriculture such as economy problem or pollution of water and ground-water have generated discussion about a change from modern -conventional to a sustainable or integrated agriculture. Microorganisms, and among them mycorrihizae, may be critical if agriculture is to return to a state where luxury levels of fertilizers and posticides are decreased. Mycorrhizae must be integrated in the cropping systems (crop rotations and itinerary of techniques) by the mean of parameters included in the model estimating fertilizers and crop yiels Mycorrhizae development and efficiency depends on three factors, the plant, the fungus and the soil. It is possible to propose at least three agronomic standards, one for each factor, to take into account mycorrhizal effects : the relative field mycorrhizal dependency (REMD), the mucorrhizzal soil infectivity (MSI) and the phosphorus fertilizer equivalent to mycorrhizae (PFEM).

VAM fungi are usually propagated on host plants growing in pots in greenhouse. External spores, intraradical vesicles as well as mycelium are propagules that could be used to start pot cultures. Technics of desinfection of propagules permit now to obtain axenic production of fungal material which allow to purifie and characterise (PCR, RFLP, sequencing) the strains. Technics of encapsulation of fungal material in alginate beads permit to obtain mass production of axenic and mycorrhizal inoculum.

Controlled mycorrhization in forest nursery consist in inoculation of selected ectomycorrhizal inoculum in nursey beds or containers which soil has been previously desinfected inoculation may be performed by using spores or mycelia produce by liquid or solid fermentation. The inoculum is mixed in the top layer of the seed bed or with the substrate used in the container. The main interest of the methods is the protection against diseases caused by soil-borne fungi (Pythium, Fusarium, Rhizoctonia). A protection against the damping thz damping off occurs sometimes before the synthesis of mycorrhizae. The most efficient fungi is Laccaria Laccata but the occurence and ecological significance of the protection depends on the environmental factors.

EVALUATION OF THE COURSE ACTIVITIES

EVALUATION OF THE COURSE ACTIVITIES

The course " Biotechnology and Agriculture Improvement in Developing Countries " was organized by the Faculty of Sciences - Marrakech on behalf of ICGEB. Additional financial assistance was received from various co-sponsoring agencies (Cadi-Ayyad - University, Third world Academy of Sciences, Food and Agriculture Organization, Arab Organization for Agricultural Development, and German Technical Cooperation Service) (Cf. Financial Statement).

As Programmed, the course was held in the Faculty of Sciences - Marrakech, from May 22 till June 03, 1994.

At the registration deadline (March, 01, 1994), more than 200 application forms were received by the organizing committee, However, in order to ensure maximum success to the course, many preparatory meetings were held The meetings served the following purposes :

- To advertise the course as broader as possible Leaflets presenting the course (Cf. Annex B) and containing information such as the course objectives, the course programme, activities planning, participation requirements and financial arrangements were dispatched to all ICGEB focal points of the geographic region of Morocco, to Directors of Research Institutions and Deans of Universities of most French speaking African and Middle East Countries. International Organizations and Institutions were also contacted for co-sponsorization and candidates proposition

- To select the most suitable candidates that fulfil the course requirements Hence, 27 candidates (Cf. List of Participants) from the following countries were selected (Algeria (6 candidats) Argentina (1), Colombia (1) Lebanon (1), Morocco (12), Senegal (2) and Tunisia (4). About 2/3 of these participants were supported by the ICGEB fund, while the other 1/3 was taken in charge by the above mentionned institutions (Cf. Financial Statement). Although, participants were made up largely of Research Institutions people it is worth noting that about 1/4 of them were from University, Even the private sector was represented by one candidate (From Algeria).

- To contact the most known international speakers and lecturers. Various aspects of Biotechnology applications to agricultural sector were considered and finally thirteen (13) were selected (Cf. List of Speakers and Lecturers) 1 From Belgium, 5 from France and 7 from Morocco.

- To conceive and produce support documents. Each lecturer was requested to send his/her document (articles, course outline, conference scheme, ...) one month ahead to the organizing committee. Sufficient amount of copies were made before the course begins. Two volumes document were bounded and distributed to all participants (Cf. Copies included).

It must be noted at the outset that all 27 selected participants have been able to attend the course and arrived either or the 20th or the 21st of May, 1994. It is worthed to mention that "the excellent organization " was one of the course characteristics and all foreign lecturers as well as participants were highly satisfied. The Dean of the Faculty and the course organizers were cougratulated by both lecturers and participants for such matter. In fact, the projected programme was entirely and timely executed including visits to various biotechnology laboratories. This, in itself, is a first sign of success and a positive achievement for a first - time experience.

Twenty - three (23) lectures and four (4) conference, in all, were given. Subjects, as detailled in the enclosed course programme, focused on the following biotechnology areas :

* Micropropagation (asexual embryogenesis and organogenesis)
* Production of disease - free plants.
* Hybridization and creation of new varieties.
* Production of secondary metabolites.
* Germplasm and utilization of plant genetic ressources.
* Somaclonal variation.
* stablishment of a commercial tissue culture unit.
* In vitro acclimatization.
* Importance of Mycorrhizae.
* Introduction to molecular biology
* Genetic material and induction of mutants.
* Molecular markers (isoenzymes, RFLP, RAPD).
* Recombinant DNA technology and gene cloning.
* Transformation techniques (Agrobacterium and gene gun).
* Transgenic plants (resistance to herbicides, diseases and insectes).

The fellowing conference were also given :

* Biotechnology and Agriculture : Impact and Perspectives
* A case Study : Morocco and Biotechnology
* Modification of Protein Biosynthesis
* In vitro Plant Regeneration Techniques.

Lectures and Conferences usually lasted about one hour 30 minutes to one hour 45 minutes and were followed by 30 to 45 minutes of debate. All participants noted that the debate time was adequate and well conceived documents that were distributed were very well conceived. (An evaluation form of the course was filled out by each participant at the end of the course).

It is also worthed to notice that all programmed visits to some Moroccan biotechnology units were realized as scheduled. Beside visits, lectures and conferences, course participants have sought and made contacts with Moroccan institutions and key figures in the biotechnology field (both in public and private sectors).

Finally, planned benefits to be derived from the course were highly achieved. The knowledge of participants in the field of plant tissue culture and genetic engineering was updated. During the course, an important exchange of information and experiences among participants was realized and they were also deeply familiarized with the most advanced biotechnology techniques and their applications in their respective country.

The Dean of the Faculty of Sciences and the organizing committee, are very proud about the course success at all levels (organization, programme content and lectures quality,...). Such first experience has already generated very favorable reactions and allowed them to start thinking of organizing the same course (but this time in English) during the next year (1994-1995). An Application form for such prupose will be send in the near futur to ICGEB.

Acknowledgnents:

The organizing committee gratefully acknowledges funding and assistance from the following people and institutions :

ICGEB :

- Prof FALASCHI A.
  Director ICGEB

- Mrs. DIANA VITI
  Office of the Director

UNIDO

- Prof. KOLOSKOV V.
  Officer in charge - Contract Unit

- Mr. KOHONEN M.
  Chief Contact Unit
  Operational Support Division.

FAO

- Mr. ROUIGHI M.
  Rep. Res Rabat

AOAD

- Mr. NAJEM B.M.
  Regional Rep., Rabat

GTZ

- Mr. HOFFMANN D.

TWAS

- Mrs. MAHDAVI M.
  Executive Director's Office

CADI - AYYAD UNIVERSITY

- Prof. KNIDIRI M.
  President of the University

- Prof. MOKHLISSE A.
  Dean of the Faculty of Sciences

- Mr. BERRAHOU S.
  General Secretary of the University

- Mr. JADOUANI E.
  General Secretary of the Faculty of Sciences

- Mr . MARGHADI M.
  Head of Foreign Relations

LECTURERS and INTERNATIONAL SPEAKERS

- Dr. AAOUINE M.
- Dr. AMRI A.
- Dr. BAAZIZ M.
- Dr. CASSE-DELBART F.
- Dr. LEPOIVRE P.
- Dr. LETOUZE R.
- Dr. MARTY F.
- Dr. PLENCHETTE C.
- Dr. SIMONEAU P.
- Dr. WALLALI L.
- Dr. ZEMZAMI M.

COURSE EVALUATION BY INTERNATIONAL SPEAKERS AND LECTURERS

CNRS URA 573 E.N.S.A.M INRA

Pr Francine CASSE DELBART

EVALUATION OF THE COURSE ORGANIZED IN MARRAKECH (MAY 1994)

The course organized in Marrakech in May 1994 was devoted to topics which are of a major interest for developed as well as developing contries. The applications of biotechnology in plant breeding are already numerous and become more and more important concerning struggle against problems such as drought and salt tolerance, various pests, poor nutritional value, and other problems often encountered in many developing countries. The technics advance very quickly, and to be able to take advantage of the progress, every country must have some scientists watching and ready for using these methodology as soon as needed. For that reason, the organization of this kind of course is, to my opinion, of major importance.

The organizing commitee was efficient and kindly present during all the course, always helping largely people (for instance in distributing photocopies as well as in confirming the plane reservations), facilitating the life of the participants and thus making easier their work. The program was well choosen. The participants were of good scientific level and have shown a real interest in learning details in new technologies. The planning was well organized, the places were well choosen for the lectures as well as for accomodation which regrouped all the participants, favouring the contacts and discussions.

For a next year, the single improvement that I can imagine is a contact between the lecturers before the course, so that a better coordination will be ensured, avoiding risks of redundant and/or missing informations.

F Delbart

June 14th 1994

IMPORTANCE AND IMPACT OF THIS SEMINAR

In developing countries, where the production of food and renewable energy are essential, together with cash crops, biotechnologies have many potential applications, but requires a progressive and adapted development corresponding to the needs of relevant population, and to the global environment.

Aiming at the acquisition of the potential but also the limitation of biotechnological techniques in the frame of developing countries, the scientific Meeting of Marrakech fit very well these objectives and provided an excellent opportunity for the participant to further and to exchange their research experience.

LEVEL OF PARTICIPANTS

Participants were very active and critical in the discussions during the seminars and even in the hotel. The ideas they brought and the insights they offered each other into other agricultural and scientific communities showed that the majority of participants were highly competents.

ORGANIZATION

The organization (balance between seminar and visit of laboratories,...) was mastered perfectly by a team of very active scientists of the Marrakech University.

P. LEPOIVRE
15 juin 1994

UNIVERSITE D'ANGERS

Faculté des Sciences

The International Course held in Marrakech last spring (from May 22nd to June 3rd 1994) concerned the agricultural applications of biotechnology in developing countries. The impact of this subject is rapidly increasing due to its potential economic and environmental significances for future agricultural practices. The program covered different topics such as plant-microorganism interactions (symbiotic and pathogenic associations), in vitro culture, and transgenic plants. The course was organised in the form of lectures, conferences and visits so that participants could have a large overview of Plant Biotechnology including its field applications while also receiving numerous informations about recent developments of researches in this area. Although the participants have different scientific backgrounds, their great motivation generated numerous discussions that helped to solve the problem of heterogeneity. These discussions were possible mainly because of the restricted number of participants. Drs Zaid A. and Oihabi A. must be congratulated for their organisation of the course. Since this program was given for the first time, they should have face numerous problems but they managed to give us a pleasant stay while making their best to facilitate our working activities. For the coming years, I would suggest: i) to send summaries of all the conferences and lectures to the teachers a few months before the beginning of the course in order to avoid any possible redundancy or missing, and ii) to include some practicals so that participants could have a more concrete view of the major techniques used in biotechnology.

Ph. SIMONEAU

Boulevard Lavoisier - 49045 ANGERS Cedex 01 - Tél. : 41 73 54 54
Télécopie : 41 73 54 54

AGRICULTURAL BIOTECHNOLOGIE. APPLICATIONS IN THE DEVELOPING COUNTRIES

20/05-03/06

The development of biotechnologies in the field of agriculture is certainly a main topic of research for the coming years. There is no doubt about the importance of the applications, particularly for the research leading to the use of rhizospheric microorganisms. The goal is to develop a sustainable agriculture with low input of chemicals (fertilizers and pesticides). Microorganisms such as mycorrhizae which improve the mineral nutrition and protect the plants against soil-borne pathogenes presents a great potential for agriculture in developing countries.

It is certainly important that people in charge of research projects are able to follow such courses, but in my opinion people working directly in the laboratory or in the field will be able to participate.

I found the meeting well organize and I take the opportunity to thank Dr Zaid and Dr Oihabi for their wellcome and to congratulate them for their good job.

For the next year I suggest, if it is possible, to organize workshops for small groups of people working on the same subject or using the same techniques, with discussion about techniques and methodology, including possibly pratical work in the laboratory or in the field.

I enjoy to participate to this course and to establish contacts with different people and some student of the University.

C. Plenchette

Le 21 juin 1994

DIRECTION DES DOMAINES AGRICOLES
Unité de Contrôle des Plants (UCP)
Km 7,5 Av. Imam Malik, Dar Es Salam
Rabat 10000 - Tel : (212)-7-750056 Fax : (212)-7-755656

Evaluation of the International Course on Biotechnology Techniques in Agriculture for the Developing Countries

The novel techniques and bioprocesses constituting biotechnology are becoming more and more adopted in agriculture as well as in agro-industries and the traditional techniques will ultimately be compltely substituted in the near future.

Biotechnology basic know-how is therefore a crucial must for the developing countries to be able to keep on their development.

The present course aimed at enriching the knowledge and skill of technicians from developing countries was worthwhile and very appropriate for familiarizing the participants, especially from frensh speaking countries, with a wide range of new techniques successefully introduced and well established in a developing country which is Morocco.

Most of the participants were from the area of in vitro culture and their knowledge with respect to monoclonal antibodies and molecular diagnostics were rather limited. However their perception and quick understanding of many new concepts I covered in my seminar indicated a great motivation of all the participants to learn.

The course was very well organized. Extremely adequate sites of illustration of biotechnology applications in Morocco were choosen for the post-course visit and many participants expressed their interest to come back and spend more time in our facilities.

For the future courses, it will be worthwhile to give more time to the practical aspects and may be some laboratory work should be included as well to incite the participants to be operative right after their return home.

Mustapha ZEMZAMI
Plant Virologist

LABORATOIRE DE BIOCHIMIE ET BIOLOGIE MOLECULAIRE DES PLANTES

B B M P

UNIVERSITE CADI AYYAD

FACULTE DES SCIENCES-SEMLALIA, MARRAKECH (MAROC)

REF.C 5/94

Marrakech le 15/06/1994

A : Drs. ZAID A. & OIHABI A.
Laboratoire de Physiologie
Végétale, Faculté des Sciences
Semlalia, B.P. S 15,
Marrakech, Morocco

Objet : Cours International"Les Applications Biotéchnologiques en Agriculture pour les Pays en voie de Développement", 22 Mai- 03 Juin 1994.

Chers Drs.ZAID A & OIHABI A.

Suite à votre demande du 09/06/1994, veuillez trouver ,ci-joint, un résumé en anglais de mon cours (2 séances, durée 3h 45 min) fait le 01 Juin 1994.
En vous remerciant, j'atteste que le thème du cours était très intéressant, surtout pour les pays en voie de développement. L'organisation et le déroulement du cours ont été bien faites.
Veuillez agréer Drs.ZAID & OIHABI, l'expression de mes sentiments les plus distingués.

Laboratoire de Biochimie
et Biologie Moléculaire
des Plantes
B B M P - Fac.Sci. 1
MARRAKECH-MAROC

M. BAAZIZ

ADRESSE : DEPARTEMENT DE BIOLOGIE, BOULEVARD DU PRINCE MY.ABDELLAH, B.P. S 15, 40000 MARRAKECH. TEL: (04) 43 46 49 5 (POSTE 513).FAX: (04) 43 67 69. TELEX: FACSMAR 74013.

FINANCIAL STATEMENT

BIOTECHNOLGY AND AGRICULTURE IMPROVEMENT IN DEVELOPING COUNTRIES

FINANCIAL STATEMENT

A- TOTAL COST OF THE COURSE

I- PARTICIPANTS

- Travel compensation :	4249 US. $
- Living expenses (Including Per Diem) :	15,645 US.$
Total:	**19,894 US. $**

II- INTERNATIONAL SPEAKERS AND LECTURERS

- Travel :	4633 $
- Subsistence (including Hotel) :	3686 $
Total:	**8,319 US. $**

III- EXPENDABLE AND MINOR NON EXPENDABLE MATERIALS

- Course leaflets	77 $
- Two cabinets	654 $
- Mobile board with accessories	490 $
- Badges (50)	40 $
- Course briefcases (50)	697 $
- Block notes and pens (50)	109 $
- Coffee-breaks	500 $
- Fuel for the course bus	500 $
- Xerox copies for all course documents (50 copies of each document)	1,200 $
Total:	**4,267 US. $**

IV-ORGANIZATIONAL EXPENSES :

- Secretarial work before, during and after the course :	654 $
- Printing accessories and xerox copies :	327 $
- Postage, phone and fax :	1,000 $
- 2 receptions diners for international lecturers :	200 $
-Closing session diner ceremony for all participants, lecturers and staff :	1,662 $
Total:	**3,843 US. $**

TOTAL COST OF THE COURSE **36,323 US. $**

B- FINANCIAL CONTRIBUTIONS OF ICGEB AND OTHER ORGANIZATIONS / INSTITUTIONS

I-ICGEB :

The ICGEB financial assistance (**23,270 US. $)** was the major one (65 % of the total budget of the course) and was used to cover the following

- Travel and subsistence allowances of international speakers and lecturers : 5,196 $
- Full or partial living expenses and travel compensation for 20 participants (out of 27) : 13,614 $
- Part of Expendable and Minor non expendable Materials : 1,817 $
- Part of organizational expenses : 2,643 $

Total : 23,270 $

II- OTHER ORGANIZATIONS AND INSTITUTIONS :

- CADI AYYAD UNIVERSITY (CAU)

The total amount is **885 $**

- Part of expendable and non expendable materials : 765 $
- Fuel for bus transportation during the course (local and during the national visit) : 120 $

-ARAB ORGANIZATION OF AGRICULTURAL DEVELOPMENT (AOAD)

The AOAD's contribution was the total financing of the following three participants :

- Miss TAGHOUTI Mouna (Morocco)
- Mrs AID Aini (ALGERIA)
- Mr FARES Felix (Lebanon).

The total amount is : **5,749 US. $** and included :

- Registration 450 $
- Travel 2179 $
- Accommodation 2040 $
- Dailly Subsistence Allowance (DSA) 1080 $

- GERMAN TECHNICAL COOPERATION (GTZ)

The GTZ covered all expenses of two Moroccan participants (MM. EL KHATTABI Omar and SFAIRI Youssef). The amount is : **1,857 US $.**

- Registration	300 $
- Accommodation	837 $
- Dailly Subsistence Allowance (DSA)	720 $

- FOOD AND AGRICULTURE ORGANIZATION (FAO)

FAO covered all expenses of Mrs SAKA Hayett (Algeria).

The total amount is : **1,735 US. $** and included :

- Registration	150 $
- Travel	545 $
- Accommodation	680 $
- Dailly Subsistence Allowance (DSA)	360 $

-THIRLD WORLD ACADEMY OF SCIENCES (TWAS)

The TWAS's financial contribution was **962 US. $** that was used to cover the travel tickets of Dr. CASSE DELBART Francine (Inernational lecturer) and Mrs KCHAOU Donia (Participant from Tunisia).

- FACULTY OF SCIENCES- SEMLALIA MARRAKECH (FSSM)

The FSSM is the course organizer on behalf of the ICGEB. The FSSM's contribution was **1,865 US. $** :

- Postage, phone and fax :	1,000 $
- Expendable and minor non expendable materials and fuel :	665 $
- Two receptions diners for lecturers	200 $

N.B. Registration fees (900 $ collected from non-ICGEB financed participants) was used to cover a part of expendable and minor non expendable materials.

C-SUMMARY

* ICGEB	23.270 US. $
* AOAD	5.749
* FSSM	1.865
* GTZ	1.857
* FAO	1.735
* TWAS	962
* CAU	885
TOTAL	36.323 US. $

INTERNATIONAL SPEAKERS AND LECTURERS FINANCED BY ICGEB

LAST AND FIRST NAME	COUNTRY OF ORIGIN	ACCOMODATION (HOTEL)	D.S.A.	TRAVEL	TOTAL ($ US.)
AAOUINE Mohamed	MOROCCO	105	109		214
AMRI Mohamed	MOROCCO		109		109
BAAZIZ Mohamed	MOROCCO		109		109
CASSE-DELBART Francine	FRANCE	261	109	625 *	995
LEPOIVRE Philippe	BELGIUM	209	109	752	1070
LETOUZE Robert	FRANCE	366		741	1107
MARTY Francis	FRANCE	314	109	741	1164
OIHABI Abdallah	MOROCCO	248	109	98	455
PLENCHETTE Christian	FRANCE	261	109	783	1153
SIMONEAU Philippe	FRANCE	209	109	741	1059
WALALI Mohamed	MOROCCO	52	109		161
ZAID Abdelouahhab	MOROCCO	248	109	98	455
ZEMZAMI Mohamed	MOROCCO	105	109	54	268
TOTAL		**2,378**	**1,308**	**4,633**	**8,319**

N.B. : * = Air ticket taken in charge by T.W.A.S.
D.S.A. : Dailly subsitence allowance

PARTICIPANTS PARTLY OR TOTALLY FINANCED BY I.C.G.E.B.

LAST AND FIRST NAME	COUNTRY OF ORIGIN	ACCOMODATION (HOTEL)	D.S.A.	TRAVEL	TOTAL
BENDIAB Khadija	MOROCCO				
BENNACEUR Malika	ALGERIA	538	196		734
BOUACHRINE Badia	MOROCCO	124	49		173
BOUDERRAH Mohamed	MOROCCO	680			680
SERRANO Carlos	COLOMBIA	538	196		734
CHETTO Mustapha	MOROCCO	680			680
CHIBANI Farhat	TUNISIA	538	196		734
EL FATIHI LALAOUI F	MOROCCO	124	49		173
EL IDRISSI Tourane	MOROCCO	124	49		173
ELHOUMAIZI Aziz	MOROCCO	124	49		173
FOFANA Amadou	SENEGAL	455	180	594	1229
KCHAOU Donia	TUNISIA	538	196	337*	1071
LALAOUI Mina	MOROCCO				
LENGLIZ Rafiâa	TUNISIA	538	196		734
MARS Mohamed	TUNISIA	538	196		734
MOUROU Youssef	MOROCCO				
NDOYE Ousmane	SENEGAL	455	180	594	1229
SENNAOUI Zoubida	ALGERIA	538	196		734
TOUZI Abdelkader	ALGERIA	538	196		734
WEILENMANN Maria E	ARGENTINA	538	196		734
TOTAL		**7,608**	**2,320**	**1,525**	**11,453**

N.B. : * = Air ticket taken in charge by TWAS.
D.S.A. : Dailly Subsistence Allowance

PARTICIPANTS TAKEN IN CHARGE BY OTHER ORGANIZATIONS / INSTITUTIONS

A.O.A.D.

LAST AND FIRST NAME	COUNTRY OF ORIGIN	ACCOMODATION (HOTEL)	D.S.A.	TRAVEL	TOTAL
AID Aini	ALGERIE	680	360	545	1585
FARES Felix	LIBAN	680	360	1634	2674
TAGHOUTI Mouna	MAROC	680	360		1040
TOTAL		**2,040**	**1,080**	**2,179**	**5,299**

G.T.Z.

EL KHATTABI Omar	MAROC	680	360		1,040
SFAIRI Youssef	MAROC	157	360		517
TOTAL		**837**	**720**		**1,557**

F.A.O.

SAKA Hayat	ALGERIE	680	360	545	1,585
TOTAL		**680**	**360**	**545**	**1,585**

AFFRANCHIR ICI

Drs Abdelouahhab ZAID
Abdallah OIHABI
Département de Biologie
Faculté des Sciences
B.P. S15 Marrakech, Maroc

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Telex : FACSMAR 74013M

Qualifications

1- Les candidats doivent être titulaires d'au moins une thèse de doctorat de troisième cycle en Sciences Végétales ou tout diplôme équivalent et être activement impliqués dans la recherche agricole et/ou l'amélioration génétique pendant les 3 à 5 dernières années. Une familiarisation avec les techniques de culture in vitro et de biologie moléculaire est souhaitable.

2- Tous les candidats doivent remplir le formulaire d'inscription et de le retourner avant le 1er Mars 1994 à l'adresse ci-contre.

Le formulaire d'inscription doit être accompagné d'un curriculum vitae précisant les diplômes obtenus, l'expérience et les activités professionnelles du candidat ainsi qu'une brève description du projet de recherche ou de développement dans lequel il est actuellement impliqué (maximum 2 pages).

3- Vu le nombre limité de places, les candidatures seront examinées par le comité d'organisation du cours, afin de sélectionner les participants appropriés.

Arrangements financiers

Les frais de participation au cours sont de 150 $ US. Ce montant est destiné à couvrir les frais des manuels et documents des cours, le transport quotidien et durant la sortie finale ainsi que le banquet de clôture. Les procédures de paiement doivent être entamées suffisamment à l'avance pour garantir l'admission. les versements doivent être effectués au compte suivant:

01 400 11 5791 74

Société Générale Marocaine de Banques

59, rue de Yougoslavie

Agence de Marrakech - Gueliz

Marrakech Maroc.

Un nombre limité de bourses sera offert par le Centre International de Génie Génétique et de Biotechnologie, pour couvrir les frais de participation, de voyage et de séjour. Le choix d'attribution de ces bourses tiendra compte de la qualification du candidat et de l'état financier de son établissement d'origine.

La demande d'attribution de bourse doit être justifiée dans la demande d'inscription.

Hébergement et transport

Les frais d'inscription au cours ne couvrent ni l'hébergement ni la nourriture. Les participants peuvent loger en ville avec un coût approximatif d'une chambre individuelle en demi-pension de 300 DH (35 $ US) par jour. Les réservations peuvent être faites par le comité d'organisation à la demande des intéressés.

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UNIVERSITE CADI AYYAD
FACULTE DES SCIENCES
MARRAKECH-MAROC

ORGANISE

UN COURS INTERNATIONAL SUR :

" LES APPLICATIONS BIOTECHNOLOGIQUES EN AGRICULTURE DANS LES PAYS EN VOIE DE DEVELOPPEMENT "

22 MAI - 3 JUIN 1994

PARRAINE PAR :

LE CENTRE INTERNATIONAL DE GENIE GENETIQUE ET DE BIOTECHNOLOGIE, TRIESTE-ITALIE

OBJECTIFS DU COURS

Avec le développement rapide en biotechnologie, il est devenu important d'avoir une connaissance parfaite des bases fondamentales de recherche et de technologie en la matière.

Le cours vise essentiellement à :

* Mettre à jour les connaissances des participants dans le domaine de la culture in vitro et de génie génétique.

* Exposer aux participants les différentes utilisations biotechnologiques en agriculture.

* Familiariser les chercheurs Africains avec les progrès réalisés en la matière et leurs applications en Pays en Voie de Développement.

PROGRAMME

A- CULTURE IN VITRO

* Micropropagation (organogenèse et embryogenèse somatique)
* Assainissement
* Hybridation et création de nouvelles variétés (sauvetage des embryons, culture et fusion de protoplastes, haploidisation)
* Sélection pour la résistance aux stress biotique (pathogènes) et abiotiques (hydrique et salin)
* Production de composés secondaires.
* Stockage de germoplasmes
* Variation somaclonale
* Etablissement d'une unité de production commerciale (organisation, équipement de base, suivi, ...etc).

B-GENIE GENETIQUE

* Introduction à la biologie moléculaire.
* Le matériel génétique et l'induction de mutations.
* Les marqueurs moléculaires (isoenzymes, RFLP, RAPD)
* Technologie de transformation et clonage des gènes.
* Techniques de transformation (Agrobacterium, canon à particules).
* Les plantes transgéniques (résistance aux herbicides, maladies et insectes).

C- CONFERENCES

* Biotechnologie : Techniques et applications en Agriculture.
* Agrobiotechnologie : Situation actuelle et perspectives d'application en Pays en Voie de Développement.
* Les biotechnologies au Maroc.
* Evaluation des risques éventuels par production d'organismes génétiquement modifiés.
* Le réseau de Biotechnologie de l'ICGEB.

D-VISITES

Une sortie finale permettra aux participants de visiter des laboratoires de recherche et de production commerciale spécialisés en biotechnologie végétale, (Faculté des Sciences, INRA (Marrakech), Domaines Royaux (Meknès), SODEA, SOGETA (Rabat)).

PLANNING DES ACTIVITES

Le cours sera organisé à la Faculté des Sciences, Université Cadi Ayyad, Marrakech-Maroc. Il durera dix jours ouvrables, du 22 Mai au 3 Juin 1994, avec des sessions le matin et l'après midi. Les cours seront dispensés en langue française par des professeurs et des chercheurs Marocains et Européens ayant des connaissances approfondies dans le domaine des biotechnologies végétales. Le programme comprendra également des conférences et des visites à des laboratoires spécialisés.

Participation

La participation est ouverte aux chercheurs et spécialistes en culture in vitro et biologie moléculaire des Pays en Voie de Développement Francophones. Toute personne concernée par les biotechnologies végétales (culture in vitro, la transformation génétique...), la recherche et l'enseignement, bénéficiera largement de ce cours.

COURS INTERNATIONAL SUR LES BIOTECHNOLOGIES VEGETALES

LES PAYS EN VOIE DE DEVELOPPEMENT

22 MAI- 3 JUIN 1994

MARRAKECH- MAROC

FORMULAIRE D'INSCRIPTION

Nom et Prénom : .....

Nationalité .....

Titre et Fonction .....

Adresse de l'employeur : .....

.....

.....

Téléphone ..... Télex ..... Fax .....

Pouvez-vous financer votre : Séjour ..... frais de participation .....

Voyage .....

Sinon, justifier .....

.....

.....

Date .....