IICA

Consultant Final Report
IICA/EMBRAPA-PROCENSUL II

SEED PHYSIOLOGY

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Daniel James Cantliffe

Brasília, junho de 1989

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

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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 Agropecuária 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: *Daniel James Cantliffe*

2. Specialist in: *Fisiologia de Sementes*

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

4. EMBRAPA Program for which consultancy is provided:

PROGRAMA : PROCENSUL II
SUB-PROGRAMA : PESQUISA VEGETAL - 02

IICA Project Activity Code: *2.SB.3.02*	Administrative Code: *R 4884 B1B 03102*
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)
01 a 16 de dezembro de 1988	*CNPH/EMBRAPA*
CONTRACT EXTENTION PERIOD (If any)	DUTY LOCATION (Center)

5. Financial support: *PROCENSUL II*

6. ACTIVITIES UNDERTAKEN BY THE CONSULTANT AND RESULTS

6.1 RESEARCH DONE UNDER DIRECT RESPONSIBILITY OF THE CONSULTANT

Research activities developed	Results Achieved

6. Research activities developed

Researchers at CNPH have no background or expertise in the area of somatic embryogenesis. The use of somatic embryos or synthetic seeds for plant production reduces or eliminates many problems with plant regeneration, especially those species which are propagated asexually such as the sweet potato. Research in my laboratory lead to protocol for rapid production and proliferation of somatic embryos in sweet potato. Also, I have reported work that mechanizes callus and embryo identification and ultimately, separation of these materials. Other reports from our laboratory have elucidated the technology and requirements necessary for direct field sowing of somatic embryos or the synthetic seeds.

The major draw back for the above research to be used in a commercialized system of synthetic seed sowing has been the inability of researchers to synchronize the development of the embryo in culture. In order to control embryo maturation, optimize storage longetivity, and induce rapid conversion to plants, it is imperative to understand causal factors related to the induction of embryogenic callus.

We have shown that an auxin transport inhibitor (TIBA) can substitute for the need for auxin (2,4-D) to induce embryogenic callus formation. This indicates that auxin is endogenously produced and internal levels can be controlled by blocking normal polar transport from the developing embryo. We reviewed the initiation of callus via our standard protocol. As embryogenesis is induced utilizing 2,4-D or TIBA as media additives, the resultant cell masses and surrounding media (TIBA only) were discussed for examination for auxin content. By identifying qualitatively and quantitatively auxin turn over and movement from newly initiated embryos we will be able to construct the causal effects of embryogenesis in vitro in the future studies. Other hormones, such as cytokinins, GA, and ABA, can be similarly assayed and identified for activity during the adventive induction of embryogenesis and, possibly more appropriately, the developing embryo. Limitations in either threshold levels of endogenous hormone, activity, or occurrence of the hormone might at any time, lead to disruption in normal synchronizational patterns of embryo development. Such alterations or deficiencies might then be amended at the proper time in the growth media, or other procedures for constantly maintaining high internal levels of hormone might be employed (ie. use of auxin transport inhibitors to maintain auxin within cells and on developing embryos). Where patterns of variation develop in normal hormonal production and/or metabolism, radiolabeled precursors will be used in future studies to detect deficiencies in pathways of hormone formation or utilization. Such an understanding of the hormone control of somatic embryogenesis would be a key to identifying and solving problems related to synchrony of developing somatic embryos. Further, to improve the synthetic seed system the results could then transferred to use in suspension cultures, thereby aiding increased singulation (individualization) of the embryos.

As the above information is developed new systems for plant transformation of sweet potato could be developed using somatic embryos. Since, in sweet potato, such new genetic information can not be transferred sexually the development of a synthetic seed system would be paramount to the maintenance of the new genetic characters. Initially with Dr. Torres assistance, we would transfer glyphosate resistance using an agrobacterium system.

The resultant research is important because it gives an opportunity to offer very low cost plant propagules that are disease free, and that carry new genetic traits. The glyphosate transformation will be used as a model to confer other resistances to this species. Furthermore, the sweet potato system of direct field delivery of somatic embryos can be used as a model for other equally important crops of the tropics and semitropics as previously mentioned.

6.2 SUPPORT TO RESEARCH UNDERTAKEN BY OTHER EMBRAPA RESEARCHERS

Research activities developed	Results achieved

6.2 Research activities developed

A cooperative program on synthetic seed technology has been established by the University of Florida and CNPH. Two research groups will be working in a coordinated effort on the project. Dr. Torres (CNPH) will spend one year in Florida in the future to study in vitro techniques related to synthetic seed technology. During this period he will initiate systems to regenerate plants from transformed cells of sweet potato. Once this protocol has been established, transformation can be made and the resultant herbicide resistance can be tested. The latter portion of the hormone and embryo synchrony research can be conducted after Dr. Torres returns to Brazil. He then could collaborate with Dr. Guedes independently developing the synthetic seed system. At the same time, work in Dr. Cantliffe's laboratory can be initiated on auxin metabolism in developing embryos. It is estimated that these two areas could have substantial progress towards completion within three years. Additional studies with other hormones, especially ABA and GA, will be researched during this time. As far as is known, no other laboratories in the world are addressing synthetic seed technological problems in this fashion, ie. a basic research approach to the standard problem of embryony synchronization. Further, no other laboratories are conferring glyphosate resistance in sweet potato.

6.3 TRAINING ACTIVITIES DEVELOPED BY THE CONSULTANT

Date	Training subject matter	Type of event*	Number of beneficiaries	
			From EMBRAPA	From other institutions
12/12/88	New Vegetable Technology in Florida	Seminar	50	---
12/13/88	Seed Production in the US	Seminar	45	---
12/14/88	Programs in Biotechnology at the University of Florida	Seminar	30	4
12/14/88	How to Produce High Quality Transplants	Seminar	30	4
12/15/88	Synthetic Seed Technology	Seminar	20	2

* Short courses, seminars, conferences, etc.

6.4 IN-SERVICE TRAINING PROVIDED BY THE CONSULTANT

In-service training subject matter	Names of counterparts
1. Synthetic Seed Technology Induction, production and sowing techniques	Dr. Antonio Carlos Torres
2. Carrot seed production practices	Dr. A.C. Guedes, Dr. P.C. Fontes, Dr. J.E. Menezes
3. Super Sweet Corn Seed Quality Improvement	Dr. J.F. Lopes, Dr. J.E. de Miranda, Dr. A.C. Guedes, Dr. P.C. Fontes, Dr. O.A. Carrijo

6.5 ACTIVITIES IN SUPPORT OF RESEARCH STRATEGY AND PLANNING

Research subject matter	Research program to which subject matter is concerned
Synthetic Seed Technology	A mutual cooperation and research effort in the field of synthetic seed technology utilizing somatic embryos of important crop species was established. The relationship is to provide an opportunity to exchange ideas, information, specific skills and techniques, and to collaborate on programs of mutual interest and benefit to both parties, which will contribute to the advancement of synthetic seed technology.

6.6 ACTIVITIES IN SUPPORT OF OTHER CENTERS AND UNIVERSITIES IMPROVING THE RESEARCH CENTERS LINKS WITH ABROAD

Subject matter on which links were recommended	Persons, centers and universities recomended for contact
1. Synthetic Seed Technology cooperative agreement between CNPH and the University of Florida	1. University of Florida Synthetic Seed Research Institute - Dr. D.J. Cantliffe
2. Plant Transformation Studies - glyphosate resistance in sweet potato, Dr. A.C. Torres, CNPH	2. University of Florida - Vegetable Crops Department with Dr. Rob Ferl and Dr. D.J. Cantliffe
3. Mass production of synthetic seeds and field sowing practices, Dr. A.C. Guedes, CNPH	3. University of Florida Synthetic Seed Research Institute and the Vegetable Crops Department - Dr. D. Gray, Dr. I.K. Vasil and Dr. D.J. Cantliffe

6.7 PUBLICATIONS AND REPORTS UNDERTAKEN WITH THE CONSULTAT'S PARTICIPATION

Author(s)*	Title of publication or Report and other bibliografic identification
D.J. Cantliffe, J.R. Schultheis, and R.P. Chee	Book Chapter in "Techniques and application of plant tissue culture" A.C. Torres, ed.

* Personal, institutional, etc.

6.8 SUPPORT PROVIDED TO EMBRAPA RESEARCHERS IN THESIS AND DISSERTATION WORK

Name of the student	Thesis subject matter and sinthesis of advice

NA

6.9 OTHER ACTIVITIES DEVELOPED BY THE CONSULTANT

1. Review of vegetable production practices in Sao Paulo state. Seminar given on 12/07/88 in Sao Paulo on Vegetable Production Practices in Florida to COTIA Cooperative Extension personnel (approximately 55 attending).
2. Review of plant tissue culture facilities at Biomatrix (Rio de Janerio), Bioplanta (Campinas) and Centro de Biotechnologia da ESALQ (Cebtec) (Piracicaba). Seminars entitled "Synthetic Seed Technology" given on 12/06/88 at BioPlanta (approximately 30 attending) and on 12/07/88 at CEBTEC (approximately 25 attending).
3. Review of Brazilian vegetable seed companies at Agroflora (Braganca Panlista) and Vigoragro (Campinas).

7. OTHER NATIONAL SYSTEM CENTERS, APART FROM DUTY STATION CENTER, ASSISTED BY THE CONSULTANT

Research center	Area of assistance provided by the consultant
CENARGEN.	Review of tissue culture programs and seminar presentation on 12/15/88 related to Synthetic Seed Technology.

8. CONSULTANT'S SUGGESTIONS AND TECHNICAL OR INSTITUTIONAL RECOMMENDATIONS FOR THE IMPROVEMENT OF THE RESEARCH SERVICE

EMBRAPA has and continues to invest heavily in training research scientists and improving facilities. Many of the professionals have Ph.D. degrees from foreign Universities, especially the U.S. Brazilian scientists are well trained, intelligent, and eager to work when they return to Brazil. In order to capitalize from this investment and to move agricultural research within Brazil and the EMBRAPA system forward, the following recommendations are being made.

1.) Increase the number and quality of technical support personnel. It is good to maintain a base of research scientists with Ph.D. degrees, but the capacity to initiate, conduct and follow-through on meaningful research programs continues to be extremely limited by the lack of technical support professionals trained at the BS and MS level. It is recommended that each Ph.D. research scientist have a minimum of one technical support person at the BS or MS level. Aggressive and/or extensive (ie. plant breeding programs) may need a minimum of two support technicians.

2.) Equipment and supplies are lacking at many EMBRAPA facilities. Scientific equipment is hard to obtain, mostly being copied at present by small private Brazilian companies from non-Brazilian manufacturers. Chemicals and supplies many times are not easily accessible or are impossible to obtain. It is recommended that EMBRAPA or some other official body of the Brazilian government contact and arrange cooperative agreements between Brazilian manufacturers of equipment and supplies and foreign suppliers for either a short or long term cooperative manufacturing agreement until Brazilian supplies become functional. The main purpose is to make chemicals, supplies, and equipment available to EMBRAPA researchers on a more immediate basis.

3.) Inflation and other monetary shortfalls limits the money needed to operate EMBRAPA and to carry on aggressive research programs. It was observed that almost none of the scientists ran research programs on grant dollars and no scientist visited had a major research grant. All of the major agricultural research programs of industrial countries are heavily funded via the grant mechanism. It is recommended that a) EMBRAPA scientists be encouraged (required) to apply for grant support dollars both within Brazil and out of the country, and b) that EMBRAPA, either internally or via external lobbying, institute a grant program to at least partially fund, on a competitive basis, the most active aggressive research programs.

4.) Research Scientists cannot remain current unless they interact with other programs outside of their local institute and state. In order for EMBRAPA's well trained Research Scientists to remain current, it is recommended that a) scientists be awarded more travel dollars to attend Brazilian, as well as foreign professional meetings. Each scientist should participate (by giving a paper or poster) in at least one major professional meeting per year. b) Furthermore, it is extremely important for EMBRAPA scientists to take study leave for a minimum of 6 months, but preferably one year, at some major foreign research institution. This could be modeled as a sabbatical system patterned after the Israeli system of applying dollars monthly, according to salary, towards study leave. The scientist would accumulate dollars according to time in service and be permitted to take one year study leave after each seven years of service to EMBRAPA. This would be a major methodology to retain moral and longetivity of EMBRAPA Research Scientists as well as maintain the highest quality of research stimulation in EMBRAPA's personnel.

9. AGREEMENTS OR COMMITTMENTS ESTABLISHED WITH EMBRAPA RESEARCHERS IN-SERVICE OF THE FUTURE DEVELOPMENT OF RESEARCH IN THE CONSULTANT'S FIELD OF SPECIALIZATION

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a.) A grant preproposal has been submitted to the U.S.A.I.D. Office in Washington, D.C. If accepted for a full proposal, $150,000 (US) will be requested to work on "Synthetic Seed Biotechnology: a model for crop improvement." A.C. Torres, A.C. Guedes, and D.J. Cantliffe are principle investigators.

b.) A cooperative agreement between CNPH, EMBRAPA, and the Synthetic Seed Research Institute, University of Florida is in preparation.

10. CONSULTANT'S COMMENTS ON CIRCUMSTANCES WHICH AFFECTED THE CONSULTANCY WORK

Date:

Signature

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.

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.

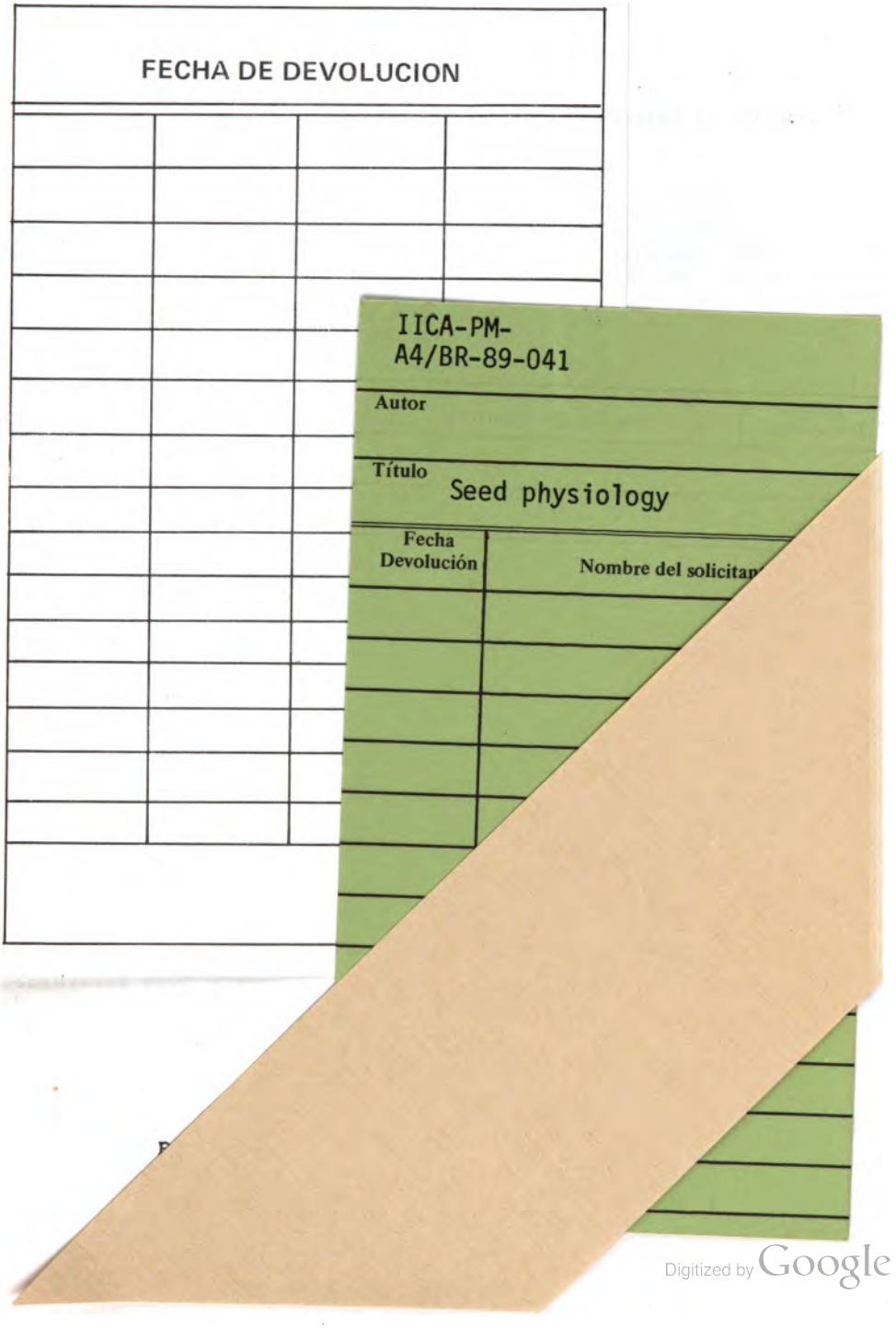
Com um mandato amplo e flexível e com uma estrutura que permite a participação direta dos Estados membros na Junta Interamericana de Agricultura e em seu Comitê Executivo, o IICA conta com ampla presença geográfica em todos os países membros para responder a suas necessidades de cooperação técnica.

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 próprios 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.



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