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Consultant Final Report
IICA/EMBRAPA-PROCENSUL II

BIOTECHNOLOGY OF FOREST SPECIES

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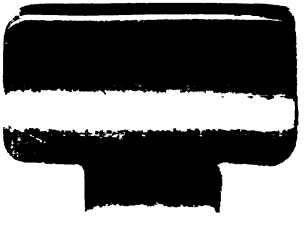

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IICA/EMBRAPA-PROCENSUL II

Edward G. Kirby, III

Brasília, setembro de 1989

INSTITUTO INTERAMERICANO DE COOPERAÇÃO PARA A AGRICULTURA
EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA

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APRESENTAÇÃO

A reprodução e difusão dos Relatórios de Consultores, no âmbito restrito das Diretorias das Unidades do Sistema Nacional de Pesquisa Agropecuária, vinculado à EMBRAPA, tem como objetivo principal o de divulgar as atividades desenvolvidas pelos consultores e as opiniões e recomendações geradas sobre os problemas de interesse para a pesquisa agropecuária.

As atividades de consultoria são realizadas no âmbito do Projeto de Desenvolvimento da Pesquisa Agrtopecuária e Difusão de Tecnologia na Região Centro-Sul do Brasil - PROCENSUL II, financiado parcialmente pelo Banco Interamericano de Desenvolvimento - BID e a EMBRAPA conforme os contratos de Empréstimo 139/IC-BR e 760/SF-BR, assinados em 14 de março de 1985 entre o Governo Brasileiro e o BID.

As opiniões dos consultores são inteiramente pessoais e não refletem, necessariamente, o ponto de vista do IICA ou da EMBRAPA.

A coordenação dos Contratos IICA/EMBRAPA agradeceria receber comentários sobre estes relatórios.

Horacio H. Stagno
Coordenador Contratos IICA/EMBRAPA

INTER-AMERICAN INSTITUTE FOR COOPERATION ON AGRICULTURE
IICA/EMBRAPA CONTRACT

CONSULTANT FINAL REPORT

1. Consultant's full name: *Edward G. Kirby III*

2. Specialist in: *Biotechnology of Forest Species*

3. Title of IICA Project: *2.SB.3*

4. EMBRAPA Program for which consultancy is provided:

PROGRAMA : PROCENSUL II
SUBPROGRAMA : 02-PESQUISA VEGETAL

IICA Project Activity Code: *2.SB.3.02*	Administrative Code: *R 4894 31E 03 102*
Title of Activity of IICA Project corresponding to this consultancy	*Cooperation with EMBRAPA on research activities in the field of crop production.*

CONSULTANT CONTRACT PERIOD	DUTY LOCATION (Center)
July 28th, to August 13th., 1989	*CNPF/EMBRAPA*
CONTRACT EXTENTION PERIOD (If any)	DUTY LOCATION (Center)

5. Financial support: *PROCENSUL II*

CONSULTANT'S REPORT

1. Unit: CNPF/EMBRAPA

2. Consultant: Dr. Edward G. Kirby, III

3. Program: Biotechnology of Forest Species

4. Sub-program: In vitro culture of forest trees: isolation and culture of protoplasts of forest species

5. Type of Consultancy: Foreign

6. Period of Consultancy: July 28 - August 13, 1989

7. Institutions Involved: CNPF/EMBRAPA and Rutgers University

8. Activities and Principal Results Achieved:

A. Discussions and Consultations:

Part of my time at CNPF was spent meeting the staff and learning about the organization and operation of the research center. I met and discussed research goals with the CNPF Director, Dr. Luciano Lisbao Junior and the Technical Chief, Dr. Jarbas Shimizu. It was a particular pleasure for me to meet again Jarbas Shimizu. Jarbas and I were graduate students together at the Forest Physiology and Genetics Laboratory at the University of Florida.

I was given a tour of the current CNPF facilities and walked through the new CNPF research building currently under construction. This new building appears bacly needed and most welcome by the staff. It will provide not only research laboratories and administrative space, but will also have a good lecture hall and a centralized shared equipment areas.

I had the opportunity to discuss in general terms the research programs in biotechnology of forest trees with Dr. Cortezzi-Graç and other researchers and technical staff members.

This group is mainly working on eucalypts, Ilex paraguaensis and an Acacia spp. used for tannin production. None of the cultures which I examined of all the species under investigation was completely satisfactory. Eucalypt cultures, especially those of nodal cultures of mature clones of Eucalyptus dunnii, appeared pale yellow in color and were not healthy and green. These cultures also had an accumulation of exudates and droplets, particularly from leaf tips. Ilex cultures appeared necrotic with some bud "die-back". Acacia cultures appeared stressed and many shoot cultures had dropped leaves. All of these symptoms, especially since they appear in all culture types point to an accumulation of ethylene in the culture environment. The question is: is ethylene itself the problem, or is ethylene production being induced by a some factor causing a stress response in the cultures?

I discussed these problems with Dr. Cortezzi-Graça and her colleagues. Exhaustive studies have been undertaken to attempt to control the accumulation of ethylene. These studies have been well thought-out and included examination of a number of individual media, study of the effect of culture containers and caps used in the in vitro work, examination of the plant hormone components of the media, use of antioxidants and charcoal, examination of supplemental organic nitrogen sources, use of elevated levels of calcium, studies of increased agar and sucrose concentrations and examination of various light intensities. To date none of these studies has resulted in a particular technique able to overcome the observed in vitro problem. It is interesting to note that similar cultures of E. dunnii maintained by Maocyr Fantini at the Klabin research facility in Monte Alegre using the identical techniques do not display the

symptoms observed at CNPF.

It is conceivable that one factor contributing to the observed behavior of the cultures could be water quality. Consistently pure water is an absolute prerequisite for plant tissue culture. At CNPF, water which is used to prepare culture media is derived from well water and is simply double distilled. Consistent, high purity water can be routinely prepared using reverse osmosis and ion exchange cartridge water purification systems. These systems are not particularly expensive in the US. For example, the NanoPure II System (Barnstead, supplied by Fisher Scientific) for raw feedwater (4 module system) in the US costs approximately $2348 list price ($1950 for system and $398 for the cartridges). It is clear that this price may be higher in Brazil.

During the first week of my visit I also had the opportunity to meet with the scientific staff and technicians in the biotechnology laboratory. I met with Dr. Cortezzi-Graça's chief technician, Silvino Mendes. He is currently doing most of the micropropagation work with E. dunnii. The goal of this work is solely to develop procedures for micropropagation of mature clones. In the micropropagation scheme which Silvino and Dr. Cortezzi-Graça have developed for E. dunnii, there are problems with shoot elongation and rooting. The variability seems somewhat clone specific. At CNPF initially this work was going rather well. Good cultures were procuced, but the rooting percentage was low. There were also problems associated with hardening. We discussed media effects, including MS, WPM, QL, Natal's medium and the effects of riboflavin. I had the opportunity to examine the cultures used for micropropagation. These cultures are derived from epicormic

shoots of selected clones. The medium used for shoot multiplication contains B5 or MS salts, 3% sucrose, 0.5 mg/l BAP and 0.001-0.01 mg/l IBA. The medium established for multiplication of axillary buds gives a maximum of 4-6 shoots per node. I am a little concerned with the experimental design. As I understand it, all the clones are mixed together in a randomized block design. Then total responses to specific culture conditions are assessed. Frankly, I feel the clonal effects are most interesting and should be noted. Many responses in vitro, particularly rooting as we have seen in Douglas-fir, may be genotype specific. It is possible that protocols will have to be "fine tuned" for individual clones.

I observed that table sugar was used for some applications in tissue culture in place of reagent grade sucrose. As indicated above, I cannot overemphasize the importance of high purity reagents used in plant tissue culture. The issue is not just purity but also consistency of the reagents.

While at CNPF I had the opportunity to visit the research facilities at Klabin do Parana at Monte Alegre. There I met with Dr. Rui Montiero, Maocyr Fantini and Paulo Kikuti. The tissue culture lab at Klabin is well-equipped, well-staffed and is geared entirely to micropropagation. I had a good chance to discuss research interests with Paulo Kikuti, who is the Technical Coordinator. At present Klabin is committed to the use of seed for propagation of eucalypts. They don't feel that rooted cuttings are the way to go for them at the present time and they like the genetic diversity they see. When asked about the problem of selfing in seed production, they felt that they are able to eliminate the selfing problem and associated inbreeding depression by selection at the seedling stage.

This may be more difficult as time and breeding progress. When asked what practical advantages they see in forest biotechnology, Paulo indicated that obtaining a male sterile line if eucalypts would be most desirable. What they would like to have haploids, and resulting homozygous diploids for identification of recessive characters.

B. Research Activities

A major goal of my visit to CNPF was to attempt to define a procedure for the isolation of protoplasts from seedling and adult clonal material of E. dunnii. Initially, microscopic observations of the cells and tissues of seedling cotyledons and clonal leaves were performed were performed to check for oil cells and potential problems in protoplast isolation caused by cells accumulating inhibitory compounds. These sorts of problems we have seen while isolating protoplasts from E. grandis. It was observed that cotyledons have fewer oil cells and accumulated products than leaves from micropropagated material. Cells are about 100µ in diameter.

Taking a cue from previous work on E. grandis at Rutgers, a protoplast isolation from dunnii cotyledons was performed following the procedure outlined in the attached protocol #1. In advance of the actual isolation, cotyledons were first sliced and soaked overnight in MES, sorbitol, DTT and PVP-40 to eliminate the phenolic substances. We worked solely with cotyledon material and the experiment was not done under sterile conditions.

The isolation went well. We were able to produce protoplasts in all the preps from cotyledon slices. The only problem was that the protoplasts were difficult to release from the donor tissue. It clearly appears that the soaking protocol (overnight) is

very beneficial.

We also isolated protoplasts from in vitro clonal leaves of E. dunnii (attached protocols #2 and #3) with satisfactory results, as indicated. With these encouraging results, an isolation under sterile conditions which would allow culture of protoplasts was undertaken (protocols #4 and #5). In performing the sterile isolation, clonal leaves from in vitro shoots were provided by Maocyr Fantini. It should be noted that certain problems were encountered. During the overnight soaking period a fairly high amount of material was used per milliliter of soaking solution, resulting in the solution becoming saturated with exudates from the leaves. We proceeded with the isolation, however very few protoplasts were produced. Many factors could have contributed to this poor isolation, including the initial saturation of the overnight soaking solution. However, this initial work will provide a very nice base from which additional experiments on the isolation and culture of protoplasts from E. dunnii can be undertaken. It should be mentioned that the isolation of protoplasts from eucalypt species is not trivial. There are no reliable reports in the literature to date describing the isolation and culture of protoplasts from any eucalypt species.

I report here a number of suggestions for further work to establish reliable protoplast isolation and regeneration from E. dunnii. I am encouraged with the results on dunnii to date and will be willing to collaborate in further work on eucalypt protoplasts.

1. Pre-isolation soak. Examine the components of the soak. Are PVP, DTT, MES all necessary? Adjustment of the amount of material (mg fresh weight) per ml of soaking

solution in indicated. Examine the effective duration of the soaking procedure.

2. Enzymatic isolation. We have determined that 0.6M sorbitol and produce sufficient plasmolysis to allow efficient protoplast isolation. In order to minimize the stress applied to the cells, it is necessary to determine if this is the minimum threshold level. In addition, examination of the duration of enzyme treatment and the concentrations of enzymes employed.

3. Protoplast starting materials. We have successfully isolated protoplasts from seedling cotyledons and leaves from in vitro shoots. Are these materials the best ones for producing protoplasts capable of cell division? Plant regeneration?

9. Suggestions and Recommendations:

A. Personnel. I was impressed with the quality, training and focus of the research staff at CNPF. In general, the staff is well-read and engaged in their work. Based on the quality of the staff and the excellent laboratory facilities which will be available in early 1990 and given the proper support, I feel that the program at CNPF could become the foremost research group in forest biotechnology in Brazil. Central to program is Dr. Cortezzi-Graça. She is a very capable, competent and talented scientist. She is keenly interested in pursuing new research directions, particularly in protoplast technology, cell cultures, and somatic embryogenesis of forest trees. It appears however, that Dr.

Cortezzi-Graça's talents as an independent scientist are not being fully utilized since she currently has extensive responsibilities at CNPF ranging from the biotechnology laboratory to greenhouse operations and extension work. In short, she has too many responsibilities. I feel that Dr. Cortezzi-Graça is capable of making a significant contribution to forest biotechnology if given the freedom, time and support necessary. To insure the productivity of the forest biotechnology group it is also essential to maintain the scientific staffing at its current level and perhaps reallocate individual responsibilities allowing development of selected research programs.

B. Materials and Supplies. As indicated earlier, it is essential in a tissue culture program to provide consistently high quality water and chemical reagents. I strongly recommend that CNPF immediately purchase a high quality water purification system without delay. Much time and money can be wasted in culturing materials on media prepared from impure water and chemicals. In addition, for the protoplast and cell culture research, which Dr. Graça has proposed, a simple inverted microscope and a photomicrography system are both required. Any possible mechanism that would expedite the procurement process (ie. purchasing of chemicals and supplies) will also clearly benefit the research program.

C. Other Comments. I was pleased to have the opportunity to visit CNPF. I am impressed with their programs and I am most interested developing and maintaining collaborative

research programs with CNPF.

Edward G. Kirby, III
Department of Biological Sciences
Rutgers University

August 17, 1989

PROTOCOL #1

August 2, 1989
IN CURITIBA

PROTOPLAST ISOLATION FROM COTYLEDONS OF *Eucalyptus dunnii*, as prepared at CNPF

Prepare the following:

2X stock:

1.6 g sucrose
20.0 ml K-salts
2.0 ml thiamine stock
2.0 ml inositol stock
1.0 ml Fe EDTA
(5.76 ml $CaCl_2 \cdot 2H_2O$ stock- eliminated, no stock)
0.16 g MES
2.0 g PVP-40
0.4 g DTT

Adjust pH to 6.5
Bring to 200 ml
Label

Protoplast Washing Solution (PWS): PWS- 0.8 M sorbitol

7.30 g sorbitol
25.0 ml 2X stock
Adjust pH to 6.5
Bring to 50 ml with dd water

Protoplast Washing Solution (PWS): PWS- 1.2 M sorbitol

10.92 g sorbitol
25.0 ml 2X stock
Adjust pH to 6.5
Bring to 50 ml with dd water

(We removed cotyledons from approx. 15 seedlings for each 0.8 M and 1.2 M treatments, sliced them in the sorbitol solns and let them soak overnight. This a from a cue from our earlier work work on the removal of the phenolic substances. All solns were retained and will be used tomorrow for the preparation of the protoplasts from the cotyledons and to re-do this same protocol from leaves from in vitro shoots of clones.)

For August 3rd:

Enzymes:

1. Remove Cellulysin and Macerase from freezer and place in desiccator for 30 min.

2. Weigh out:

For 0.8 M sorbitol:

0.5 g Cellulysin
0.13 g Macerase
3.64 g sorbitol (Sigma)

For 1.2 M sorbitol:

0.5 g Cellulysin
0.13 g Macerase
5.46 g sorbitol

3. Keep enzymes and sorbitol on ice in 50 ml beakers.

4. Add 25.0 ml of 2X stock solution to graduate and bring to 50.0 ml with dd water.

5. Add approximately 17 ml of the above solution to each of the enzyme and sorbitol mixes in the 50 ml beakers and seal with parafilm.

6. Place ice bucket on stirring plate and stir at low speed to avoid foaming for 45 min to 1 hr.

7. Adjust pH to 6.5

8. Place 25 ml volumes in 2 centrifuge tubes or 2 50 ml cellulose nitrate tubes.

9. Centrifuge at 6,000 rpm for 10 min in centrifuge.

10. Decant enzymes and store in 125 ml flask.

11. Carefully remove overnight soaking soln from 0.8 and 1.2 M sorbitol.

12. Replace with enzyme solns, as prepared above.

13. Examine after 3-4 hrs.

NOTES: Good results. Healthy looking protoplasts were produced in about 3.5 hrs on both the 1.2 and the 0.8 M sorbitol. It appears that the overnight soak was quite beneficial. There is a problem, however, in disassociating the protoplasts from the cotyledon material. The protoplasts are fragile and drawing the solution + cotyledon slices through the Pipetman worked to free the protoplasts from the cotyledon slices, but also burst the cotyledons. Net assessment: a good first attempt, but we need to improve protoplast release from the parent material.

PROTOCOL #2

August 3, 1989
IN CURITIBA

PROTOPLAST ISOLATION FROM LEAVES OF CLONAL MATERIAL OF *Eucalyptus dunnii*, as prepared at CNPF

Prepare the following:

2X stock: (This is the same soln as prepared 8/2)

1.6	g sucrose
20.0	ml K-salts
2.0	ml thiamine stock
2.0	ml inositol stock
1.0	ml Fe EDTA
0.16	g MES
0.4	g DTT
2.0	g PVP-40

Adjust pH to 6.0
Bring to 200 ml
Label

Protoplast Washing Solution (PWS): PWS- 0.6 M sorbitol

5.47 g sorbitol
25.0 ml 2X stock
Adjust pH to 6.0
Bring to 50 ml with dd water

Protoplast Washing Solution (PWS): PWS- 0.8 M sorbitol

7.29 g sorbitol
25.0 ml 2X stock
Adjust pH to 6.0
Bring to 50 ml with dd water

Protoplast Washing Solution (PWS): PWS- 1.0 M sorbitol

9.12 g sorbitol
25.0 ml 2X stock
Adjust pH to 6.0
Bring to 50 ml with dd water

Plant Materials:
Examination of leaves from the in vitro propagated material from clones Material used was from in vitro shoots produced from clones. We took leaves and sliced thinly and allowed them to soak overnight, each in 5 ml of the 3 PWS solns prepared above.

PROTOCOL #3

August 4, 1989
IN CURITIBA

CONTINUATION OF PROTOPLAST ISOLATION FROM LEAVES OF IN VITRO PROPAGATED CLONES

Enzymes:

1. Remove Cellulysin and Macerase from freezer and place in desiccator for 30 min.
2. Weigh out:

For 0.6 M sorbitol:
- 0.5 g Cellulysin
- 0.13 g Macerase
- 2.74 g sorbitol (Sigma)

For 0.8 M sorbitol:
- 0.5 g Cellulysin
- 0.13 g Macerase
- 3.64 g sorbitol (Sigma)

For 1.0 M sorbitol:
- 0.5 g Cellulysin
- 0.13 g Macerase
- 4.56 g sorbitol

3. Keep enzymes and sorbitol on ice in 50 ml beakers.
4. Add 25.0 ml of 2X stock solution to graduate and bring to 50.0 ml with dd water.
5. Add approximately 17 ml of the above solution to each of the enzyme and sorbitol mixes in the 50 ml beakers and seal with parafilm.
6. Place ice bucket on stirring plate and stir at low speed to avoid foaming for 45 min to 1 hr.
7. Adjust pH to 6.0
8. Place 25 ml volumes in 2 centrifuge tubes or 2 50 ml cellulose nitrate tubes.
9. Centrifuge at 6,000 rpm for 10 min in centrifuge.
10. Decant enzymes and store in 125 ml flask.
11. Carefully remove overnight soaking soln from 0.8 and 1.2 M sorbitol.
12. Replace with enzyme solns, as prepared above.
13. Examine after 3-4 hrs.

NOTES:

All the preparations released protoplasts. The same problem which was noted yesterday was also noted today, ie. the fact that the leaf material is not well enough macerated to release the protoplasts directly. However, it was observed that by drawing the enzyme solution directly into a 20 ml pipet and moving the solution up and down, the protoplasts are readily released, along with a tremendous amount of debris.

Reasoning is that because the 0.6 M sorbitol solution released good protoplasts, this solution is probably preferable, giving the protoplasts the least stress of all the isolation solutions attempted.

August 8, 1989
IN CURITIBA

PROTOPLAST ISOLATION FROM LEAVES OF CLONAL MATERIAL OF *Eucalyptus dunnii*, as prepared at CNPF

Prepare the following:

2X stock: (This is the same soln as prepared 8/2)

0.8	g sucrose
10.0	ml K-salts
1.0	ml thiamine stock
1.0	ml inositol stock
0.5	ml Fe EDTA
0.08	g MES
0.16	g DTT (this is all that as left from bottle)
2.0	g PVP-10

Adjust pH to 6.0
Bring to 100 ml
Label

Protoplast Washing Solution (PWS): PWS- 0.6 M sorbitol

5.47 g sorbitol
25.0 ml 2X stock
Adjust pH to 6.0
Bring to 50 ml with dd water

This solution was filter sterilized using the syringe units available.

Plant Materials:

Leaf material was obtained from Maocyr Fantini at Klabin. We prepared enough material for four (4) beakers containing 5 ml each for the overnight wash. Material used was from in vitro shoots produced from clones. We took leaves and sliced thinly and allowed them to soak overnight, each in 5 ml of 0.6 M PWS soln prepared above.

PROTOCOL #5

August 9, 1989
IN CURITIBA

CONTINUATION OF PROTOPLAST ISOLATION FROM LEAVES OF IN VITRO PROPAGATED CLONES

Enzymes:

1. Remove Cellulysin and Macerase from freezer and place in desiccator for 30 min.

2. Weigh out:
   For 0.6 M sorbitol:
   0.5 g Cellulysin
   0.13 g Macerase
   2.74 g sorbitol (Sigma)

3. Keep enzymes and sorbitol on ice in 50 ml beakers.

4. Add 25.0 ml of 2X stock solution to graduate and bring to 50.0 ml with dd water.

5. Add approximately 17 ml of the above solution to the enzyme and sorbitol mix in the 50 ml beaker and seal with parafilm.

6. Place ice bucket on stirring plate and stir at low speed to avoid foaming for 45 min to 1 hr.

7. Adjust pH to 6.0 and bring to 25 ml with the present 1X solution prepared above.

8. Centrifuge at 6,000 rpm for 10 min in centrifuge.

9. Decant enzymes and store in 125 ml flask.

10. Carefully remove overnight soaking soln using sterile pipet tips, as prepared previously.

11. Replace with enzyme solns, as prepared above.

12. Examine after 3-4 hrs.

MEDIUM AND WASHING SOLUTION:

Growth Regulator Stocks:

2,4-D:

23 mg 2,4-D
3 ml 100% Ethanol
22 ml dd water

BAP:

11.0 ml BAP
2.0 ml 1 N HCl
8.0 ml dd water
Prepare 1/100 dilution by adding 0.1 ml to 9.9 ml dd water

Medium Preparation:

2X STRENGTH
4.0 g sucrose
ca. 60 ml dd water
10.0 ml K-salts
1.0 ml thiamine HCl
1.0 ml inositol
0.5 ml 1/4 $FeSO_4$-EDTA
0.08 g MES
0.6 ml 2,4-D stock
0.1 ml BAP stock (or 5 ml of 1/100 dilution of BAP stock)
21.88 g sorbitol

Adjust pH to 6.0.

Bring to 100 ml with dd water.

Remove 75 ml and add to 75 ml dd water.

Filter sterilize and keep in sterile erlenmeyer flask.

Filter sterilize remaining 25 ml of 2X and reserve in sterile erlenmeyer.

Add 25 ml dd water to erlenmeyer.

Add 0.15 g Sea-Plaque agarose and autoclave.

Add to 25 ml of 2X and keep above room temperature until ready to plate protoplasts.

INSTITUTO INTERAMERICANO DE COOPERAÇÃO PARA A AGRICULTURA

O Instituto Interamericano de Cooperação para a Agricultura (IICA) é o organismo especializado em agricultura do Sistema Interamericano. Suas origens datam de 7 outubro de 1942, quando o Conselho Diretor da União Pan-Americana aprovou a criação do Instituto Interamericano de Ciências Agrícolas.

Fundado como uma instituição de pesquisa agronômica e de ensino, de pós-graduação para os trópicos, o IICA, respondendo às mudanças e novas necessidades do Hemisfério, converteu-se progressivamente em um organismo de cooperação técnica e fortalecimento institucional no campo da agropecuária. Essas transformações foram reconhecidas oficialmente com a ratificação, em 8 de dezembro de 1980, de uma nova convenção, que estabeleceu como fins do IICA estimular, promover e apoiar os laços de cooperação entre seus 31 Estados membros para a obtenção do desenvolvimento agrícola e do bem-estar rural.

Com um mandato amplo e flexível e com uma estrutura que permite a participação direta dos Estados membros na Junta Interamericana de Agricultura e em seu Comitê Executivo, o IICA conta com ampla presença geográfica em todos os países membros para responder a suas necessidades de cooperação técnica.

As contribuições dos Estados membros e as relações que o IICA mantém com 12 Países Observadores, e com vários organismos internacionais, lhe permitem canalizar importantes recursos humanos e financeiros em prol do desenvolvimento agrícola do Hemisfério.

O Plano de Médio Prazo 1987-1991, documento normativo que assinala as prioridades do Instituto, enfatiza ações voltadas para a reativação do setor agropecuário como elemento central do crescimento econômico. Em vista disso, o Instituto atribui especial importância ao apoio e promoção de ações tendentes à modernização tecnológica do campo e ao fortalecimento dos processos de integração regional e sub-regional.

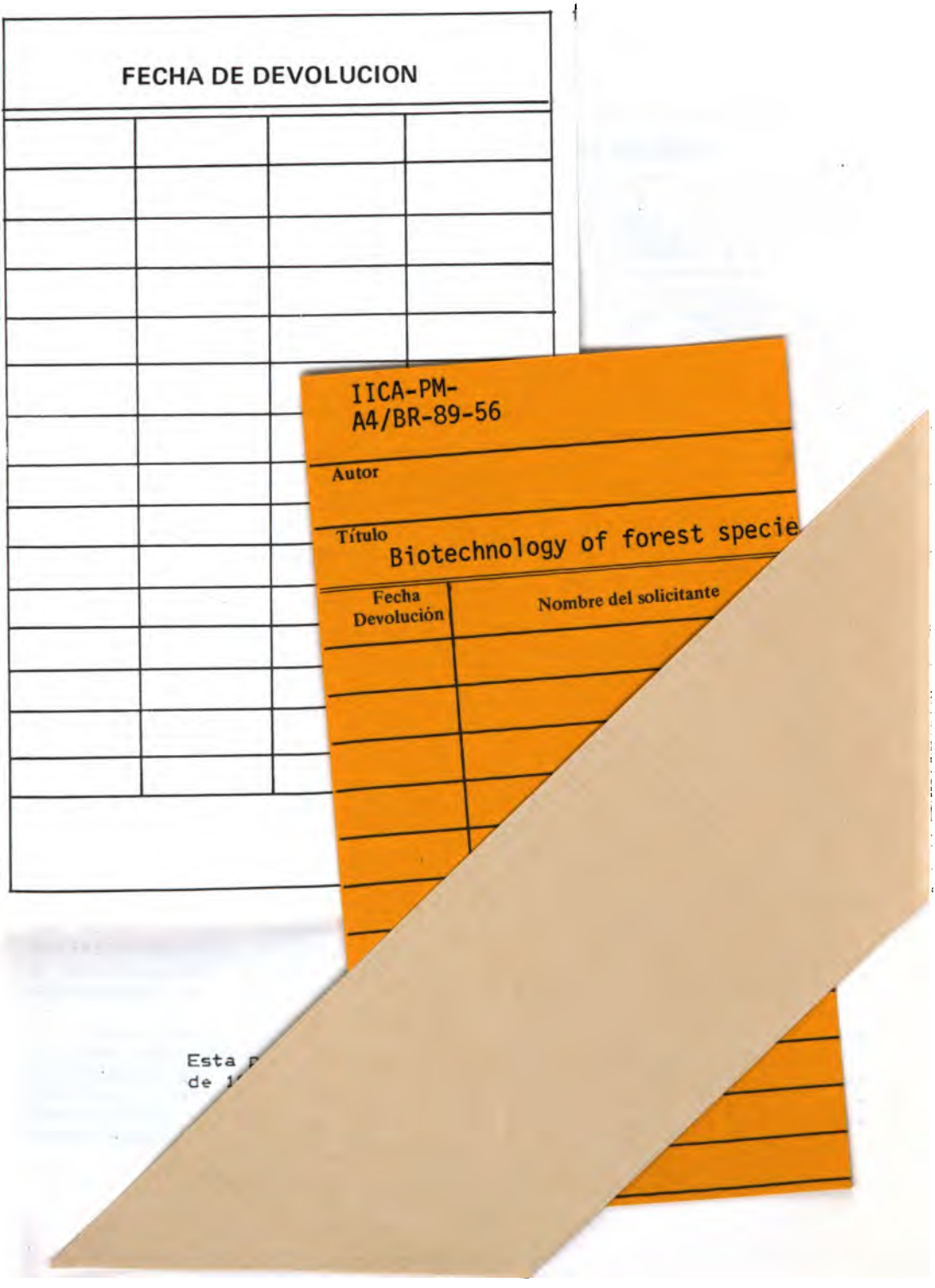
Para alcançar tais objetivos o IICA concentra suas atividades em cinco áreas fundamentais, a saber: Análise e Planejamento da Política Agrária; Geração e Transferência de Tecnologia; Organização e Administração para o Desenvolvimento Rural; Comercialização e Agroindústria, e Saúde Animal e Sanidade Vegetal.

Essas áreas de ação expressam, simultaneamente, as necessidades e prioridades determinadas pelos própios Estados membros e o âmbito de trabalho em que o IICA concentra seus esforços e sua capacidade técnica, tanto sob o ponto de vista de seus recursos humanos e financeiros, como de sua relação com outros organismos internacionais.

Programa II. Geração e Transferência de Tecnologia

O Programa de Geração e Transferência de Tecnologia é a resposta do IICA a dois aspectos fundamentais: (i) o reconhecimento, por parte dos países e da comunidade técnico-financeira internacional, da importância da tecnologia para o desenvolvimento produtivo do setor agropecuário; (ii) a convicção generalizada de que, para aproveitar plenamente o potencial da ciência e da tecnologia, é necessário que existam infra-estruturas institucionais capazes de desenvolver as respostas tecnológicas adequadas às condições específicas de cada país, bem como um lineamento de políticas que promova e possibilite que tais infra-estruturas sejam incorporadas aos processos produtivos.

Nesse contexto, o Programa II visa a promover e apoiar as ações dos Estados membros destinadas a aprimorar a configuração de suas políticas tecnológicas, fortalecer a organização e administração de seus sistemas de geração e transferência de tecnologia e facilitar a transferência tecnológica internacional. Desse modo será possível fazer melhor aproveitamento de todos os recursos disponíveis e uma contribuição mais eficiente e efetiva para a solução dos problemas tecnológicos da produção agropecuária, num âmbito de igualdade na distribuição dos benefícios e de conservação dos recursos naturais.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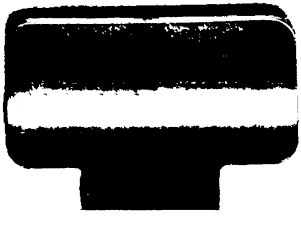
Biotechnology of forest specie
Fecha Devolución
Nombre del solicitante



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