

**EUROPEAN CO-OPERATION
IN THE FIELD OF
SCIENTIFIC AND TECHNICAL RESEARCH**

Brussels, 3 November 1993

COST 301/93

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COST

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Secretariat
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NOTE

Subject: Memorandum of Understanding for the implementation of a European Research Action on arbuscular mycorrhizas in sustainable soil-plant systems (COST Action 821)

Delegations will find attached the text of the abovementioned Draft Memorandum of Understanding as finalized by the Working Party of Legal/Linguistic Experts.

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MEMORANDUM OF UNDERSTANDING
FOR THE IMPLEMENTATION OF A EUROPEAN RESEARCH ACTION
ON ARBUSCULAR MYCORRHIZAS IN SUSTAINABLE SOIL-PLANT SYSTEMS (COST ACTION
821)

The Signatories to this Memorandum of Understanding, declaring their common intention to take part in the Action "Arbuscular Mycorrhizas in Sustainable Soil-Plant Systems", have reached the following understanding:

SECTION 1

1. The Signatories intend to co-operate in an action to promote research into the field of Arbuscular Mycorrhizas in Sustainable Soil-Plant Systems (hereinafter referred to as the "Action").
2. The main objective of the Action is to promote and co-ordinate precompetitive research on the impacts of arbuscular mycorrhizas in sustainable soil-plant systems within Europe.
3. The Signatories hereby declare their intention of carrying out the Action jointly, in accordance with the general description given in Annex II, adhering as far as possible to a timetable to be decided by the Management Committee referred to in Annex I.
4. The Action will be carried out through concerted action, in accordance with the provisions of Annex I.
5. The overall value of the activities of the Signatories under the Action is estimated at approximately ECU 38,8 million at 1993 prices.

6. The Signatories will make every effort to ensure that the necessary funds are made available under their internal financing procedures.

SECTION 2

Signatories intend to take part in the Action in one or several of the following ways:

- (a) by carrying out studies and research in their technical services or public research establishments (hereinafter referred to as "public research establishments");
- (b) by concluding contracts for studies and research with organizations (hereinafter referred to as "research contractors");
- (c) by contributing the provision of a Secretariat and/or other co-ordinatory services or activities necessary for the aims of the Action to be achieved;
- (d) by arranging for inter-laboratory visits and by co-operating in a small-scale exchange of staff in the later stages.

SECTION 3

1. This Memorandum of Understanding will take effect for four years on its signing by at least five signatories. This Memorandum of Understanding may expire on the entry into force of an agreement between the Community and the non-Community COST member countries having the same aim as that of the present Memorandum of Understanding. This change in the rules governing the Action is subject to prior agreement of the Management Committee referred to in Annex I.

2. This Memorandum of Understanding may be amended in writing at any time by arrangement between the Signatories.

3. A Signatory which intends, for any reason whatsoever, to terminate its participation in the Action will notify the Secretary-General of the Council of the European Communities of its intention as soon as possible, preferably not later than three months beforehand.

4. If at any time the number of Signatories falls below five, the Management Committee referred to in Annex I will examine the situation which has arisen and will consider whether or not this Memorandum of Understanding should be terminated by decision of the Signatories.

SECTION 4

1. This Memorandum of Understanding will, for a period of six months from the date of the first signing, remain open for signing, by the Governments of the countries which are members of the COST framework and also by the European Communities.

The Governments referred to in the first subparagraph and the European Communities may take part in the Action on a provisional basis during the abovementioned period, even though they may not have signed this Memorandum of Understanding.

2. After this period of six months has elapsed, application to sign this Memorandum of Understanding from the Governments referred to in paragraph 1 or from the European Communities will be decided upon by the Management Committee referred to in Annex I, which may attach special conditions thereto.

3. Any Signatory may designate one or more competent public authorities or bodies to act on its behalf in respect of the implementation of the Action.

SECTION 5

This Memorandum of Understanding is of an exclusively recommendatory nature. It will not create any binding legal effect in public international law.

SECTION 6

1. The Secretary-General of the Council of the European Communities will inform all Signatories of the signing dates and date of entry into effect of this Memorandum of Understanding and will forward to them all notices which he has received under this Memorandum of Understanding.

2. This Memorandum of Understanding will be deposited with the General Secretariat of the Council of the European Communities. The Secretary-General will transmit a certified copy to each of the Signatories.

CO-ORDINATION OF THE ACTION

CHAPTER I

1. A Management Committee (hereinafter referred to as "the Committee") will be set up, composed of not more than two representatives for each Signatory. Each representative may be accompanied by such experts or advisers as he or she may need.

The Governments of the countries which are members of the COST framework and the European Communities may, in accordance with the second subparagraph of Section 4(1) of the Memorandum of Understanding, participate in the work of the Committee before becoming Signatories to the Memorandum without, however, having the right to vote.

When the European Communities are not a Signatory to the Memorandum of Understanding, a representative of the Commission of the European Communities may attend Committee meetings as an observer.

2. The Committee will be responsible for co-ordinating the Action and, in particular, for making the necessary arrangements for:
 - (a) the choice of research topics on the basis of those provided for in Annex II, including any modifications submitted to the Signatories by the competent public authorities or bodies; any proposed changes to the Action framework will be referred for an opinion to the Committee of Senior Officials on Scientific and Technical Research (COST);

- (b) advising on the direction which work should take;
 - (c) drawing up detailed plans and defining methods for the different phases of execution of the Action;
 - (d) co-ordinating the contributions referred to in subparagraph (c) of Section 2 of the Memorandum of Understanding;
 - (e) keeping abreast of the research being done in the territory of the Signatories and in other countries;
 - (f) liaising with appropriate international bodies;
 - (g) exchanging research results among Signatories to the extent compatible with adequate safeguards for the interests of Signatories, their competent public authorities or bodies and research contractors in respect of industrial property rights and commercially confidential material;
 - (h) drawing up the annual interim reports and the final report to be submitted to the Signatories and circulated as appropriate;
 - (i) dealing with any problem which may arise out of the Action, including those relating to possible special conditions attached to accession to the Memorandum of Understanding in the case of application submitted more than six months after the date of the first signing.
3. The Committee will establish its rules of procedure.
4. The Secretariat of the Committee will be provided at the invitation of the Signatories by either the Commission of the European Communities or one of the Signatory States.

CHAPTER II

1. Signatories will invite public research establishments or research contractors in their territories to submit proposals for research work to their respective competent public authorities or bodies. Proposals accepted under this procedure will be submitted to the Committee.
2. Signatories will request public research establishments or research contractors, before the Committee takes any decision on a proposal, to submit to the public authorities or bodies referred to in paragraph 1 notification of previous commitments and industrial property rights which they consider might preclude or hinder the execution of the Actions of the Signatories.

CHAPTER III

1. Signatories will request their public research establishments or research contractors to submit periodical progress reports and a final report.
2. The progress reports will be distributed to the Signatories only, through their representatives on the Committee. The Signatories will treat these progress reports as confidential and will not use them for purposes other than research work. In order to assess better the final data on the Action, the Signatories are invited, for the preparation of the final report, to state the approximate level of spending at national level arising from their involvement in the said Action. The final report on the results obtained will have much wider circulation, covering at least the Signatories' public research establishments or research contractors concerned.

CHAPTER IV

1. In order to facilitate the exchange of results referred to in Chapter I, paragraph 2(g), and subject to national law, Signatories intend to ensure, through the inclusion of appropriate terms in research contracts, that the owners of industrial property rights and technical information resulting from work carried out in implementation of that part of the Action assigned to them under Annex II (hereinafter referred to as "the research results") will be under obligation, if so requested by another Signatory (hereinafter referred to as "the applicant Signatory"), to supply the research results and to grant to the applicant Signatory or to a third party nominated by the applicant Signatory a licence to use the research results and such technical know-how incorporated therein as is necessary for such use if the applicant Signatory requires the granting of a licence for the execution of work in respect of the Action.

Such licences will be granted on fair and reasonable terms, having regard to commercial usage.

2. Signatories will, by including appropriate clauses in contracts placed with research contractors, provide for the licence referred to in paragraph 1 to be extended on fair and reasonable terms, having regard to commercial usage, to previous industrial property rights and to prior technical know-how acquired by the research contractor insofar as the research results could not otherwise be used for the purpose referred in paragraph 1.

Where a research contractor is unable or unwilling to agree to such extension, the Signatory will submit the case to the Committee, before the contract is concluded; hereafter, the Committee will state its position on the case, if possible after having consulted the interested parties.

3. Signatories will take any steps necessary to ensure that the fulfilment of the conditions laid down in this Chapter will not be affected by any subsequent transfer of rights to ownership of the research results. Any such transfer will be notified to the Committee.
 4. If a Signatory terminates its participation in the Action, any rights of use which it has granted, or is obliged to grant, to, or has obtained from, other Signatories in application of the Memorandum of Understanding and concerning work carried out up to the date on which the said Signatory terminated its participation will continue thereafter.
 5. The provisions of paragraphs 1 to 4 will continue to apply after the period of operation of the Memorandum of Understanding has expired and will apply to industrial property rights as long as these remain valid, and to unprotected inventions and technical know-how until such time as they pass into the public domain other than through disclosure by the licensee.
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GENERAL DESCRIPTION OF THE ACTION

1. BACKGROUND

1.1. CURRENT STATE-OF-THE-ART OF RESEARCH IN THE FIELD

Arbuscular mycorrhizas (AM) are a universal symbiosis between plants and fungi and essential components of soil-plant systems. They are very common and occur in the majority of plant species in natural and agro-ecosystems. Colonization by AM fungi results in the formation of internal structures (arbuscule) within the root and an extensive external mycelium. They thus act as a major interface between plants and the soil, by influencing or regulating resource allocation between abiotic and biotic components of the soil-plant system. They are involved in many key ecosystem processes, including nutrient cycling and soil structural conservation, and have been shown to improve plant health through increased protection against abiotic and biotic stresses.

Increasing environmental degradation and instability, due to anthropogenic activities, and in particular the fragility of the soil resource has led to an increased awareness of the need to develop practices resulting in more sustainable natural and agro-ecosystems. Sustainability can be defined as the successful management of resources to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving resources.

Because of the fundamental importance of AM in key ecosystem processes, an understanding of the symbiosis is an essential prerequisite for the development of any sustainable soil-plant system.

Achievements of the past COST Action 810 on "Arbuscular Mycorrhizas (1989-1993)"

In the beginning, five countries were involved in this Action. The number has since expanded to eleven, involving more than 45 laboratories. In addition, applications from two eastern European countries were approved in 1992.

Although the complexity of the arbuscular mycorrhizal symbiosis is great and thus research is necessarily multidisciplinary, the consolidation of research into well-structured project groups (8) led to effective organization. Because of this, co-operation between laboratories during the period 1989-1993 was extensive and largely achieved by a combination of specialist scientific meetings (15) and exchanges of scientists (46 up until the end of 1992) both promoting co-ordination and combining scientific expertise. This co-operation has been extremely effective and has resulted in a number of transnational experiments, publications (in particular two special issues of International Reviews), EC Research Proposals and the formation of an arbuscular mycorrhizal taxonomical database, the Bank of European Glomales.

Considerable advances have been made in the following topics:

1. The positive role of AM in nutrient cycling (especially P) and in improving soil structure.
2. The importance of AM on abiotic stress tolerance and their role in preventing heavy metal and radionuclide uptake by plants.
3. The role of AM in protecting plants against soil pathogens.
4. The synergistic action of AM on N fixing activities (e.g. Rhizobium) and in general with beneficial soil bacteria.

5. The influence of AM fungal colonization on root morphology and gene expression resulting in a more efficient underground system.
6. The improvement of our knowledge in the physiological, biochemical, and structural aspects of plant-fungus exchanges.
7. The applications of AM to the production of micropropagated plants.
8. The establishment of the Bank of European Glomales (BEG) (AM fungi).

1.2. WHY THE CO-OPERATION SHOULD BE CARRIED OUT WITHIN THE CONTEXT OF COST

The new orientation of the Common Agricultural Policy (CAP of the EC) requires the development of new and more ecologically balanced approaches to plant production. The consequent necessity to understand biological processes in nutrient transformation, plant protection and soil conservation increases the need for intensifying research into mycorrhizas.

Because of its complexity, mycorrhiza research calls for a multi-disciplinary approach that can be achieved only by combining scientific expertise and resources from several member states. This Action will effectively promote such co-ordination, resulting in more efficient use of both Community and national funds in order to develop and maintain a European approach to understand the function of mycorrhizas in soil-plant systems.

1.3. HOW THE ACTION RELATES TO OTHER INTERNATIONAL SCIENTIFIC PROGRAMMES

An important aspect of our activity is to improve the promotion of collaboration with other COST Actions dealing with "Micropropagation" and "Early Detection of Plant Pathogens".

The creation of the Bank of European Glomales (BEG) will also form the base for an exchange of comprehensively characterized fungal strains among European research groups as well as within the equivalent co-ordinating structure in Northern America (INVAM).

2. OBJECTIVES OF THE ACTION

This Action will achieve three main objectives:

1. to promote and co-ordinate precompetitive research on the impacts of arbuscular mycorrhizas in sustainable plant-soil systems within Europe;
2. to provide the necessary know-how for increasing the competitiveness of European research at a crucial moment for the development of new management techniques in agriculture: i.e. the use of soil micro-organisms as a biological tool to improve plant development and health;
3. to promote biotechnology in the production and application of mycorrhizal fungi in sustainable agriculture, particularly through the BEG.

3. SCIENTIFIC CONTENT

This Action is built on COST Action 810 achievements, and the following new orientations are proposed to consolidate research on arbuscular mycorrhizas.

3.1. MYCORRHIZAL FUNGI: BIODIVERSITY, PHYLOGENETICS AND POPULATION DYNAMICS

Fungal isolates beneficial to agriculture and the environment will be identified, utilizing all available techniques, i.e. from morphology to molecular biology. Their genetic make-up and functional groupings (pH range; stress tolerance; nutrient scavenging ability) will be characterized to enhance understanding and management of the symbioses. Methods of germplasm conservation will be established. The BEG registration scheme and co-operative sharing of well characterized cultures to assist in achieving common research goals will be progressed to make information available to European (international) laboratories. An expert system for identification of European mycorrhizal fungi will be developed.

The relationships among different components of arbuscular mycorrhizal fungal populations with emphasis on the interaction with other soil micro-organisms will be elucidated.

3.2. GENETICS AND PHYSIOLOGY OF MYCORRHIZAL SYSTEMS

The genetic component of mycorrhizal fungi-plant interactions must be identified. Symbiotic genes must be isolated and their products and modes of action characterized. Selection systems in the past have inadvertently selected for mycorrhizal fungi that can tolerate high nutrient levels, but which may not be most beneficial to the plant under low-input systems. Understanding this will assist in reversing this trend and selecting plants for optimum symbiotic efficacy and hence reduced dependence on inorganic fertilizers.

The regulating mechanisms of AM for growth and morphogenesis, especially in relation to root architecture (involved in nutrient and water uptake) should be better understood. The biological routes through which the plants and arbuscular mycorrhizal fungi communicate need to be better defined at the molecular and cellular level.

Such knowledge will allow us to select and manage fungus-plant partners best matched to their environment.

3.3. MYCORRHIZAS IN SUSTAINABLE SYSTEMS: THEIR ROLE IN BIOGEOCHEMICAL CYCLING

Resources available to plants are limited, and mycorrhizas can greatly help in their better use. They can be of particular benefit to low-input agriculture and to the environment through improving plant growth, development and health.

Despite recent progress, there is still a need to increase our understanding of the mycorrhizal mechanisms involved in plant growth and edaphic processes such as biogeochemical cycling: maintenance and restoration of soil structure, stability and fertility; and soil rehabilitation: mitigation of desertification and erosion. The role of external mycelium of mycorrhizas in phosphate uptake is understood, but its activity in relation to other macro- and micro-nutrients and organic matter cycling requires comprehensive investigation. Further research is needed on interactions between the mycelium of AM fungi and other soil organisms.

The relevance of mycorrhizas in set-aside lands and their importance to ruderal plant communities in relation to plant succession and diversity needs to be elucidated through ecological and physiological studies.

3.4. MYCORRHIZAS IN ABIOTIC AND BIOTIC STRESS ALLEVIATION AND PLANT PROTECTION

As the use of pesticides and inorganic fertilizers is reduced, plants bred for use in high-input systems will come under increasing stress. New varieties of plants must be bred for these new low-input agricultural systems. The entire plant-AM fungi system must be considered in order to obtain optimal use of available resources.

Currently there are no satisfactory pesticides for the control of most root pathogens. Arbuscular mycorrhizas have been shown to reduce damage by such pests under some circumstances. Interactions between AM and Plant Growth Promoting Rhizobacteria (PGPR) and other biocontrol agents appear to be effective for the biological control of root pathogens. Investigation into the incidence and mechanisms of this effect should be pursued with the aim of making use of them for the improvement of plant health.

Pollution and other damage caused by human activity can result in a reduction in plant health through stress. Arbuscular mycorrhizas improve nutrient balance and have been shown to alleviate the problems caused by heavy metal pollution. They also may influence plant water relations and assist plant establishment in sites subject to desertification. Current knowledge of the role of AM in alleviating stress and in plant protection is limited and research is urgently required in order to provide a scientific basis for the development of optimal plant-AM systems.

4. TIME-TABLE

The time required to pursue the scientific projects will be four years. The evaluation of the progress of the Action will be by annual meetings on specific subjects in the following sequence:

1994: methods of germplasm conservation, the molecular techniques for characterizing the biodiversity of AM fungi and the establishment of an expert system for identification of European AM fungi.

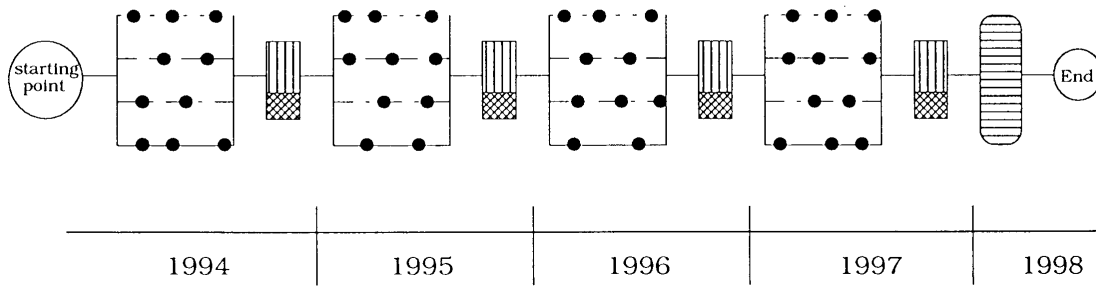
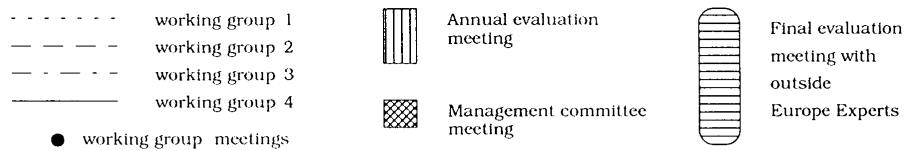
1995: research progress on the mycorrhiza genes for assisting plant breeders in selecting plants for optimum symbiotic efficacy.

1996: – regulating mechanisms of AM in relation to root architecture and plant development;
– elucidation of the biological routes of communication between host plants and AM fungi.

1997: the role of arbuscular mycorrhizas in biogeochemical cycling, soil structure and aggregate stability and on the impact of AM fungi in biotic and abiotic stress alleviation and plant protection.

A final meeting will be held in 1998 to evaluate the achievement of the Action. International experts from outside Europe will be asked to participate and provide a critical analysis on the achievements.

Diagram



5. ORGANIZATION AND MANAGEMENT

The action will be divided into the following 4 new working groups:

1. Arbuscular mycorrhizal fungi: biodiversity, phylogenetics and population dynamics.
2. Genetics and physiology of arbuscular mycorrhizal systems.
3. Arbuscular mycorrhiza in sustainable systems: their role in biogeochemical cycling.
4. Arbuscular mycorrhiza in abiotic and biotic stress alleviation and plant protection.

Co-ordinators of these working groups will be designated by the Management Committee. These working groups will meet regularly to co-ordinate and promote research activities.

Annual evaluation meetings (see Time-table) will be held:

- to review the results achieved and will include non-European-Experts and Officials from the EC Commission;
- to promote co-operation within the participating institutes;
- to finalize publications; and

- critically to evaluate progress achieved in practical applications.

Special emphasis will be placed on promoting mycorrhizal research in Eastern European Countries through organizing working meetings on the development of experimental approaches and methodology. Research activities on mycorrhiza from the different European regions will thus be integrated within a pan-European Action.

The Management Committee will meet at least once a year, if possible in conjunction with the annual meeting.

Based on the previous experience of co-operation between COST 810, COST 88 and COST 87, joint working groups will be established between this Action on arbuscular mycorrhiza and other relevant COST Actions. The Management Committee of these Actions will establish the rules of such co-operation.

The final evaluation of the Action is specified under "4. TIME-TABLE".

6. ECONOMIC DIMENSION OF THE ACTION

Western Europe	70 man-years scientific staff 70 man-years technical staff
Eastern Europe (without CES)	10 man-years scientific staff 10 man-years technical staff
Total	160 man-years

50 man-years X 60 000 ECU	ECU 3 million
50 man-years X 40 000 ECU	ECU 2 million
60 man-years X 20 000 ECU	ECU 1,2 million
Total personnel costs	ECU 6,2 million/year
Laboratory equipment and consumable	ECU 2,4 million
Overhead costs	ECU 1,1 million
Total estimated costs covered from national sources ECU 9,7 million/year	

