



GOBIERNO DE CHILE
FUNDACIÓN PARA LA
INNOVACIÓN AGRARIA



6

PROGRAMA DE FORMACIÓN PARA LA INNOVACIÓN AGRARIA

APOYO A LA PARTICIPACIÓN EN
ACTIVIDADES DE FORMACIÓN



PRESENTACIÓN DE PROPUESTAS
POR VENTANILLA ABIERTA



FORMULARIO

ENERO 2002



PROGRAMA DE FORMACIÓN PARA LA INNOVACIÓN AGRARIA - PARTICIPACIÓN-

FOLIO DE
BASES

CÓDIGO
(uso interno)

FP-V-2002-1-f-5+

1.- ANTECEDENTES GENERALES DE LA PROPUESTA

NOMBRE DE LA PROPUESTA

Desarrollo de sistemas eficientes para producción y explotación de híbridos interespecíficos de *Eucalyptus globulus*.

LUGAR DE REALIZACIÓN DE LA ACTIVIDAD

País: Australia

Ciudad : Hobart, Tasmania

TIPO O MODALIDAD DE FORMACIÓN

Curso de especialización en genética y biotecnología forestal

AREA DE LA ACTIVIDAD

Rubro: Genética y biotecnología forestal

Tema : Híbridos comerciales de *Eucalyptus globulus*

INSTITUCIÓN O ENTIDAD RESPONSABLE QUE DICTA U ORGANIZA LA ACTIVIDAD DE FORMACIÓN A LA CUAL SE POSTULA

Nombre: Cooperative Research Centre for sustainable production forestry (CRC)
Plant Science Department. University of Tasmania.

Página Web: <http://www.forestry.crc.org.au>

POSTULANTE INDIVIDUAL (Adjuntar curriculum vitae en Anexo 1 y pauta resumida en Anexo 2)



Nombre: Patricio Milton Rojas Vergara
RUT:
Dirección particular: Mahuzier 7. Departamento 202. Concepción
Fono: 41-339344

Institución o empresa donde trabaja: Universidad de Concepción
Consultor en genética

Cargo actual y relación contractual : Investigador Genética Forestal

Dirección comercial: Victoria 631. Concepción

Fono: 41-204980

Fax: 41-246004

E-mail: projasv@udec.cl

Firma



ENTIDAD PATROCINANTE (en caso que corresponda)

Nombre Entidad Patrocinante:

Facultad de Ciencias Forestales . Universidad de Concepción

RUT :

Dirección : Victoria 631

Fono : 41-204980

Fax :41-246004

E-mail :

Nombre Representante Legal del Patrocinante:

Sr. Fernando Drake. Decano de la Facultad de Ciencias Forestales.

RUT :

Dirección : Victoria 631

Fono : 41-204848

Fax : 41-246004

E-mail : fdrake@udec.cl


Firma



FECHA DE REALIZACIÓN

Inicio : 15 de Febrero de 2003

Término : 15 de Junio de 2003

COSTO TOTAL DE LA PROPUESTA

FINANCIAMIENTO SOLICITADO

44 %

APORTE DE CONTRAPARTE

56 %

2. JUSTIFICACIÓN DE PARTICIPACIÓN EN LA PROPUESTA

Se estima que las plantaciones de ***Eucalyptus*** en Chile alcanzarán 600.000 has en una década más (INFOR, 2002) por lo cual la importancia industrial de la especie dentro del sector forestal aumentará significativamente. Es por otra parte sabido que las demandas de futuros productos y mercados obligarán a nuestro país a mejorar sustantivamente la calidad de las plantaciones a través de una tecnología silvicultural y genética más intensiva. El cultivo del ***Eucalyptus*** (***E. globulus***, ***E. nitens***) a diferencia del ***Pinus radiata*** es más exigente en cuanto a la calidad de los suelos, el material genético empleado y la magnitud de la interacción genotipo x ambiente.

En este contexto la generación de plantaciones de híbridos y clones de ***Eucalyptus globulus*** de alta productividad permitirá una mejor calidad de las plantaciones y un mejor aprovechamiento de los sitios disponibles para plantación, aprovechando además de integrar características genéticas de distintas especies. De esta forma el híbrido ***E. globulus x E. nitens*** puede combinar los genes de la calidad pulpable de ***E. globulus*** con la productividad volumétrica de ***E. nitens*** y su mayor tolerancia al frío.

La especialización obtenida de este curso permitirá la investigación sobre producción de líneas híbridas de ***E. globulus*** en huertos semilleros obteniendo semilla para distintos objetivos de adaptación (sequía, heladas) y producción (madera aserrada, chapas, pulpa, etc). Al momento la producción de semilla híbrida en flores de ***E. globulus*** no es posible debido a la unilateral incompatibilidad de la biología reproductiva de la especie y las barreras fisiológicas, genéticas y estructurales de la flor para los cruzamientos artificiales con especies de flores pequeñas.

La polinización artificial en madres (flores femeninas) de ***E. globulus*** permitirá una alta eficiencia de semillas híbridas/flor polinizada debido a la mayor cantidad de semillas/cápsula de la especie. El mayor tamaño de la flor en relación a otras especies como ***E. nitens*** permitirá un mayor rendimiento operacional de las labores de polinización en los huertos semilleros, permitiendo reducir significativamente los costos de la semilla híbrida de ***E. globulus***.



3. OBJETIVOS DE LA PROPUESTA

3.1. GENERAL:

El curso tiene como objetivo capacitar en el desarrollo de métodos eficientes para producción y el aprovechamiento industrial de semilla híbrida de *Eucalyptus*.

E. globulus x *E. nitens*

(combina la resistencia al frío y la productividad de *E. nitens* con las excelentes propiedades pulpables de *E. globulus*)

E. globulus x *E. gunnii*

(combina las propiedades pulpables de *E. globulus* con la resistencia al frío de *E. gunnii* y su mayor enraizamiento para la propagación clonal)

❖ **Producto tecnológico 1 : semilla híbrida para zonas con heladas en precordillera (VIII, IX, X regiones)**

E. globulus x *E. camaldulensis*

(combina las propiedades pulpables de *E. globulus* con la resistencia a la sequía de *E. camaldulensis*)

❖ **Producto tecnológico 2: semilla híbrida para zonas semiáridas (IV-V-VI-VII regiones)**

3.2 ESPECÍFICOS:

Los objetivos específicos son los siguientes :

- Determinar tratamientos de polinización óptimos para la producción de semilla híbrida usando *E. globulus* como madre. Esto incluye el uso de marcadores morfológicos y moleculares para verificar la hibridación y monitorear los niveles de contaminación de los diferentes tratamientos.
- Determinar si existen algunos efectos recíprocos en la performance de los híbridos.
- Determinar si la modificación del largo de estilo o el estadio de la yema floral usada en los cruzamientos afectará la composición de las progenies híbridas F₁ o si esto puede ser usado para manipular la composición de las retrocruzas. "backcrossing"
- Determinar si existe variación genética entre de la especie *E. globulus* para el éxito de la hibridación y si los cruzamientos intraespecíficos pueden ser usados como predictores de la cruce híbrida.

Estudiar las características genética de las progenies F₁ y poblaciones híbridas avanzadas.



4. ANTECEDENTES DE LA INSTITUCIÓN QUE DICTA LA ACTIVIDAD DE FORMACIÓN (Adjuntar antecedentes adicionales en el Anexo N° 3)

Dr. Bradley Potts
Plant Sciences Department
Email : B.M.Potts@utas.edu.au

CRC for Sustainable Production Forestry
GPO Box 252-55 Hobart 7001
<http://www.forestry.cr.org.au>
Tasmania, AUSTRALIA



5. PROGRAMA DE ACTIVIDADES DE LA PROPUESTA (Adjuntar antecedentes solicitados en el Anexo N° 4)

5.1 CARTA O CERTIFICADO DE ACEPTACIÓN DEL POSTULANTE DE ACTIVIDAD DE FORMACIÓN (Adjuntar en Anexo N° 5)



6. RESULTADOS E IMPACTOS ESPERADOS

- ❖ Obtener protocolos de polinización artificial para la generación de semilla híbrida de ***Eucalyptus globulus*** en huertos semilleros
- ❖ Factibilidad de producir semilla híbrida a escala operacional y a un costo competitivo con los cruzamientos intraespecíficos de ***E. globulus***
- ❖ Posibilidad de reforestar zonas marginales (por sequía o por heladas) con ***E. globulus*** entre la IV a la X región
- ❖ Aumentar la productividad de las plantaciones seleccionando híbridos de mayor productividad
- ❖ Exportar semilla híbrida de ***Eucalyptus globulus*** al extranjero

7.- ACTIVIDADES DE DIFUSIÓN

FECHA	TIPO DE ACTIVIDAD	OBJETIVO	LUGAR	Nº Y TIPO BENEFICIARIOS	INFORMACIÓN A ENTREGAR
Julio 2003	Charla	Entregar protocolos de polinización artificial para la hibridación de E. globulus	CORMA	Empresas privadas del sector forestal que plantan Eucalyptus	Protocolos de polinización artificial para la generación de híbridos de E. globulus
Agosto 2003	Charla	Entregar protocolos de polinización artificial para la hibridación de E. globulus	CONAF-INIA	Empresas públicas y PYMES del sector forestal que plantan Eucalyptus	Protocolos de polinización artificial para la generación de híbridos de E. globulus
Septiembre 2003	Día de Terreno	Efectuar protocolos de polinización artificial para la hibridación de E. globulus en un huerto semillero	Huerto semillero	Empresas privadas, públicas y PYMES del sector forestal que plantan Eucalyptus	Protocolos de polinización artificial para la generación de híbridos de E. globulus
Octubre 2003	Publicación Paper	Entregar resultados de la especialización	Revista de investigación	Todos	Como revertir la incompatibilidad unilateral de E. globulus



8.- ITINERARIO PROGRAMA DE TRABAJO

FECHA (Día-mes-año)	ACTIVIDAD	OBJETIVO	LUGAR
Febrero a Junio 2003	Revisión bibliográfica asistida por Dr. Brad Potts (CRC-U. Tasmania)	Estudiar factores genéticos, fisiológicos y estructurales de la flor que explican la incompatibilidad unilateral de E. globulus en cruzamientos con Eucalyptus de flores pequeñas	HOBART, TASMANIA
Febrero a Junio 2003	Curso Marcadores moleculares. Dr. Renee Vaillancourt (CRC-U. Tasmania)	Marcadores para selección de plantas híbridas	HOBART, TASMANIA
Julo a Septiembre de 2003	Preparación de Actividades de Formación y Extensión	Entregar a los potenciales usuarios de la información (empresas privadas, públicas y PYMES) el producto de la investigación	CONCEPCION, CHILE



ANEXO 1

CURRICULUM VITAE DEL POSTULANTE

Curriculum Vitae

Patricio Rojas Vergara



Dirección :

Mahuzier 7. Dpto. 202. Edificio
Providencia
Fono : 041-339344
CONCEPCIÓN
Email : <projasve@arauco.cl>

Antecedentes Personales

Fecha Nacimiento	7.12.54
Estado civil	Casado
Idiomas	Inglés y portugués
RUT	

Estudios

Secundarios

1966-1971. Instituto Zambrano, Hermanos de la Salle.

Universitarios

1972-1977. Ingeniero Forestal, Facultad de Ciencias Forestales, Universidad de Chile, 1972-77

Estudios de Posgrado

1982. Curso de Silvicultura en zonas templado-frías. INIA. Pontevedra. Galicia. España.

1982. Análisis de Sistemas, ECOM - Universidades Chilenas

1988. Congreso Brasileño de Biotecnología Forestal, Belo Horizonte

1988-1989 . Maestría en Ciencias Forestales, Escuela Superior de Agricultura Luís de Queiroz, Universidad de Sao Paulo. BRASIL. Beca International Development Research Centre. CANADA.

1988. Diseños estadísticos para ensayos genéticos, U. de Sao Paulo.

1991. Curso corto de mejoramiento genético. University of Florida. Estados Unidos de Norteamérica.

1994. Planificación Estratégica, Consultora. Anguita. Santiago.

1996-1997. Diplomado en Gestión de Empresas, Universidad Adolfo Ibáñez.

1996-1997. Diplomado en Administración de Empresas, Universidad de Concepción.

2001. Programa de Doctorado. Plant Science Dpt. U. of Tasmania. AUSTRALIA (actualmente en desarrollo en tiempo compartido)

Becas

➤ **Embajada de España.** Dirección de Asuntos Exteriores. Curso de Silvicultura en zonas templado-frías. INIA. Pontevedra. Galicia. Octubre de 1982.

➤ **International Development Research Center (IDRC). Canadá.** Financiamiento programa de Maestría en Genética Forestal

de **Eucalyptus**. Universidad de Sao Paulo. Brasil (2 años).

➤ **International Post Research Scholarship. Australia.** University of Tasmania (2001)

Empleos

1978-1979

Contrato con INFOR para desarrollar proyectos de silvicultura relacionado con especies y procedencias de zonas áridas y semiáridas. El proyecto fue financiado por CONAF y las Naciones Unidas (PNUD).

1979-1983

Investigador del Departamento de Silvicultura de INFOR. Principales tópicos de investigación: ensayos de introducción de especies y procedencias de especies del género **Pinus y Eucalyptus**.

1984

Jefe de proyecto de la actividad CONAF/PNUD/FAO/CHI76003 "Evaluación de ensayos de introducción de especies en la zona árida y semiárida de Chile".-

1985-1987

Jefe de Proyecto "Manejo silvicultural de especies del género Eucalyptus" financiado por INFOR/CORFO y compañías forestales. La principal responsabilidad fue planificar e implementar técnicas silviculturales aplicadas a especies de rápido crecimiento del género **Eucalyptus : E. globulus, E. nitens, E. regnans and E. delegatensis**.

El programa de investigación incluyó diferentes aspectos silviculturales como : vivero y técnicas de establecimiento de **Eucalyptus** de rápido crecimiento, tales como preparación de suelos, nutrición, control de malezas. Otras técnicas silviculturales también fueron evaluadas como : ensayos de espaciamientos, raleos, podas y manejo de rebrotes (monte bajo). Este programa inició en Chile la investigación de mejoramiento genético de especies del género **Eucalyptus**. Se incluyó la investigación en ensayos de progenies y procedencias, selección de familias y

ensayos de propagación vegetativa por estacas.

1988-1989

Estudiante del programa de postgrado en la Universidad de Sao Paulo en Piracicaba - Brasil. Este programa fue financiado a través de una beca del International Development Research Centre (IDRC-Canadá).

El principal área de investigación del programa estuvo orientado a la silvicultura y el mejoramiento genético de **Eucalyptus**. La tesis desarrollada incluyó una comparación de diferentes materiales genéticos en plantaciones experimentales. El objetivo fue comparar la propagación por semillas y clones de familias selectas en ensayos de progenies. Los clones se probaron en arreglos mono y multiclonales. Las principales características evaluadas en las parcelas experimentales fueron la densidad básica de la madera y el volumen cúbico de los árboles para la producción de pulpa.

1990

Jefe de Proyecto del programa de mejoramiento genético de INFOR. Las principales actividades desarrolladas incluyeron la producción de plantas y el establecimiento de ensayos de progenies de **E. globulus y E. nitens**.

1990-1994

Profesor Asistente de la Universidad de Concepción. Facultad de Ciencias Forestales.

Se diseñó el curso de mejoramiento genético forestal. El trabajo consistió en clases formales y el desarrollo de tópicos de investigación con los alumnos, como también la orientación de trabajos de tesis con empresas forestales (Forestal Chile y Forestal Arauco).

1994

Gerente Técnico de CONAF

Planificación estratégica de la nueva institucionalidad del Servicio Forestal del Estado. Participación Congreso Mundial sobre desarrollo sustentable. Nueva Delhi. India. Participación seminario "Perspectivas

del cultivo del **Eucalyptus** en Chile". Tokio-Japón. Visita a Mito Station Centro de biotecnología y genética forestal.

1990-1997

Jefe del programa "Fibre Yield Improvement Program (FYIP) del grupo Santa Fe (Shell Forestry).

El plan maestro consideró el mejoramiento del rendimiento y la calidad de la pulpa de las plantaciones de **Eucalyptus** de la empresa Forestal y Agrícola Monteagula. Los principales trabajos desarrollados fueron :

1. Producir plantas en vivero correspondientes a familias de polinización abierta para la plantación de ensayos de progenies

2. Diseñar y plantar 70 ensayos genéticos de terreno como : especies y procedencias, ensayos de híbridos, ensayos clonales, plantación de huertos semilleros de plantas de semillas y clonales (de injertos).

3. Cosechar semilla para los requerimientos del vivero incluyendo las, áreas productoras de semillas (**APS**) y huertos semilleros (HSS & HSC).

4. Cosecha de semilla en rodales comerciales de **E. globulus** y **E. nitens** para venta.

5. Desarrollar un programa de estudios en tecnología de la madera incluyendo mediciones directas e indirectas de las propiedades físicas y químicas de la madera. Relación con la planta industrial de Santa Fe.

6. Iniciar un programa de investigación de biología reproductiva de **E. globulus** y **E. nitens**. Las principales actividades incluyeron fonología, procesamiento de polen y almacenamiento en laboratorio, polinización controlada en terreno. Los principales híbridos sintetizados fueron : **E. nitens** x **E. globulus**, **E. nitens** x **E. camaldulensis**, **E. nitens** x **E. viminalis**.

7. Promover intercambio genético (polen y semillas) con otras compañías extranjeras

como FOSA(Uruguay), SAPPI & HLH(Sudáfrica), RIOCELL (Brasil)

8. Manejar un presupuesto anual de U\$ 300.000 .

9. Colectar, manejar y procesar una base de datos de diferentes ensayos genéticos llamada GENETICA.

10. Usar la información genética generada (valores de mejora genética) para la depuración genética de ensayos de progenies y huertos semilleros (de semillas y clonales).

11. Entregar información al programa clonal para la liberación de clones operacionales a terreno.

1998

División Genética BIOFOREST S.A.

Proyecto Genes de Eucalyptus. Programa de Cruzamientos Operacionales de **Eucalyptus** con Bosques Arauco S.A.

Proyecto Biología reproductiva y protocolos de hibridación de Eucalyptus (FONTEC N° 99-1754).

Cooperativa de Mejoramiento Genético-CRC University of Tasmania.

Proyecto "Desarrollo e implementación de herramientas moleculares para la caracterización de material genético forestal". FDI-INIA-BIOFOREST-CMGF. 2001-2004

Giras y Seminarios Técnicos

➤ **IUFRO meeting "Eucalyptus productivity. Principles of species introduction" in Pontevedra, Spain October, 1992.** Visita a las principales organizaciones de investigación forestal en España: Galicia, Navarra y Servicio Forestal de Barcelona (Cataluña).

➤ **Visita a las principales compañías forestales de Brasil, Marzo 1986.** Visita a

Klabin, Champion Cellulose, Aracruz e IPEF (Instituto Forestal Brasileiro - Sao Paulo)

➤ **IUFRO meeting "Intensive Forestry. The role of Eucalyptus" in Durban, South Africa, 1991.** Visita a SAPPI, HLH, ICPF y otras compañías.

➤ **Visita a la Universidad de Florida, USA. 1991.** Entrenamiento corto en el paquete estadístico SAS.

➤ **Visita técnica a programas de mejoramiento genético forestal de empresas del sur de Brasil, 1992.** Klabin do Parana and Riocell.

➤ **IUFRO meeting "Resolving tropical forest resources concern through gene conservation, tree improvement and domestication of new species. Cartagena, Colombia. 1992.**

➤ **Pre-conference tour en Venezuela (Carton de Venezuela) y Colombia (Carton de Colombia). SMURFIT.**

➤ **Workshop in New Delhi, India. Sustainable Forestry. Julio 1994**

➤ **Seminario de Eucalyptus en Tokio, Japan. Organizado y financiado por Mitsubishi. Septiembre, 1994.** Visita al Centro de Biotecnología Forestal (Mito Biotechnological Forest Research Center)

➤ **CRCTHF-IUFRO meeting "Eucalyptus plantations: Improving Fibre Yield and Quality". Conference in Hobart, Australia 19-24 February 1995.** Visita a los bosques nativos de Eucalyptus en Australia, incluyendo la distribución natural de *E. globulus* y *E. nitens* con investigadores del CSLRO. El recorrido incluyó los estados de New South Wales, Central Victoria and Tasmania.

➤ **University of Tasmania, Plant Sciences. Hobart, Australia. (Febrero-Junio 2001).** Desarrollo del programa de doctorado. Estadía.

Publicaciones

INFOR, 1979. CONAF/PNUD/FAO/CRI-761003
Una metodología para el establecimiento y análisis de ensayos de introducción de especies y procedencias.

INFOR, 1979. Informe Técnico 86.
Supervivencia y crecimiento de especies del género *Eucalyptus* y *Pinus* probados en la zona costera de la región del Maule.

Chile Forestal. Junio, 1980.
Nuevas especies para la reforestación en Chile.

INFOR, 1980. Informe Técnico 89.
Especies de *Eucalyptus*, una alternativa de forestación en la 8va. región.

INFOR, 1980. Informe Técnico 93.
Crecimiento de *Eucalyptus* y *Pinus*.

IUFRO meeting "Fast growing species". Sao Paulo-Brazil. 1980.
Algunos antecedentes acerca de la introducción de especies del género *Eucalyptus* en la zona centro-sur de Chile".

IUFRO meeting "Eucalyptus productivity. Principles of species introduction" in Pontevedra, Spain Octubre, 1992..
Crecimiento y productividad de 4 especies de *Eucalyptus* en la zona centro-sur de Chile.

Simpósio CORFO/INFOR en Pucon. Noviembre, 1993.
Primeros resultados de floración y producción de semillas de *E. nitens*. Primeros resultados de hibridación de *Eucalyptus*.

Fibre Yield Improvement program of E. globulus. Santa Fe. Chile. IUFRO Conference in Silviculture and Improvement of Eucalyptus. Bahía-Salvador. Brasil. 1997

Consultorías

GRUPO ARAUCO . 1987. Eucaliptos de interés económico para las compañías del Grupo

Arauco : Forestal Celco, Arauco y Forestal Pedro de Valdivia. El trabajo incluyó aspectos de silvicultura intensiva para especies de rápido crecimiento.

FORESTAL ANCHILE. 1990. Silvicultura de especies de rápido crecimiento de ***Eucalyptus***.

FORESTAL AGROMEN. 1998. Preparación del proyecto FONTEC-CORFO. "Establecimiento de un Huerto Semilero de ***Eucalyptus globulus*** para abastecer de semilla mejorada genéticamente a medianos y pequeños propietarios forestales". **Aprobado.**

FORESTAL EL ALAMO. 1998. Preparación del proyecto FONTEC-CORFO "Desarrollo de la propagación comercial de clones de ***Populus***, ***Eucalyptus*** y otras especies. **(Aprobado).**

Concepción, Julio del 2002.



ANEXO 2

PAUTA DE ANTECEDENTES RESUMIDA DEL POSTULANTE



PAUTA DE ANTECEDENTES RESUMIDA

ANTECEDENTES PERSONALES

Nombre completo	PATRICIO MILTON ROJAS VERGARA
RUT	
Número de Pasaporte	
Fecha de Nacimiento	7 DE DICIEMBRE DE 1954
Nacionalidad	CHILENA
Dirección particular	MAHUZIER 7. DEPARTAMENTO 202. CONCEPCIÓN
Fono particular	41-339344
Fax particular	
Dirección comercial	VICTORIA 631. CONCEPCIÓN
Fono y Fax comercial	FONO 41-204980 FAX
Banco y número de cuenta corriente para depósito de fondos correspondientes	
Nombre y teléfono de la persona a quien avisar en caso de emergencia	FANNY GALAZ GUERRERO FONO CASA : 41-339344 FONO ESCUELA : 41-541066

Completar ambas secciones o sólo una de ellas, según corresponda

ACTIVIDAD PROFESIONAL Y/O COMERCIAL (ACTUAL)	
Nombre y RUT de la Institución o Empresa a la que pertenece	UNIVERSIDAD DE CONCEPCIÓN FACULTAD DE CIENCIAS FORESTALES
Cargo	INVESTIGADOR GENÉTICA Y BIOTECNOLOGÍA
Antigüedad	3 AÑOS
Resumen de las labores y responsabilidades a su cargo	PREPARACIÓN Y EJECUCIÓN DE PROYECTOS CIENTÍFICO TECNOLÓGICOS EN EL ÁREA DE GENÉTICA Y BIOTECNOLOGÍA FORESTAL
Otros antecedentes de interés	CONSULTOR Y ASESOR EN GENÉTICA DE EUCALYPTUS DE EMPRESAS PRIVADAS
ACTIVIDAD COMO AGRICULTOR (ACTUAL)	
Tipo de Agricultor (pequeño, mediano o grande)	
Nombre de la propiedad en la cual trabaja	
Cargo (dueño, administrador, etc.)	
Superficie Total y Superficie Regada	
Ubicación (detallada)	
Rubros a los que se dedica (incluir desde cuando se trabaja en cada rubro) y niveles de producción en el rubro de interés	
Resumen de sus actividades	



Organizaciones (campesinas, gremiales o empresariales) a las que pertenece y cargo, si lo ocupa	
Descripción de la principal fuente de ingreso	ASESORÍAS EN GENÉTICA FORESTAL A EMPRESAS PRIVADAS Y PYMES
Últimos cursos o actividades de formación en las que ha participado	VARIOS CURSOS DE POSTGRADO QUE SE DETALLAN EN CURRICULUM VITAE

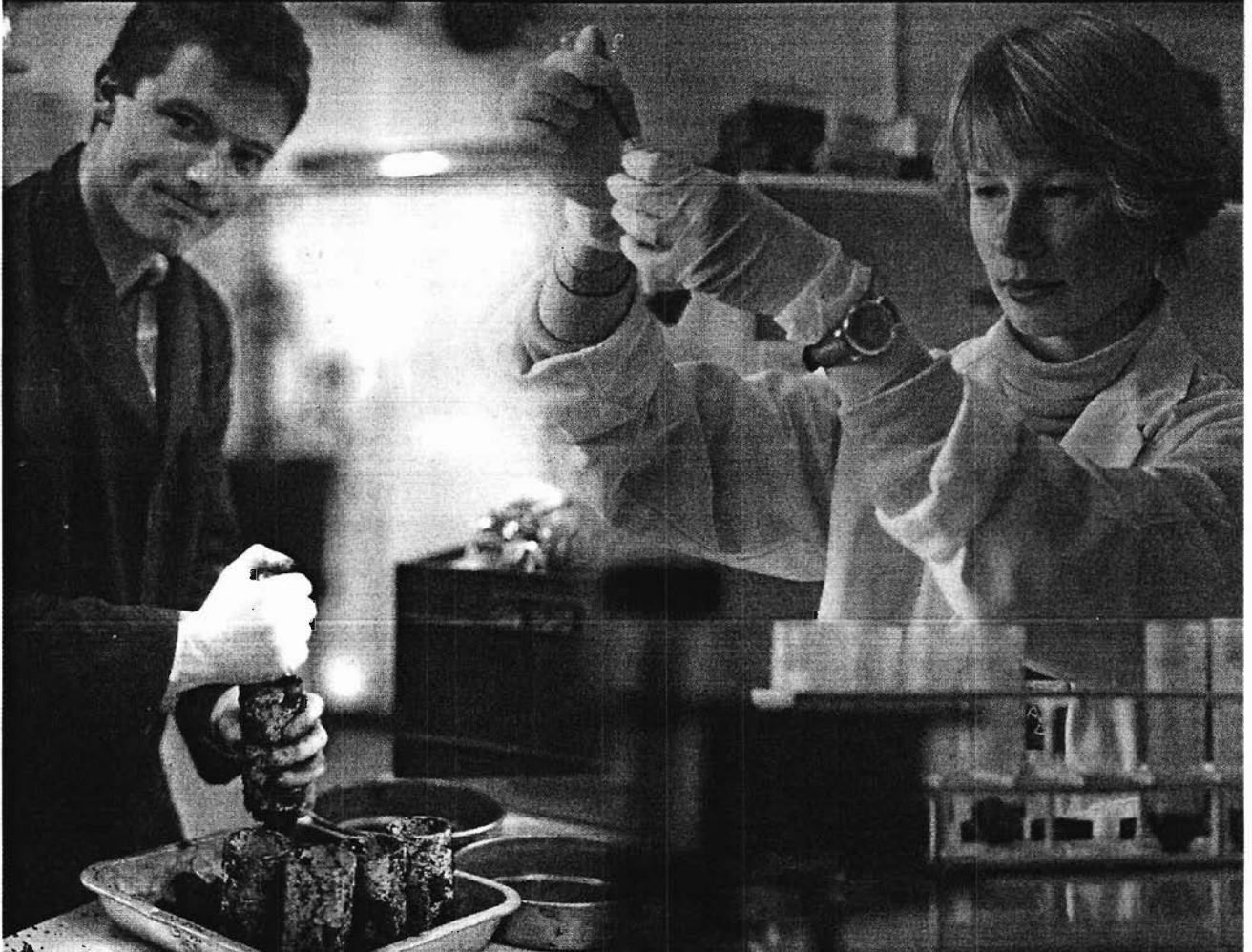


ANEXO 3
ANTECEDENTES DE LA INSTITUCION QUE EFECTUA O DICTA LA
ACTIVIDAD DE FORMACIÓN



COOPERATIVE RESEARCH CENTRE
FOR SUSTAINABLE PRODUCTION FORESTRY

SCHOLARSHIPS IN FORESTRY



Help build a sustainable forest industry in Australia

DO A PhD WITH US



About the CRC for Sustainable Production Forestry

- The CRC is a collaborative venture between five universities, two CSIRO Divisions and many of the major forest companies in Australia. It is funded by under the Federal Government's Cooperative Research Centres program.
- CRC research is conducted to improve the quality and quantity of wood produced from Australian forests so Australia is better positioned in the international market place, while ensuring wood is grown in a sustainable manner for the benefit of future generations.
- The CRC is keen to attract high quality research students in any area of forestry but particularly in areas outlined below in the 'Current Research'.
- The CRC has a vibrant education program currently involving 60 postgraduate and honours students. Graduates of our courses are well trained to meet industry needs and are therefore highly employable, because, as students, they have a close links with industry and CSIRO during their degrees, either through joint supervision of projects or through the use of industry trials.

Genetic Improvement Program

Manager: Dr Brad Potts

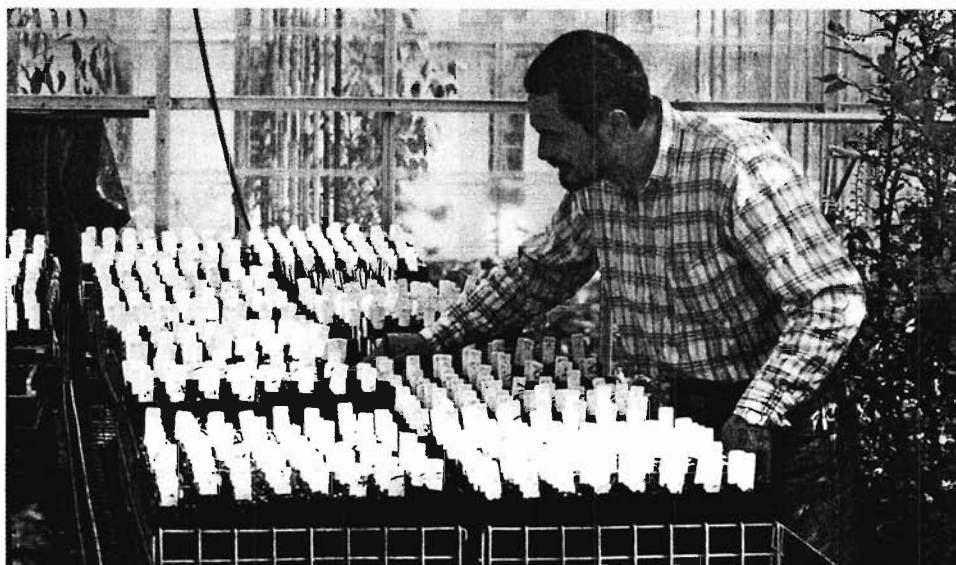
A major expansion of the plantation estate of eucalypts and pines is occurring throughout Australia with a vision to treble the estate by 2020. Improved genetic quality of the plantation stock is essential if Australia is to be competitive in international markets when this estate is harvested. Large tree breeding programs being run by CRC partners in both the tropical and temperate regions demonstrate the importance of breeding and aim to reduce the costs of plantation establishment, harvesting and processing, as well as to add value to pulp and timber.

The research undertaken in the Genetic Improvement Program aims to ensure that plantation stock is of the highest possible genetic quality. It aims to improve the efficiency of breeding and ensure the genetic gains are rapidly and efficiently transferred to Australia's increasing plantation estate. In brief, the program aims to:

- define appropriate breeding objectives for individual firms and the sector, from forest growers to industrial processors;

- identify selection criteria and methods for assessing wood quality, growth, pest and disease resistance, and other key traits, and statistical methods for their analysis;
- determine the molecular and quantitative genetic control of important traits, and how this changes with age, site and silvicultural treatment;
- improve strategies to select, breed and deploy elite genotypes;
- improve our ability to control and manipulate reproductive characteristics in order to optimise deployment systems;
- ensure rapid uptake of technological advances made in Australia and overseas, particularly in the rapidly changing field of molecular genetics; and
- provide training and education in forest genetics and breeding, and be a forum for discussion in Australia.

The research outcomes will directly assist breeders of pines, eucalypts, and other native species in our member organisations, as well as organisations multiplying and distributing improved seed.



Genetics and reproductive biology of eucalypts

Leader: Dr Brad Potts

Projects based at: University of Tasmania

This project aims to provide the basic biological information necessary for effective exploitation of temperate eucalypt species. It will determine the extent to which traits of economic and biological importance are under genetic control and amenable to artificial selection and breeding. Such traits include growth, wood quality, pest and disease resistance and reproductive characteristics. Further, as cloning is no longer considered an economically viable means of deployment in Australia, the demand for improved seed is currently unprecedented. The project will study factors affecting sexual reproduction in order to optimise the quantity and quality of seed from eucalypt seed orchards.

Hybrid breeding

Leader: Dr Mark Dieters

Projects based at: Queensland Forest Research Institute (QFRI)

There is escalating interest in the use of hybrids in forestry in Australia and overseas. However, little is known about the genetics of hybrid populations and the most efficient means of breeding improved hybrids. Through its partner organisations, the CRC has one of the best genetic bases of artificial forest tree hybrids in the world. This project aims to:

- understand the genetics of hybrid populations, focusing on growth and wood properties; and
- develop or introduce into Australia the most advanced strategies for breeding hybrids.

The project focuses on the tropical pine species (*Pinus elliottii* and *P. caribaea* var *hondurensis*) and their hybrids being deployed by Queensland DPI.

Breeding Strategies

Leader Mr Greg Dutkowski

Projects based at: University of Tasmania

Research in this project is aimed at developing 'state-of-the-art' strategies for selection, breeding and deployment which can be integrated into programs run by CRC partners. The project aims to:

- improve genetic models for estimating breeding values;
- improve selection by developing models which allow the integration of economic information into breeding value prediction;
- improve tree breeding decision-making by evaluating different breeding strategies; and
- support members (e.g. Southern Tree Breeders Association) in the planning and implementation of their breeding and deployment programs.



Molecular genetics of eucalypts

Leader: Dr René Vaillancourt

Projects based at: University of Tasmania

The rapidly changing field of molecular genetics is providing unprecedented insights into the genome and population structure of eucalypts and offers powerful tools for use by tree breeders. Already molecular markers are being used for fingerprinting for quality control, determining relatedness, paternity analysis and gene flow studies, as well as understanding the genetic control of quantitative traits.

This project focuses on eucalypts and aims to use molecular markers to:

- provide a better knowledge of inbreeding, heterosis and the role of genetic diversity in breeding and base populations of eucalypts;
- quantify the factors affecting outcrossing, gene flow, and contamination in seed orchards; and
- characterise the number and location of major genes (QTLs) affecting commercially important traits (e.g. growth, wood density, pest and disease resistance).

Molecular approaches to tree improvement

Leader: Dr Gavin Moran

Projects based at: Australian National University and CSIRO-FFP

This project aims to study genes controlling commercial traits in *E. globulus* focusing on wood and fibre properties. It will:

- determine the number and location of QTL controlling wood and fibre properties and growth in *E. globulus*; and
- map and characterise candidate genes involved in wood and pulp properties.

A framework genetic linkage map for *E. globulus* is being completed using nearly 200 RFLP markers developed by CSIRO in *E. nitens* as well as 45 microsatellite and isozyme markers. In addition, candidate genes are being mapped. These include genes involved in lignin biosynthesis and cellulose biosynthesis.

Molecular genetic improvement for tropical and subtropical production

Leader: Prof Robert Henry

Projects based at: Southern Cross University

This project will apply molecular genetic techniques to the improvement of tropical and sub-tropical forestry species, including *Pinus* hybrids, *Araucaria cunninghamii* (hoop pine) and *Eucalyptus cloeziana*. Investigations in progress include evaluation of inbreeding in natural populations and investigation of putative hybrids. Mapping and QTL analyses are being conducted to attain a greater understanding of key commercial traits in the *P. elliotii* var *elliotii* x *P. caribaea* var *hondurensis* F₁ hybrid which will allow the incorporation of marker-aided selection (MAS) into QFRI-QDPI breeding and propagation programs. The research strategy aims to:

- generate genetic maps for *P. elliotii* var *elliotii* and *P. caribaea* var *hondurensis* F₁ hybrids;
- generate new populations suitable for genetic mapping;
- perform marker-trait co-segregation analysis for growth, form and wood properties;
- examine QTL stability in a range of genetic backgrounds, across sites and different silvicultural conditions; and
- explore the use of MAS in the development of breeding and propagation populations, and its potential in a clonal forestry program.



Wood quality

Leader: Ms Carolyn Raymond

Projects based at: University of Tasmania and
CSIRO-FFP

Wood quality is one of the most important determinants of profitability, whether plantations are harvested for pulp, sawn timber or other solid wood products. However, wood property traits are expensive and difficult to measure and there is a poor understanding of their genetic control and relationships with breeding objectives. For these traits to be integrated into breeding and deployment programs it is essential to develop cost effective, non-destructive sampling techniques which can be used on a large scale.

Work in the Genetic Improvement Program is concentrating on:

- developing non-destructive sampling strategies for wood and fibre properties;
- defining relationships between wood, pulping and sawn timber properties;
- determining the magnitude and importance of genotype by environment interactions for wood properties; and
- developing breeding objectives for a range of wood products.



Sustainable Management Program

Manager: Dr Chris Beadle

Plantations and farm forests, can be a sustainable resource if the factors necessary for production remain favourable over successive crop cycles. Management decisions and applications influence sustainability in a major way. This program examines the environmental factors and silvicultural practices that influence forest production, and casts these into a quantitative framework with the use of process-based models. We play a critical role in delivering the knowledge needed to ensure that practices implemented by forest managers in Australia are sustainable and subject to ongoing improvement in terms of economic and environmental performance. This provides a valuable adjunct to the work of other research organisations involved in the definition and development of criteria for sustainability.

In temperate Australia, the major research focus is on the expanding resource of eucalypt plantations which is likely to play a significant role in regional development. In subtropical Queensland, research concentrates on the existing coniferous plantation resource. Although the specific crops differ among regions, the basic soil and physiological processes which underlie productivity are the same and provide a unifying theme across the program.

In addition, we aim to produce outcomes of significant benefit to the community through the provision of high quality training for postgraduate students, and research which has the potential to enhance regional development.

Modelling production and wood quality

Leader: Dr Peter Sands

Projects based at: University of Tasmania and CSIRO-FFP, University of Queensland and QFRI

The aims of this project are to:

- produce process-based models which enable the productivity of plantations to be predicted for specific management questions, and for which input data can be readily and cheaply obtained by forest managers;
- define the effects of site and climatic factors on wood properties, determine the feasibility of altering wood properties via silvicultural treatments, and develop tools for predicting response of wood properties to environmental factors; and
- develop decision support systems for plantation management.

Site productivity

Leader: Dr Philip Smethurst

Projects based at: University of Tasmania and CSIRO-FFP

The aims of this project are:

- to determine the extent to which nutrient and water supply can sustain high leaf areas and tree growth rates after canopy closure;
- to evaluate the effects of slash management strategies (during the inter-rotation period) on nutrient supply and other soil conditions that affect productivity; and
- to improve our understanding of water storage and access to it in relation to soil profile characteristics, rainfall, and ground water.



Management of tropical soils

Leader: Ass Prof Paul Saffigna

Projects based at: Griffith University and QFRI

The aims of this project are:

- to evaluate the impacts of soil and stand management on both quantity and quality of soil organic matter in subtropical plantations;
- to develop effective soil organic matter management regimes for sustaining the productivity of these plantations;
- to evaluate the impacts of silvicultural practices on N pools and dynamics in hoop pine plantations;
- to quantify the effects of both silvicultural practices and environmental conditions on soil N availability and on plantation N demands;
- to quantify the effects of harvesting, site preparation practices and seasonal conditions on soil physical processes in subtropical pine plantations; and
- to quantify the relationships between surface condition, site hydrology, soil physical characteristics and leaching processes during the inter-rotation period of the pine plantations.

Silvicultural systems and farm forestry

Leader: Dr Chris Beadle

Projects based at: University of Tasmania and CSIRO-FFP, Australian National University

The aims of this project are :

- to provide guidelines for the preparation and management of seedling stock during plantation establishment;
- to develop weed management systems which minimise the use of herbicides including the use of non-competing species as cover crops;
- to develop pruning, thinning and spacing systems which are suitable for converting industrial pulpwood plantations to clearwood regimes and for farm forestry; and
- to assess the benefits and costs of trees on farms, and the real or perceived barriers to the adoption of commercial forestry on part or all of the farm enterprise, and develop an enhanced understanding of the factors which determine regional timber supply.



Resource Protection Program

Manager: Dr Clare McArthur

The Resource Protection Program aims to develop a comprehensive understanding of the biology, ecology and impact of a number of key pests (insect and vertebrate) and diseases of eucalypt plantations in temperate Australia. Using this information, it also aims to develop management techniques and products to minimise the effects of pests and diseases on the quantity and quality of forest products. These techniques are being developed consistent with the principles of sustainable forest management.

The program aims to produce integrated pest management (IPM) strategies for a number of key pests such as the Tasmanian leaf beetles (*Chrysophtharta bimaculata* and *C. agricola*), autumn gum moth (*Mnesampela privata*) and several marsupial herbivores. In addition, the biology, ecology and control of a number of other pest species, including some fungal pathogens, will be studied to provide the basis for future development of IPM strategies. In some regions, research will focus on establishing the identity and distribution of pest and disease species, as these details are not yet known. Finally, efficient and effective monitoring protocols are being developed for some of these pest and disease species to determine when and whether control actions are necessary.



Biology, ecology and economic impact of insect pests

Leader: Dr Geoff Allen, Dr Rob Floyd

Projects based at: University of Tasmania, Australian National University and CSIRO-Entomology

This project aims to provide a strong foundation of basic research on the biology and ecology of the major insect species across various geographic regions so that Insect Pest Management (IPM) strategies can be developed. Particular emphasis in the project is centred upon *M. privata* (autumn gum moth) across all regions of southern Australia and the leaf beetles *C. agricola* and *C. bimaculata* in Tasmania. Other insect species currently under study include *Acacicola orphana* (fireblight beetle), *Heteronyx* spp. (Melolonthine scarab beetles) and *Heteronychus arator* (African black beetle). Areas of research include phenology, host-plant interactions, natural enemies, mating systems, monitoring protocols and impacts on tree growth.

Insect control techniques and IPM

Leader: Dr Geoff Allen, Dr Rob Floyd

Projects based at: University of Tasmania, Australian National University and CSIRO-Entomology

Forest managers are constantly looking for non-chemical options for insect control that are effective, environmentally friendly and economically viable. Individual non-chemical control approaches are generally not as efficacious as chemical insecticides and must be used in conjunction with other options

in an IPM strategy to achieve adequate control. However, there are very few non-chemical options currently available to managers of eucalypt plantations in temperate Australia. This project will develop a number of non-chemical control options, as well as improve the use of chemical insecticides, for incorporation into IPM strategies.

Strategies to reduce vertebrate browsing damage

Leader: Dr Clare McArthur

Projects based at: University of Tasmania

This project addresses the problem of reducing browsing damage to seedlings, using physical and vegetation characteristics of the environment (whole plantation and its surrounding habitat) as its framework. These environmental characteristics should have a significant influence on the browsers: how many browsers are present, and how they use plantations and other habitats as refuges and feeding areas. The aims of this project are to:

- understand this interaction between browsers and the environment, and the consequence of it on damage levels to seedlings;
- investigate the impact of introduced cover crops on browsing of seedlings;
- develop methods for monitoring damage and predicting risk and, finally, to design appropriate options to reduce browsing damage through various planting strategies.

Resistance of planting stock to vertebrate browsers

Leader: Dr Clare McArthur

Projects based at: University of Tasmania

A key method for reducing browser damage to eucalypts is to produce more resistant trees. This may be achieved by genetic and phenotypic manipulation of trees. The aims of this project are to:

- investigate both the genetic basis of resistance of eucalypts, and the effects of environment on this resistance;
- determine whether resistance can be modelled as a function of leaf chemistry, mainly using near-infra-red spectroscopy (NIRS).

These aims rely on determining the relative damage to, and preferences for, various plant types by browsing herbivores. Results will be used to identify resistant genotypes, develop a rapid method for estimating susceptibility using leaf chemistry, and to predict susceptibility of seedlings as a function of their growth environment. These three aspects can be incorporated into an overall strategy for predicting and reducing browser damage of eucalypts at plantation establishment.



Strategies to minimise loss due to fungal attack

Leader: Dr Caroline Mohammed

Projects based at: University of Tasmania and
CSIRO-FFP

The objective of this project is to develop management tools to limit the impact of stem decay fungi and the leaf pathogen *Mycosphaerella*. The project will also investigate the sustainability of forest management by examining the biodiversity of decay fungal/invertebrate assemblages in different ecological niches (logs retained of different sizes). Studies of stem decay focus on defence mechanisms that trees use to restrict the spread of decay, especially in pruned and thinned *E. nitens* and *E. globulus* plantations destined for solid wood production.

In contrast to other angiosperms and more comparable to conifers, the reaction zone (RZ, zone associated with decay) in *E. nitens* has lower moisture content than adjacent sapwood. Mineral elements (K, Ca, Mg and Mn), which could play a role in determining water content, are in lower concentrations in the reaction zone than in healthy sapwood or decayed wood.



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ANEXO 4
ANTECEDENTES CURRICULARES Y/O
CONTENIDOS DE LA ACTIVIDAD DE FORMACIÓN



**UNIVERSITY OF TASMANIA
FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF PLANT SCIENCE**

**PROPOSAL FOR A HIGHER DEGREE BY RESEARCH PROJECT
(2001-2003)**

**THE DEVELOPMENT OF EFFICIENT SYSTEMS FOR THE
PRODUCTION AND EXPLOITATION OF INTERSPECIFIC
HYBRIDS OF *Eucalyptus globulus***

**PATRICIO ROJAS VERGARA
FOREST ENGINEER, MSc**

**SUPERVISOR
DR. BRAD POTTS
UNIVERSITY OF TASMANIA-CRCSPF
HOBART- AUSTRALIA**



**COOPERATIVE RESEARCH CENTRE
FOR SUSTAINABLE PRODUCTION FORESTRY**

**CONCEPCIÓN- CHILE
AUGUST-2.000**

1. OBJECTIVES

Aims: The project aims to develop efficient methods for the production and exploitation of *Eucalyptus globulus* hybrids. In brief the project will determine:

- (i) The optimal treatments for production of hybrid seed using *E. globulus* as the female parent. This will include using morphological and molecular markers to verify hybridity, and monitoring the level of contamination in the various treatments.
- (ii) Whether there are any reciprocal effects on hybrid performance.
- (iii) Whether changes in style length or maturation impact on the genetic composition of resulting progenies and can be used as a means of manipulating the composition of backcross generations.
- (iv) Whether there is genetic variation within *E. globulus* for the success of hybridisation and whether the success and performance under intra-specific crossing can be used as a predictor of intra-specific performance.
- (v) The genetic characteristics of F₁ and advanced generation hybrid populations.

2. BACKGROUND

There are 1.8 million hectares of *Eucalyptus globulus* ssp. *globulus* planted in the world mainly for pulp and paper production, with a growth rate of between 9 to 35 m³/year (Tibbits, 1997). Chile has the second largest *E. globulus* plantation estate in the world after the Iberian Peninsula. It has around 250,000 hectares (INFOR, 1999) with an annual growth rate of between 25 to 35 m³/year; and a basic density of the wood of 492 kg/ m³ between 8 to 10 years (Peredo, 1999).

The main factor restricting the cultivation of *E. globulus* in Chile is frost. On colder sites, *E. globulus* is replaced by *E. nitens*. However, in spite of having better growth, *E. nitens* produces less pulp per hectare due to the lower basic density of the wood and reduced pulp yield compared with *E. globulus*. There is also a general reluctance by pulp mills to use *E. nitens* pulp. There is therefore increasing interest in improving the cold tolerance of *E. globulus* to extend the area available to this high quality pulpwood species. Hybridisation with cold tolerant species is seen as one means of achieving this objective through the development of frost resistant genotypes with *E. globulus*-like growth and pulpwood characteristics.

2.1 The problem with producing hybrids of *E. globulus*.

To effectively breed and deploy hybrids it is necessary to: (i) have cost effective pollination techniques to allow large numbers of hybrid combinations to be generated and screened and (ii) have an efficient means of clonal deployment or of mass producing selected hybrid seed. In the case of *E. globulus* and many of its hybrids (e.g. *E. nitens* x *globulus* Rasmussen *et al.* 1995), cloning by either hardwood cuttings or by *in vitro* techniques is difficult, which means that intensive selection for rooting ability must be undertaken to find genotypes which clonally propagate at levels which are cost-effective for large scale deployment. The mass production of hybrid seed of outstanding full-sib families is an alternative. However until recently, this option has never been a serious possibility due to the high cost of hybrid seed production. This is partly due to the fact that most species (e.g. *E. nitens* and *E. gunnii*) which are being crossed with *E. globulus*, have markedly smaller flowers and must be used as the female parent in the cross. This is because their short pollen tubes are unable to grow the full length of the *E. globulus* style, resulting in a unilateral barrier to hybridisation with many species. This is unlikely to be due to physiological incongruity (e.g. Ellis *et al.* 1991) as seed set is frequently obtained in taxonomically wider crosses or when *E. globulus* is used as the pollen parent. The barrier is believed to be mainly structural and simply due to the pollen-tubes of the smaller flowered species being unable to grow the full length of the style of the large-flowered *E. globulus* (Gore *et al.* 1990). These smaller flowered species have less seed per flower than *E. globulus* and their more delicate flowers means that crossing is more time-consuming and thus expensive than when *E. globulus* is used as the female. Further, although F₁ hybrid seed set is often possible when the small flowered species are used as the female parent, seed set is still reduced compared to intra-specific outcrosses, possibly due to pollen tubes overshooting the ovules.

2.2 Recent developments in controlled pollination of eucalypts

Recent developments in controlled pollination of eucalypts have now opened the possibility of mass production of controlled pollinated seed of *E. globulus* and potentially a means of mass-producing hybrids using the large flowered species *E. globulus* as the female parent. Due to its large flower size *E. globulus* is probably the only eucalypt in which controlled pollinated families could be cost-effectively produced for deployment (Shelbourne 1999).

The technique traditionally used in the pollination controlled of *Eucalyptus* requires at least three visits:

- (1) emasculation at operculum shed in order to prevent selfing and isolation of the flower in order to prevent contamination from non-target pollen;
- (2) pollination with the target pollen at maximum receptivity of the stigma, 3 to 28 days after operculum shed, depending on the species and environment; and
- (3) removal of the isolation bag after the fertilisation, about 2 to 4 weeks after pollination.

In the case of *E. globulus* and many other species of eucalypts, new developments have now reduced the pollination procedure to a single visit (Cauvin 1988; Harbard *et al.* 1999, 2000; Williams *et al.* 1999). It has been found that pollination does not depend on the stigma and pollination can be just as successful when pollen is applied to the cut surface of the style at the time of emasculation or even earlier (prior to operculum shed). The style can be either transversely cut (Williams *et al.* 1999) or sliced (Harbard *et al.* 1999). Pollination appears possible when between 10 to 66% of the style is removed in *E. globulus*. Plastic or silicon tubes have also been used which slip over the style itself allowing contamination to be prevented without having to isolate the whole flower (e.g. Barbour, 1997). It is therefore unnecessary to return to the flower to remove the isolation bag.

These developments have dramatically cut the cost of controlled crossing in eucalypts and in the last few years operational crossing of *Eucalyptus globulus* in seed orchards has been successfully implemented in Chile (Harbard *et al.* 1999, 2000). The production of full-sib *E. globulus* families for deployment allows the capturing of both additive and non-additive genetic gains as well as eliminating the inbreeding depression through self pollination which may occur in open-pollinated seed orchard seed. It is estimated that the mass pollination of full-sib families may increase genetic gains in stem volume by up to 12% compared to an open pollination seed orchard containing the top 20 selected clones (Griffin *et al.*, 1999). The deployment of full sib *E. globulus* families is likely to be advantageous in the short and medium term until developments in clonal propagation reduce the cost of clonal propagation.

These new pollination procedures have also opened the way for mass production of hybrid seed to allow either:

- (i) high selection intensities to be applied to identify elite genotypes which can also be efficiently cloned for deployment or
- (ii) direct deployment of elite hybrid families, thereby eliminating the constraint of clonal propagation all together.

A key element in the efficient production of hybrid seed is the ability to use *E. globulus* as the female parent due to the ease of controlled crossing. This is advantageous as selections are already established in orchards (eliminating the cost of grafting and establishing arboreta of minor species), controlled crossing is usually operationally easier using *E. globulus* as the female due to its large flower size, the seed set per capsule (29 seed per capsule under controlled crossing) is usually much higher than the smaller flowered species and the species has a great flowering window in Chile (August to December).

The most-likely solution to overcome the structural barrier to using *E. globulus* as a female in crosses with small-flowered species is to cut the *E. globulus* style, thereby reducing the distance that the pollen tube must grow to reach the base of the *E. globulus* style. Unpublished reports of early attempts to produce hybrids between *E. globulus* and *E. nitens* using this techniques were noted to be unsuccessful (Potts and Cauvin 1988; Gore et al. 1990). However, it is believed that in these cases, either the style was completely removed or pollinated several days after cutting. Bioforest data has shown that even intra-specific crossing is unsuccessful if the style is completely removed, but successful when up to 2/3 of the style is removed. Intra- and inter-specific hybrids have been produced using the cut style technique with females of smaller-flowered species such as *E. camaldulensis*, *E. grandis* and *E. dunnii* and *E. urophylla* (Harbard et al. 2000). Interspecific hybrids with females of *E. globulus* and pollen of the small-flowered *E. dunnii* have now been produced using the cut style technique in Australia (Barbour and Spencer 2000). In this case, leaving 60% of the style resulted in greater seed set than when 80% of the style was left.

3. RESEARCH PLAN

The proposed research will focus on six critical questions:

1. What is the optimal style length and flower stage to produce hybrids with *E. globulus* as a female?

Determine the optimal position and manner to cut the *E. globulus* style and the effect of flower maturation on the success of hybridisation for each species combination.

2. Can the efficiency of controlled pollination procedures using females of the small-flowered species be improved?

Currently the production of hybrids with *E. globulus* necessitates the use of small flowered species as the female parent. The cut-style treatment has been reported as successful with several of these species (*E. camaldulensis*, *E. grandis* and *E. dunnii* and *E. urophylla*; Harbard *et al.* 2000). However, attempts to use this technique with the delicate style of *E. nitens* have to date been either unsuccessful (Williams *et al.* 1999) or resulted in very poor seed set (10% capsule harvest; 9 seed/100 flowers crossed; Harbard *et al.* 2000; Bioforest unpubl. data for capsule set), even with intra-specific crossing. This project will therefore explore other approaches to improving the pollination efficiency for *E. nitens* and possibly other small flowered species. For example, the development of new means of style or whole flower isolation has the potential to substantially increase pollination success in these small-flowered species. It has already been shown in *E. globulus* that the traditional bagging technique results in poorer capsule set compared with placing a tube over the style (e.g. *E. globulus* Williams *et al.* 1999; Harbard *et al.* 2000).

3. Are there reciprocal effects in F₁ hybrid success and performance?

There are increasing numbers of reports of reciprocal effects in the success and performance of hybrids in *Eucalyptus*. Reciprocal effects have been reported by Harbard *et al.* (2000a) in *E. dunnii* x *grandis* F₁ crosses. In a reciprocal 3x3 factorial, *E. grandis* females produced twice as many seed as *E. dunnii* females, however a significantly higher percentage of the F₁'s produced using the *E. dunnii* as female died. However there was no difference in the ratio of normal to defective seedlings. Sedgley and Granger (1996) reported ovule degeneration in crosses between *E. spathulata* and *E. platypus*, including failure of the hybrid zygote to divide. However when *E. spathulata* was the female, there was also slower embryo development and reduced cellularization of the endosperm. de Assis (2000) reports that in the majority of reciprocal crosses, rooting ability showed a maternal effect. When used as female, easy to root species or clones produced easier to root hybrids. Also it was noted that *E. dunnii* x *grandis* and *E. dunnii* x *urophylla* hybrids had fewer abnormalities than their reciprocals which suggested

that there may be some type of maternal effect in their expression. Reciprocal effects have also been reported in *E. grandis* x *tereticornis* crosses for seed quality traits and seedling morphology by Bierwagen *et al.* (2000) and for hybrid vigour in reciprocal crosses involving *E. urophylla*, *E. camaldulensis*, and *E. exserta* by Kha and Cuong (2000).

The success and performance of F_1 hybrids produced using *E. globulus* as a female will be compared with exactly the same crosses produced using the small-flowered species as the female parent.

4. Does style length or development stage affect the genetic composition of hybrid progenies?

There has already been reported loss of genetic material from one-or-other parent in interspecific backcrosses of *E. grandis* x *globulus* to either parent (Myburg *et al.* 2000). However this distortion was mainly in favour of the recurrent parent *E. grandis* which resulted in resistance to the introgression of donor DNA from *E. globulus* into the *E. grandis* genetic background. Similar effects have been reported in *E. gunnii* x *globulus* F_2 's (Vaillancourt *et al.* 1995). One explanation for these losses may involve differences in floral morphology and be due to linkage with genes affecting pollen tube growth. There are large differences in the pollen tube length between *E. globulus* and *E. nitens* and *E. gunnii*. Evidence would suggest that the style length and pollen tube length is inherited in an intermediate manner in the F_1 (Tilyard and Potts unpubl. data) but there is like to be segregation in pollen tube length. The smaller pollen tubes are likely to be linked with other genetic material from the smaller flowered species and thus it will be the more *E. globulus*-like genotypes that tend to effect fertilisation after growing through the full style. The frequency of genetic material from the small flowered species is likely to increase if the style length is reduced. If this is the case then the efficiency of backcrossing may be manipulated by changing style length to increase the frequency of genes of one or other species. This project will investigate the effects of the length of the *E. globulus* style cut and reciprocal effects on the genetic composition of backcross progeny.

There is also evidence that seed set per capsule is increased by style cutting at anthesis compared to normal pollination of the receptive stigma which raises the possibility that the receptive stigma may be discriminating against some pollen genotypes. If this were the case then cutting the style may alter the genetic composition of the resulting

progeny. There is also the possibility that this trend may be accentuated by cutting the style of less mature flowers. This project will therefore use hybrid backcrossing as a tool to detect such treatment effects on the genetic composition of hybrid progenies. If such effects can be detected in hybrid progeny then it may be worthwhile testing for more subtle effects in intra-specific crossing.

Large progeny sizes of *E. gunnii* x *globulus* and *E. nitens* x *globulus* backcross families will be used to test these effects. Differences between progenies will be examined using both quantitative (e.g. levels of abnormalities and growth, morphological differences) and molecular (isozymes or microsatellites) approaches.

5. Do *E. globulus* genotypes differ in their success of hybridisation?

There is increasing evidence that parents of the same species may differ markedly in their propensity of hybridisation. For example, Harbard et al (2000) report marked differences in the success of hybridisation amongst *E. dunnii* females. Volker (1995) also reports marked differences in the later success of hybridisation between *E. globulus* females of different provenance (Taranna vs King Island).

Variation in hybridisation potential amongst *E. globulus* females will be assessed using pollen parents of *E. gunnii*, *E. nitens* and *E. viminalis* as well as backcrosses involving *E. gunnii* x *globulus* and *E. nitens* x *globulus* pollen. Crossing will be undertaken using the cut style technique and progenies assessed for levels of abnormalities and early performance. Intra-specific crosses will also be undertaken as a control and the same females (up to 50 different genotypes) used for each pollen species combination to determine whether differences in hybridisation potential are species-specific.

6. Can hybrid performance be predicted by pure species performance?

Differentiation of hybrid breeding strategies depends on a knowledge of the genetic parameters of hybrid populations and how these relate to those estimated from the pure species populations. Key issues are whether the best pure species selections also produce the best hybrid combinations, their relative variability and the magnitude of specific combining effects in pure species and hybrid (Potts et al. 2000). The

full-sib progeny generated from (5) will be established in field trials and genetic parameters (additive and non-additive effects) for early growth will be studied and the genetic correlations between cross types determined.

4. SIGNIFICANCE AND APPLICATION OF THE RESEARCH

The successful selection of elite hybrids for either cloning or deployment as full-sib families will initially depend upon having the capacity to produce and test large numbers of genotypes (Perrow and Cotterill 2000; Griffin *et al.* 2000). This project will result in the development of efficient procedures for the large scale production of F₁ hybrids for screening to allow a high selection pressure to be applied to identify elite hybrid combinations or specific genotypes.

While currently most research in forestry has focused on F₁ hybrids. In most cases, key traits of significance (e.g. frost resistance – Tibbits *et al.* 1991 and wood properties Tibbits *et al.* 1995) are often inherited in an intermediate manner in the F₁'s and it may be difficult to find exceptional combinations of key characteristics. This research will therefore explore the possibility of backcrossing to generate unique trait combinations. The identification of such genotypes will allow the favoured *E. globulus*-like characteristics to be extended into plantations on colder sites currently supporting *E. nitens* plantations and increase the economic worth of plantations on colder sites.

With the development of efficient pollination techniques and selection of appropriate female parents the large-scale production of selected F₁ or back-cross hybrid families by mass-controlled pollination may also be possible using grafted seed orchards, avoiding the reliance on clonal propagation for hybrid deployment. The cost of clonal propagation is seen as a major limitation to hybrid deployment in countries such as Australia.

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5. DETAILS OF RESEARCH EXPERIENCE AND EXPERIENCE

1978-1979

Contract with INFOR (Chilean Forest Institute) in order to develop projects of forestry related with species and origins of arid and semiarid zones and. The project was financed by CONAF and the United Nations (PNUD).

1979-1983

The development of efficient systems for the production and exploitation of interespecific hybrids of *Eucalyptus globulus*. Proposal for a higher degree by research project (2001-2003). University of Tasmania. Faculty of Science & Engineering. School of Plant Science.

Investigator of the Department of Forestry of INFOR. Main topics of investigation: research of exotic species introduction and origins. (*Pinus* and *Eucalyptus*).

1984

Project Leader of the activity "Evaluation of species introduction of species in the arid and semiarid zone of Chile."- Program of Investigation: CONAF/ PNUD/ FAO/ CHI76003.

1985-1987

Project Leader of Project "Silviculture Management of *Eucalyptus* species" financed by INFOR/ CORFO and forests companies. The main responsibility was plan and implement silviculture techniques applied to fast growing species such as *E. globulus*, *E. nitens*, *E. regnans* *E. delegatensis*.

The program of investigation included several aspects like: nursery, soil preparation, nutrition, weed control. Other silvicultural traits were also evaluated like: spacings, thinnings, prunings and coppice management. This program began the investigation of genetic improvement of species of the *Eucalyptus* genus in Chile. The investigation included genetic variation of progenies and origins, selection of families and research on vegetative propagation through cuttings.

1988-1989

Student of the program of Post Graduate degree in the University of Sao Paulo in Piracicaba- Brazil. This program was financed through a scholarship of the International Development Research Center (IDRC- Canada). The main area of investigation of the program was guided to the forestry and the genetic improvement of *Eucalyptus*. The developed thesis included a comparison of several genetic materials in experimental plantations. The objective was to compare the propagation for seeds and clones of select families. The clones were proven on pure stands and also in arrangements. The main characteristics evaluated in the experimental plots were the basic density of the wood and the cubic volume of the trees for the production of pulp.

1990

Project Leader of the program of genetic improvement of INFOR. The main developed activities included the production of plants and the establishment of progeny trials of *E. globulus* and *E. nitens*.

1990-1994

Assisting Professor of the University of Concepción. Faculty of Forestry Sciences. The course of genetic forest improvement was designed. The work consisted of formal classes and the development of topics of investigation with the students, as well as the orientation of works of thesis with forests companies (Forestal Chile and Forestal Arauco).

1994

The development of efficient systems for the production and exploitation of interespecific hybrids of *Eucalyptus globulus*. Proposal for a higher degree by research project (2001-2003). University of Tasmania. Faculty of Science & Engineering. School of Plant Science.

Technical Manager of CONAF (Corporación Nacional Forestal).
Strategic planning for the Forest Service of the State (1994-2000).

1990-1997

* Project Leader of the program "Fibre Yield Improvement Program (FYIP) of the group Santa Fe developed by SHELL FORESTRY in Chile. The master plan considers the improvement of the yield and the quality of the pulp of the plantations of *Eucalyptus* of the company. The main goals achieved until 1997 were:

* Producing thousand of seedlings and clones in the nursery corresponding to hundred of families of open pollination for the commercial plantations and also for genetic test in the field.

* Designing and plant 70 genetic trials in the field: species and origins, hybrid test, clonal test, seedling and clonal seed orchards.

* Harvesting seed for the requirements of the nursery including the Seed Production Areas (SPA) and seed orchards (SSO, CSO).

* Crop of seed in commercial stands of *E. globulus* and *E. nitens* for sale.

* Developing a program of studies in technology of the wood including direct and indirect mensurations of the physical and chemical properties of the wood. Relationship with the industrial plant of Santa Fe.

* Beginning a program of investigation of reproductive biology of *E. globulus* and *E. nitens*. The main activities included phonology, pollen processing and storage in laboratory, controlled pollination controlled. The main hybrid synthesized have been *E. nitens* x *E. globulus*, *E. nitens* x *E. camaldulensis*, *E. nitens* x *E. viminalis*.

* Promoting genetic exchange (pollen and seeds) with other foreign companies like FOA (Uruguay), SAPPI & HLH (Sudafrica), RIOCELL (Brazil).

* Manage an annual budget of U\$ 300.000.

* Collecting, manage and process a data base of several genetic trial called GENETICA call.

* Using the genetic generated information values of genetic improvement for the genetic purification of progeny trials. (seedlings and cuttings).

* Giving information to the clonal program clonal for the deployment of operational clones to the field.

1998

Scientist Research of Genetic division of the Bioforest company Corp.

The development of efficient systems for the production and exploitation of interespecific hybrids of *Eucalyptus globulus*. Proposal for a higher degree by research project (2001-2003). University of Tasmania. Faculty of Science & Engineering. School of Plant Science.

- Eucalyptus Genes project.
A mass control-pollination of *E. globulus* spp *globulus* program based on one single visit was implemented in Arauco with a goal of 30 Kgs of seed during the period 1998-2001
- A research project called : "Reproductive biology and hybridization of Eucalyptus (FONTEC-CORFO)" is under development.

6. PUBLICATIONS

1-	
TITULO	Perspectivas del uso de la micropropagación en la silvicultura
FECHA	1990
AUTORES	Espejo, J.; Arce J.,P.; Rojas V.,P.
DATOS PUBLICACION	Santiago, Chile, Chile Forestal. 8p.
SERIE	Chile Forestal. Documento Técnico n.044
2.-	
TITULO	Nuevas especies para la forestación en Chile
FECHA	1980
AUTORES	Prado D.,J.A.; Barros A.,S.; Rojas V.,P.; Barros R.,D.
DATOS PUBLICACION	Santiago, Chile, CONAF. 8p.
SERIE	CONAF. Chile Forestal. Suplemento n.Jul/80
NOTAS	Publicado como suplemento de Chile Forestal 5(58)80.
3-	
TITULO	Metodología para la instalación y análisis de ensayo de introducción de especies forestales
FECHA	1980
AUTORES	Prado D.,J.A.; Barros A.,S.; Rojas V.,P.; Barros R.,D.; Vita, A.; Rustom, A.; Cogollor, G.; Alvarez, S.
DATOS PUBLICACION	Santiago, Chile, Proyecto CONAF/PNUD/FAO. 68p.
SERIE	CONAF/PNUD/FAO. Proyecto FO: DP/CHI/76/003. Documento de Trabajo n.31
PROYECTO	Investigación y Desarrollo Forestal. Patrocinado por CONAF/PNUD/FAO. No.FO: DP/CHI/76/003
NOTAS	Este Informe es resultado de un convenio con la Universidad de Chile y el INFOR. En Btca. también Informes I y II (INFOR 127 e INFOR 128).
4-	
TITULO	Metodología para la instalación y análisis de ensayo de introducción de especies forestales

The development of efficient systems for the production and exploitation of interespecific hybrids of *Eucalyptus globulus*. Proposal for a higher degree by research project (2001-2003). University of Tasmania. Faculty of Science & Engineering. School of Plant Science.

FECHA	1980
AUTORES	Prado D.,J.A.; Barros A.,S.; Rojas V.,P.; Barros R.,D.; Vita, A.; Rustom, A.; Cogollor, G.; Alvarez, S.
DATOS PUBLICACION	Santiago, Chile, Proyecto CONAF/PNUD/FAO. 68p.
SERIE	CONAF/PNUD/FAO. Proyecto FO: DP/CHI/76/003. Documento de Trabajo n.31
PROYECTO	Investigación y Desarrollo Forestal. Patrocinado por CONAF/PNUD/FAO. No.FO: DP/CHI/76/003
NOTAS	Este Informe es resultado de un convenio con la Universidad de Chile y el INFOR. En Btca. también Informes I y II (INFOR 127 e INFOR 128).

5-

TITULO	Efecto de la preparación del sitio, fertilización y control de la competencia en el establecimiento de <i>Eucalyptus globulus</i>
FECHA	1986
AUTORES	Rojas V.,P.
DATOS PUBLICACION	Nacimiento, Chile, Forestal Río Vergara. 4p.
SERIE	Forestal Río Vergara . Avances en Investigación Forestal n.DID/09 Este artículo está basado en el trabajo de Prado D.,J.A.; Rojas V.,P.: "La importancia de la preparación del sitio y la fertilización en el establecimiento de plantaciones de <i>Eucalyptus globulus</i> en la zona semiárida de Chile". INFOR, 1986.
NOTAS	

6-

TITULO	Crecimiento de algunas especies de los géneros <i>Cupressus</i> , <i>Eucalyptus</i> y <i>Pinus</i> en la costa de la Región del Maule, VII Región
FECHA	1979
AUTORES	Barros A.,S.; Rojas V.,P.
DATOS PUBLICACION	Santiago, Chile, INFOR. División Silvicultura; CORFO. 20p. maps, grafs, tbls.
SERIE	INFOR. Informe Técnico n.086
RESUMEN	Se evalúa la respuesta de esas especies, a través de los parámetros de supervivencia y desarrollo, para seleccionar aquellas que pueden ser incluidas en futuros planes de forestación

7-

TITULO	Los eucaliptos como alternativa para la forestación en la VIII Región
FECHA	1979
AUTORES	Prado D.,J.A.; Rojas V.,P.

The development of efficient systems for the production and exploitation of interespecific hybrids of *Eucalyptus globulus*. Proposal for a higher degree by research project (2001-2003). University of Tasmania. Faculty of Science & Engineering. School of Plant Science.

DATOS PUBLICACION	Santiago, Chile, INFOR. División Silvicultura; CORFO. 27p. maps, grafs, tpls.
SERIE	INFOR. Informe Técnico n.089
RESUMEN	Se entregan resultados de supervivencia y desarrollo del género <i>Eucalyptus</i> plantadas experimentalmente en el predio La Leonera, Comuna de Tomé

8-

TITULO	Plantaciones experimentales con especies de <i>Eucalyptus</i> en la Zona Central, secano costero de la V Región
FECHA	1980
AUTORES	Rojas V.,P.
DATOS PUBLICACION	Santiago, Chile, INFOR. División Silvicultura; CORFO. 21p, anexos. grafs, tpls.
SERIE	INFOR. Informe Técnico n.092
RESUMEN	Se consideran dos lugares de ensayo (Peñuelas y Santa Marta), en los cuales se comparan las especies probadas, a los 10 años de edad. Los parámetros considerados en el análisis son: Mortalidad, DAP, altura y área basal

9-

TITULO	Crecimiento de especies de los géneros <i>Pinus</i> y <i>Eucalyptus</i> . Secano costero. VI Región
FECHA	1980
AUTORES	Barros A.,S.; Rojas V.,P.
DATOS PUBLICACION	Santiago, Chile, INFOR. División Silvicultura; CORFO. 27p. tpls.
SERIE	INFOR. Informe Técnico n.093
RESUMEN	Los resultados son de parcelas experimentales instaladas durante los años 1967, 1969, 1970, en el predio San Antonio de Petrel, comuna de Pichilemu, a los 10 años de edad
MATERIAS	SECANO COSTERO / INTRODUCCION DE ESPECIES / CRECIMIENTO / CHILE / SEXTA REGION / SAN ANTONIO DE PETREL / PICHILEMU / <i>Eucalyptus delegatensis</i> / <i>Eucalyptus fastigata</i> / <i>Eucalyptus globulus</i> / <i>Eucalyptus grandis</i> / <i>Eucalyptus melliodora</i> / <i>Eucalyptus obliqua</i> / <i>Eucalyptus regnans</i> / <i>Pinus contorta</i> / <i>Pinus coulteri</i> / <i>Pinus jeffreyi</i> / <i>Pinus nigra</i> / <i>Pinus ponderosa</i> / <i>Pinus radiata</i>
UBICACION	SEDE SANTIAGO
SOLICITE POR	Chile. INFOR. Informe Técnico n.093

10-

TITULO	Crecimiento de seis especies forestales ensayadas entre Arauco y Llanquihue
FECHA	1979
AUTORES	Rojas V.,P.; Barros R.,D.
DATOS PUBLICACION	Santiago, Chile, INFOR. División Silvicultura. 25p. map, tpls.

The development of efficient systems for the production and exploitation of interespecific hybrids of *Eucalyptus globulus*. Proposal for a higher degree by research project (2001-2003). University of Tasmania. Faculty of Science & Engineering. School of Plant Science.

SERIE	INFOR. Informe Técnico n.094
RESUMEN	Resultados obtenidos, a los 10 años, con 6 especies (<i>Eucalyptus globulus</i> , <i>E. delegatensis</i> , <i>Pinus radiata</i> , <i>Pseudotsuga menziesii</i> , <i>Nothofagus obliqua</i> , <i>N. alpina</i>) plantadas en parcelas experimentales en la zona Sur de Chile. La especie de mayor crecimiento fue <i>E. delegatensis</i>
11-	
TITULO	Sistema computacional INTROESP (Introducción de Especies Forestales)
FECHA	1984
AUTORES	Rojas V.,P.; Salas G.,G.
EN	CONAF. Chile Forestal vol.10, n.108, pp. 22-23
12-	
TITULO	Preparación del sitio y fertilización en el establecimiento de plantaciones de <i>Eucalyptus globulus</i> en la zona semiárida de Chile
FECHA	1987
AUTORES	Prado D.,J.A.; Rojas V.,P.
EN	INFOR. Ciencia e Investigación Forestal vol.01, n.1, pp. 017-027
13-	
TITULO	Ensayos de procedencias de <i>Eucalyptus camaldulensis</i> Dehnh en la zona semiárida de Chile
FECHA	1987
AUTORES	Barros A.,S.; Rojas V.,P.
EN	INFOR. Ciencia e Investigación Forestal vol.01, n.1, pp. 029-040
14-	
TITULO	Propagación vegetativa por estacas en <i>Eucalyptus camaldulensis</i> Dehnh
FECHA	1987
AUTORES	Rojas V.,P.; Arce J.,P.; Arriagada B.,M.
EN	INFOR. Ciencia e Investigación Forestal vol.01, n.2, pp. 001-009
15-	
TITULO	Resultados preliminares en fertilización de apoyo para <i>Eucalyptus globulus</i>
FECHA	1988
AUTORES	Toral I.,M.; Rojas V.,P.
EN	INFOR. Ciencia e Investigación Forestal vol.02, n.3, pp. 045-056
16-	
TITULO	Silvicultura clonal de <i>Eucalyptus</i>
FECHA	1990

The development of efficient systems for the production and exploitation of interespecific hybrids of *Eucalyptus globulus*. Proposal for a higher degree by research project (2001-2003). University of Tasmania. Faculty of Science & Engineering. School of Plant Science.

AUTORES EN	Rojas V.,P. INFOR. Ciencia e Investigación Forestal vol.04, n.1, pp. 120-123
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17-

TITULO	Análisis del desarrollo del quillay (<i>Quillaja saponaria</i> Mol.) en la zona árida y semiárida chilena
FECHA	1983
AUTORES EN	Prado D.,J.A.; Barros A.,S.; Rojas V.,P.; Barros R.,D. Universidad de Chile. CEZA. Terra Arida n.04, pp. 438-454
CONGRESOS	Congreso Internacional de Estudios de Zonas Áridas y Semiáridas. La Serena, Chile, 15-19 Enero 1980. Patrocinado por Universidad de Chile

18-

TITULO	Seminarios presentados al Curso de Genética y Mejoramiento Forestal. Resúmenes. Abstracts. Primer semestre 1995
FECHA	1995
AUTORES	Rojas V.,P.
DATOS PUBLICACION	Concepción, Chile, Universidad de Concepción. Facultad de Ciencias Forestales. [83p.]

19-

TITULO	Estudio de las especies del género <i>Prosopis</i> en la Pampa del Tamarugal. Tomo I. Revisión bibliográfica y actualización de la información existente en el país
FECHA	1981
AUTORES	Wrann H.,J.; Prado D.,J.A.; Aguirre A.,J.J.; Rojas V.,P.; Barros R.,D.; Hernández C.,M.
DATOS PUBLICACION	Santiago, Chile, INFOR. 170p., anexos. tbs, 2 map.
NOTAS	Parte del Programa Pampa del Tamarugal, de CORFO.

20-

TITULO	Programa de conservación, ordenación y mejoramiento genético
FECHA	1994
AUTORES	Rojas V.,P.
EN	Fundación Chile; Grupo Silvícola; CONAF Diversificación y silvicultura. Nuevas experiencias. Tercer taller silvícola. Concepción, Chile, Octubre 1994. pp.103-145
CONGRESOS	Taller silvícola, 3. Concepción, Chile, Oct. 1994. Patrocinado por Fundación Chile; Grupo Silvícola; CONAF

21-

TITULO	Evaluación ensayos introducción de especies vegetales existentes en zonas silvestres áridas y semiáridas de Chile.
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The development of efficient systems for the production and exploitation of interespecific hybrids of *Eucalyptus globulus*. Proposal for a higher degree by research project (2001-2003). University of Tasmania. Faculty of Science & Engineering. School of Plant Science.

FECHA	Informe final 1985
AUTORES	Rojas V.,P.; Vita A.,A.; Jobet J.,M.; Peralta P.,M.; Cabello M.,M. Santiago, Chile, INFOR. División Silvicultura; Universidad de Chile. Facultad de Ciencias Agrarias, Veterinarias y Forestales.
DATOS PUBLICACION	141p, anexos, 1 map.
Patrocinado por	CONAF/PNUD/FAO. n.CHI-83-017
NOTAS	Informe preparado para el Proyecto CONAF/PNUD/FAO/CHI-83-017. Actividad II.1.

22-

TITULO	Especies forestales exóticas de interés económico para Chile
FECHA	1986
AUTORES	Prado D.,J.A.; Barros A.,S.; Wrann H.,J.; Rojas V.,P.; Barros R.,D.; Aguirre A.,S.
DATOS PUBLICACION	Santiago, Chile, INFOR. División Silvicultura; CORFO. 168p. ilus, grafs, maps, tbls.
PROYECTO	Introducción de especies forestales. Patrocinado por CORFO
RESUMEN	Entrega los resultados más relevantes obtenidos en el programa de selección de especies introducidas, para que los forestadores cuenten con información respecto a especies que podrían reemplazar al género Pinus en replantación. Se consideran 3 zonas edafoclimáticas, sugiriendo áreas de forestación para especies principales: Eucalyptus, Pinus radiata, P. muricata y Pseudotsuga menziesii

23-

TITULO	Evaluación de parcelas experimentales de introducción de especies
FECHA	1979
AUTORES	Barros R.,D.; Rojas V.,P.
DATOS PUBLICACION	Santiago, Chile, Universidad de Chile. Facultad de Ciencias Forestales. 127p.
TESIS	Universidad de Chile. Facultad de Ciencias Forestales. Grado de Ingeniero Forestal

24-

TITULO	Efecto de la preparación del suelo, fertilización y control de la competencia en el establecimiento de plantaciones de Eucalyptus globulus en la zona semiárida de Chile
FECHA	1985
AUTORES	Prado D.,J.A.; Rojas V.,P.
EN	Webb, D., ed.; Barros A.,S., ed. Forestación en zonas áridas y semiáridas. Actas. [2º Encuentro Regional CIID, América Latina y El Caribe. Santiago, Chile. 13-17 May.1985] . pp.233-

The development of efficient systems for the production and exploitation of interspecific hybrids of *Eucalyptus globulus*. Proposal for a higher degree by research project (2001-2003). University of Tasmania. Faculty of Science & Engineering. School of Plant Science.

CONGRESOS	247 Encuentro Regional CIID, America Latina y El Caribe. 2. Santiago, Chile, 13 y 17 May.1985. Patrocinado por INFOR; CIID [Canada]
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25-

TITULO	Sistema computacional para el archivo y procesamiento de informacion de ensayos de introducción de especies
FECHA	1985
AUTORES	Rojas V.,P. Webb, D., ed.; Barros A.,S., ed.Forestación en zonas áridas y semiáridas. Actas. [2° Encuentro Regional CIID, América
EN	Latina y El Caribe. Santiago, Chile. 13-17 May.1985] . pp.348- 402
CONGRESOS	Encuentro Regional CIID, America Latina y El Caribe. 2. Santiago, Chile, 13 y 17 May.1985. Patrocinado por INFOR; CIID [Canada]

26-

TITULO	Situación actual de los programas de introducción de especies forestales en Chile. Informe I.
FECHA	1979
AUTORES	INFOR; Universidad de Chile
DATOS PUBLICACION	Santiago, Chile, INFOR. División Forestal; Universidad de Chile. Facultad de Ciencias Forestales. 386p, anexos.
Patrocinado por	CONAF/PNUD/FAO. n.CHI-76-003 Documento interno.
NOTAS	Participantes: Barros A.,S., Rojas V.,P., Barros R.,D., Navia A.,P., Vita A.,A., Toro V.,J., Cogollor H.,G.. Actividad I-2.2. Introducción de especies forestales. El Informe III se publicó como Documento de Trabajo n.31 del Proyecto. En Btca. también Informe II (INFOR 128).

27-

TITULO	Areas cubiertas por ensayos de especies y ubicación de nuevas experiencias. Informe II
FECHA	1979
AUTORES	INFOR; Universidad de Chile
DATOS PUBLICACION	Santiago, Chile, INFOR. División Forestal; Universidad de Chile. Facultad de Ciencias Forestales. 87p, apend. Cuad.
Patrocinado por	CONAF/PNUD/FAO. n.CHI-76-003 Documento interno.
NOTAS	Personal participante: Barros A.,S., Rojas V.,P., Barros R.,D., Navia A.,P., Prado D.,J.A., Elgueta S.,H., Vita A.,A., Toro V.,J., Cogollor H.,G., Caldentey P.,J. El Informe III se publicó como

The development of efficient systems for the production and exploitation of interspecific hybrids of *Eucalyptus globulus*. Proposal for a higher degree by research project (2001-2003). University of Tasmania. Faculty of Science & Engineering. School of Plant Science.

Documento de Trabajo n.31 del Proyecto. En Btca. también Informe I (INFOR 127).

28-

TITULO	Otras coníferas como alternativa para la forestación en la zona centro sur del país
FECHA	1981
AUTORES	Rojas V.,P.
EN	INFORSeminar: Nuevas especies forestales de interés económico para Chile . 27p.

29-

TITULO	Fibre Yield Improvement Program (FYIP) of <i>Eucalyptus globulus</i> Labill in Santa Fe Group, Chile. In:Proceedings IUFRO Conference on Silviculture and Improvement of <i>Eucalyptus</i> , Salvador Brasil
FECHA	1997
AUTORES	Rojas V.,P., Griffin A.R
EN	In:Proceedings IUFRO Conference on Silviculture and Improvement of <i>Eucalyptus</i> , Salvador Brasil. Vol 1 206-211

30-

TITULO	Avaliacao de plantios clonais e multiclonais em relacao a outros materiais geneticos de <i>E. grandis</i> no Estado de Sao Paulo
FECHA	1990
AUTORES	Rojas V.,P
EN	Tese de dissertacao. Ciencias Florestais. ESALQ/Universidade de Sao Paulo. Brasil