

May 2009

Workshop Report on:

**Collaboration on plant biotechnology between
Chile – INIA / Univ of Chile and
The Netherlands – WUR**

**'Reaching out, reaching up to join forces to solve world
food limitations'**



May 2009

**INIA /WUR International Workshop
18-19 of May, 2009
Programme**

1st Day (May 18) (La Platina Experimental Station, Santiago de Chile)

Session I

Opening:

Chairman: Dr. Carlos Fernández (Director of La Platina Station)

9:00-9:05 Welcome Leopoldo Sánchez , (National Director of INIA)

9:05-9:15 Welcome His Excellency, Mr Hero de Boer (Dutch Ambassador to Chile)

Introduction:

9:15 - 9:35 Overview of Netherlands Research system and WUR organization (Robert Hall, Deputy Director CBSG)

9:35 – 10:00 Overview of Chilean Research system and INIA organization (E. Labra INIA Director of R&D)

10:00 – 10:15: Coffee break

Session II

Chairman : Manuel Pinto (INIA)

10:15 – 10:45 Breeding, molecular breeding (including trans and cisgenesis) at WUR (focus on stress) (Ton den Nijs)

10:45 – 11: 00 Breeding & molecular breeding at INIA) (Carlos Muñoz)

11:00 – 11: 15 Molecular breeding, focus on abiotic stress (María Teresa Pino)

11:15 - 11:30 Questions & Discussion

Session III

Chairman: Roeland Van Ham (WUR)

11:30 - 12:00 Genomics at WUR (Robert Hall)

12:00 – 12: 15 Genomics at INIA (Patricio Hinrichsen)

12:15 – 12:30 Transgenesis at INIA (Humberto Prieto)

12:30 - 12:45 Questions & Discussion

12:45 – 13:30 Lunch

13:30 – 14:45 Visit to La Platina Station facilities

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Session IV

Chairman: Robert Hall (WUR)

14:45 – 15:15 Bioinformatics at Wageningen (Roeland Van Ham)

15:15 – 15:45 Bioinformatics at the Univ. of Chile and INIA (Andrés Aravena, Nilo Mejias)

15:45 – 16:00 Questions & Discussion

16:15 - 17:30 Visit to Bioinformatics facilities at the University of Chile

18.00 Return to hotel

2nd Day (May 19th) (Rayentué Experimental Station, Rancagua)

9:00 Depart to Rayentue Experimental Station

10:30 Arrival to Rayentue

10:30 – 11:15 Visit to Rayentué facilities

11:30 – 13:30 Official Opening Ceremony at Rayentue Station:

a) Launching the HortScience Centre project and

b) Inauguration of the facilities of the Post harvest Stone Fruit Centre.

Special ceremony with the attendance of government and INIA authorities.

13:30 – 14:30 Lunch

VI Session

Chairman : Edmundo Acevedo (Univ. de Chile)

14:30 - 14:45 The Centre for advances studies in HortScience - CEAF (M.Pinto)

14:45 – 15:00 Collaboration INIA/ Wageningen at present: The case of potato genome project. (Boris Sagredo)

14:45 – 15:15 Concepts of value chain development (Siert Wiersema)

14:45 – 15:00 Questions & Discussion

15:00 – 15:15: Coffee break

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Final Session

15:15 – 16:15 Commission Work .

Round Table Discussion: Genomics; Bioinformatics; Breeding & stress tolerance and Supply chain development. Each group will discuss separately and make the point on each area of interest. This has to be done considering the main objectives we agreed

The objectives are:

- 1. To present the focus of on-going research and state of the art in the three research areas selected*
- 2. To identify possible areas of cooperation between INIA and the Plant Science Group of Wageningen UR including projects, exchange of staff, PhD studies etc.*
- 3. To propose an agenda as to how we will proceed to develop the cooperation between our two organisations*

for the workshop.

16:15 – 16:30 Conclusions and final remarks

18.00 Travel South to Hotel

3rd Day (20th May)

For the third day (May 20) visit to the agriculture area close to Rayentue Station including a winery in the Chilean Central Valley and a Plant propagation / nursery / breeding company

May 20 evening return to Santiago

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A short Summary of the observations, conclusions and Action Points:

Executive Summary:

Following initial activities set in motion by the WUR Latino Office via Dr Peter Zuurbier a delegation from WUR Plant Sciences Group together with a representative of Wageningen International has visited Chile to assess and discuss opportunities for research collaboration in the field of Agro-food. A two day workshop was held, prior to which, regular interactions per email had been used in order to firstly determine the main topics for discussion and to decide which WUR representatives should attend and be able to give a sufficiently broad view of Wageningen Activities. This workshop has been successfully held and completed and the outcome is described in this short report.

The **first conclusion** of this activity is that considering the importance of Agro-food production and export by both countries, collaboration in the field of precompetitive research should offer valuable opportunities for creating added value.

A **second conclusion** is that as well as complementary areas of biological research, additional opportunities for biology / technology collaboration are readily identifiable. The latter in particular, regarding –omics technology applications, quantitative genetics and cisgenesis.

A **third conclusion** is that from the Chilean side, there is also interest not only for research collaboration but also, opportunities for collaboration regarding education activities (e.g. plant breeding courses, quantitative genetics) should be investigated.

Finally, depending upon the specific outcome of recent formal agreements between the partner Ministries of Agriculture and WUR, a follow-up strategy needs to be defined which is focused upon the initiation of bilateral projects between Chilean partners and WUR. Such projects should initially focus on those topics listed here as having been identified as having highest priority and added value. This should be the goal of the following workshop planned for October.

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Background

This workshop came about following regular interactions between the WUR Latino Office (Dr Peter Zuurbier) and INIA over the last few months / years. At these meetings it became evident that, especially in the field of plant and food science there were likely to be a lot of common interests. Furthermore, there were evidently several key areas where complementarity rather than competition could create potential opportunities for collaboration and the effective combination of materials and expertise. INIA and its collaborator the University of Chile, Santiago, being effectively the Chilean equivalents of DLO and Wageningen University (WUR) were identified as suitable Chile – Dutch sparring partners to undergo an intensive 2 day interaction in the form of a workshop to ascertain the desire to collaborate and identify the specific opportunities for interactions which should initially receive highest priority.

A key point of relevance is that during the week following the planned workshop in Chile, The Chilean President was to have an Official State visit to The Netherlands and was to be accompanied by the Chilean Minister of Agriculture. During this visit the Presidential delegation was to pay a visit to WUR during which a MoU was to be signed defining a commitment to collaboration between Chile and the Netherlands in the area of Agro-Food research. Consequently, the planned workshop was very effectively planned (if a little premature!). Related to this point, and to further emphasize the desire from the Dutch side to fully investigate all opportunities for collaboration, the Dutch Ambassador to Chile, His Excellency Mr. Hero de Boer, was pleased to attend and give a speech at the opening of the workshop.

Aims of the Activity

The primary aim of this workshop was to bring together Plant Genetics and Biotechnology Experts from both countries to discuss areas of common interest. In addition Mr S. Wiersema was to perform an analysis of chain management / postharvest issues of relevance to Chile agriculture. Regarding the former, prior to the workshop, parties from both sides (Dr Hall and Dr Pinto representing The Netherlands and Chile respectively) exchanged ideas as to the key topics likely to be of most relevance. Considering the broad nature of the activities in Wageningen, the lead in this was given to Chile. Resulting from this exchange it was decided to concentrate on three broad areas of expertise: Genomics, Bioinformatics and Breeding (for stress). However, the choice of attendees from the Dutch side was specifically made to involve key players with a broad interest and overview of what was currently happening at WUR. Beforehand also, information on the participants from both sides was exchanged in order to prepare for the most effective interaction. A programme of presentations and discussions was prepared to bring to the table those people and topics considered as having the greatest potential for future collaboration. In addition, future means of co-funding joint projects would be discussed. The primary output from this activity was

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therefore to be this report on the areas of complementarity and added value together with a proposed set of follow-up steps where appropriate.

Observations and outcomes: plant biotechnology

Prior to the kick-off of the workshop the Dutch delegation had a meeting with the INIA General Director Mr L Sánchez, the INIA La Platina Director Dr Fernandez and later also with the Dutch Ambassador to Chile Mr de Boer. All parties clearly indicated a clear goal to hold a successful meeting and to work together to achieve a suitable outcome in a sphere of professional collegiality. While it was a primary aim of the meeting to identify opportunities for collaboration, the general consensus was that the importance of agriculture to both countries was so great and with all players currently operating in a global market, it was inconceivable that there were no areas for effective collaboration to the benefit of both sides and that it was our job to identify these during the two day workshop.

Next to the Dutch delegation, ca 30 experts from the Chilean side attended during the two day workshop. The presentations were well prepared and received and immediately revealed many areas of common interest. Both groups were very enthusiastic about the possibilities for joining forces and after the various presentations the subsequent round table discussion was used to identify and prioritize areas where collaboration can result in complementarity and added value. The considerable interaction and detailed questioning during the presentations was indicative of a feeling of enthusiasm and mutual respect.

Conclusions and Action Points

The following summary and conclusions were made regarding any potential collaboration:

- Both groups were enthusiastic and open for full collaboration and the joining of expertise
- Both countries are major players on the global food and Agro markets with major export portfolios – but often with contrasting products or with the same product in opposite seasons.
- While Chile has major activities in crops of little relevance to the Netherlands (eg table grape) these are however still important as collaboration in the area of omics (NL) and biology (Chile) are highly interesting.
- The culture for research within INIA is very similar to that within WUR/DLO. There is already a lot of interaction with local industry and INIA is already familiar with

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working in multi-partner consortia of both Academic and Industrial partners. In this regard the situation in Chile is roughly equivalent to the situation in the Netherlands regarding Public-Private partnerships such as CBSG and TTI-Green Genetics. Both strategic as well as fundamental research are the norm.

- It became clear that there are opportunities for collaboration not only regarding research but also regarding education. For example, Chile currently misses a full undergraduate programme aimed at traditional breeding (molecular breeding is however, well represented.) This offers opportunities for WU to accept Chilean BSc / MSc students for supplementary education modules linking in to the WU system.
- In the field of bioinformatics, student exchange might also be a highly interesting option to investigate
- There are many areas for collaboration – those listed below were considered to be initially the most promising. At the end of the document is a list of identified project ideas for initial collaboration.

Key areas of collaboration to be given highest priority in any possible follow-up action:

- Bioinformatics and biostatistics / qualitative genetics – there is a need from both sides for suitable trained people. Possible links to Biometris (a Business unit of Wageningen UR specically focussing on biostatistics) are of interest regarding biostatistics in general, multi-variate analyses and GxE expertise
- Opportunities for crop transformation and particularly applying cis-genesis methodology particularly for vegetatively propagated crops such as apple, peach and grape.
- Metabolomics for fruit (grape) quality (pre-harvest and post harvest)
- Genetics and physiology of abiotic stress in crops (light, cold, heat and drought)

Action points:

1. Robert Hall and Manuel Pinto to complete the report for NL / Chile
2. Ton den Nijs to keep INIA contacts informed about the developments in the Chilean/Dutch bilateral broad expert group which should draw up the general collaborative plan.
3. Ton den Nijs to send info to INIA contacts on possibilities for Chilean students to enroll in MS courses Plant Breeding (already done).

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4. Maria Theresa Pino to send the english version of the Inova Chile/Corfo program to Ton den Nijs (already done).
5. Maria Theresa Pino with Manuel Pinto to collate proposals for abiotic stress tolerance research and send them to Ton den Nijs, including temporary staff exchanges in the Becas Chile program. (already done)
6. Manuel Pinto to meet with with people from the Programme of human resources of CONICYT and inform on the possibilities they have for funding exchanges of scientists and students (already done)
7. Manuel Pinto to contact Gerard van der Linden, group leader Abiotic stress tolerance in WUR Plant Breeding (already done - no response yet).
8. Potato Genome Sequencing Consortium, including Chilean and dutch partners to meet and decide on strategy (Boris Sagredo).
9. Ton den Nijs to link up with Univiveros (Luis Fernandez) to explore possible Public/Private binational program for pome and stonefruit breeding, involving also dutch company Inova Fruit. (Already done: preliminary plan for a visit to Chile by director of Inova Fruit and Ton den Nijs in February 2010.)
10. Carlos Muñoz to explore possibilities for cooperation in quinoa-breeding and genetics as an alternative, non-coeliaky cereal crop.
11. Carlos Muñoz and Ton den Nijs to exchange ideas about exploration of Chiles natural biodiversity for novel crop development.
12. Carlos Muñoz and Humberto Prieto to explore possibilities of interaction on the field of cisgenesis with WUR, particularly for apple, stone fruits and grapevine
13. Manuel Pinto to keep WUR contacts informed about actions in Chile concerning developments in the Chilean/Dutch bilateral cooperation. At this respect Dr. Jos Van der Vooren from the Latino office of WUR and Federico Vossenaar from the Agriculture Ministry of Netherland last 22 – 23 June, visited INIA and the Chilean Agriculture Ministry. During their visit, there was the formation of a working group which should draw up a general collaborative plan. This working group was formed with the representatives from both Agric. Ministeries (Chile and Netherland), Conicyt, Wageningen University, University of Chile, Catholic University and INIA.
14. Manuel Pinto to organize a visit of the Chilean group to Wageningen by the end of October 2009.

Project title / topic	Chile contact	Dutch contact	2 sentence outline
To apply metabolomics to mining in order to optimize the industrial process for the monitoring, biomass production and bioleaching of low grade sulfured ore.	Andrés Aravena	Robert Hall	To establish a metabolomics lab for application in biomining and establish suitable technology applications through intergroup training
Metabolomics of table grape	Manuel Pinto	Robert Hall	Apply metabolomics approaches to study table grape quality, perform phenotyping and investigate biochemical profile / quality changes following genetic / environmental perturbation.
Transcriptomic evaluation of grapevine berries during development and under different conditions	Patricio Hinrichsen and Mauricio González	To be decided	
Cis-genesis	Humberto Prieto and Carlos Muñoz	Ton den Nijs	To use cisgenesis as a technique to introduce desired characters in fruit crops particularly in apple, stone-fruit and grapevine
Post Harvest in Fruit and vegetables	Bruno Defilppi	To be decided	To test in Chile proven technologies and post-harvest systems developed by WUR that could have an immediate impact on the current export chain in Chile. To test relevant post-harvest technologies and to address key problems in the export chain, particularly those related to long transport distances.
Breeding for abiotic stress in potato and pepper	María Teresa Pino	G. van der Linden	To contribute to the better understanding of the physiological and genetics mechanisms underlying the tolerance to drought and low temperature in potato and pepper
Anoxia and salt stress in stone fruit rootstocks	Manuel Pinto	G. van der Linden	To use the physiological and genomics approach to study mechanisms and genes controlling tolerance to salt and anoxia stress in rootstock varieties of Cherry and Peach.
Breeding in new crops	Carlos Muñoz	Ton den Nijs	Cooperation in quinoa-breeding and genetics as an alternative as non-coeliac cereal crop and to explore of Chiles natural biodiversity for novel crop development.
Value chain development	Edmundo Acevedo	Siert Wiersema	to use the value chain approach to identify key bottlenecks and research priorities on selected crops
Education and Training	Edmundo Acevedo/M. Pinto	Ton den Nijs / Richard Visser	to establish a collaboration between INIA -Univ.of Chile and WUR for training and education in horts and omics sciences. This collaboration will be partially developed

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			in the frame of the new Centre for Advances Studies in HortScience (CEAF)
Biotech options for speeding up apple breeding	Carlos Muñoz/ Manuel Pinto	Ton den Nijs	Apply cisgenesis for quickly improving existing apple cvs.
Bioinformatic and Biostatistics	Nilo Mejia and Andrés Aravena	Ham, Roeland van	Bioinformatics and systems approaches omics data integration in grape vine
Bioinformatic and Biostatistics	Nilo Mejia and Andrés Aravena	Ham, Roeland van	Mass spectrometry data processing and management
Bioinformatic and Biostatistics	Nilo Mejia and Andrés Aravena	Ham, Roeland van	Automation of genome annotation through workflow management and deployment of webservice
Bioinformatic and Biostatistics	Nilo Mejia and Andrés Aravena	Ham, Roeland van	Next generation sequencing technology for genome sequencing, SNP discovery and gene expression analysis in grape vine

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Observations and outcomes: Post-harvest

Unit at INIA-La Platina (Santiago)

The Unit operates with 5 scientists. Head of the unit is Dr Bruno Defilippi with a PhD from University of Davis, California. In addition, the unit works with about 15 additional persons, including chemists, technicians and students.

The laboratory seems well equipped and maintained.

Research concentrates on fresh commodities with emphasis on:

- post-harvest physiology and technology
- flavor quality in fruits
- ethylene biosynthesis and perception
- control of physiological disorders in temperate and subtropical fruits under long term storage, particularly stone fruit, table grapes, kiwi fruit and avocado
- controlled and modified atmosphere in fresh commodities
- sensory analysis of fruits
- fruit breeding for flavor characteristics

Due to long distances of production sites to consumer markets, post-harvest quality aspects related to taste and flavor of fruits receives much attention in the research programme. Another aspect of long transport distances to consumers is that fruits have to be harvested early resulting in irregular maturity with large differences in maturity between individual fruits. This is particularly a problem in Kiwi fruit.

Post-harvest research is financed for 70 % by the state and for 30 % by private companies. Particularly export companies are interested in contract research.

The Unit works together with University of Chile and two other smaller post harvest groups.

Field visits (Wednesday 19 May)

Visits were made to a tomato grower, a plant nursery, a packaging plant for apples, kiwis etc, and a farmers cooperative.

The **tomato grower** had two ha of rustic greenhouses covered with plastic. Plastic has to be changed every three years, tomatoes are grown in field soil in stead of substrate, and pest management is relatively poor. The system is somewhere in between a modern greenhouse and the open field. However, this structure permits two crops per year which makes it more profitable than field production of tomatoes. Apparently, low tomato prices do not permit investment in better quality greenhouses.

The **nursery** (Los Olmos in San Fernando) has some 7 ha under greenhouses, most of which are locally constructed. With a total production of 180 million plants per year, this is one of the largest nurseries in Chile. Plants include fruits (kiwi, table grapes,

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stone fruits, apple), horticultural crops (onion, lettuce, etc.) and a small amount of tree crops for forestry.

Many plant species are multiplied under license agreement with the (foreign) breeder and owner of the variety. It is the aim of the company to work in a consortium to develop their own varieties and become more independent of foreign varieties, particularly in fruit species.

The **packaging plant** (FRUSAN) is a fully equipped and modern plant that receives apples and kiwis from a large number of producers. The company washes and packs the produce and takes care of the export procedures. The company is Global GAP certified and assists their member producers to become certified producers. FRUSAN is directly involved in transfer of technology to their growers and suppliers of the packaging plant.

The **cooperative** COPEVAL is now a commercial company providing inputs to many farmers in Chile. COPEVAL has also a division involved in transfer of technology that organizes field days and seminars with lecturers from INIA and Universities. Also, study tours to Europe and USA are organized.

Observations and comments

Following are some general observations aimed at broadening the cooperation Chile-NL.

- a) Variety development receives major emphasis in Chile. INIA considers development of genomics and bioinformatics as the winning strategy for the mid and long term. For the short term, however, there are many opportunities to take advantage of proven technologies in production and post-harvest systems developed by WUR and their partners that could have an immediate impact on the current export chain in Chile. Pilot testing of relevant post-harvest technologies to address key problems in the export chain, particularly those related to long transport distances, may be included in the overall cooperation Chile-WUR.
- b) We recommend linkage between the INIA post-harvest Unit and A&F Science Group of Wageningen UR to work out areas of cooperation.
- c) The breeding efforts by private companies (nurseries) in Chile is a promising development that may be included in the plans for cooperation.
- d) Transfer of technology and capacity building for different target groups might be complementary to the proposed research cooperation and might be included in the work plans.
- e) Value chain development has become subject of major research projects and PhD studies at Wageningen UR. Value chain studies on selected commodities would be a good instrument to identify key bottlenecks and redefine research priorities.

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Appendix

Background information sources WUR / PRI delegation

Dr Robert Hall (PhD Edinburgh, 1984) has ca 25 years research experience. He has held posts as Cluster Leader and Head of Department in various fields of cell and molecular biology. He currently holds the following posts: Cluster Leader Metabolic Regulation within Plant Research International and Acting Director of the Netherlands Centre of Biosystems Genomics. He is also on the Management Board of the Netherlands Metabolomics Centre. He is on the Editorial Boards of J Plant Physiology, Molecular Biotechnology and is Associate Editor of the journal Metabolomics. He is a Member of Board of Directors (Secretary) of the International Metabolomics Society. He has ca100 publications of which ca. 75% are in peer-reviewed journals. His primary research activities are centred on functional genomics and developing metabolomics technologies for application in plants for both science and industry. He is also Coordinator of the EU project META-PHOR which started in October, 2006 and which is focused on developing novel metabolomics technologies and bioinformatics strategies for plants.

Key References

1. FITZGERALD, M.E., McCOUCH, S., HALL, R.D. (2009) More than a grain of rice: the quest for quality. **Trends In Plant Science** 14: 133-138
2. Butelli, E., Titta, L., Georgio, M., Mock, H-P., Matros, A., Peterek, S., Schijlen, E.G.W.M., Hall, R.D., Bovy, A.G., Martin, C.A. (2008) Induced anthocyanin biosynthesis in purple fruit with enhanced antioxidant, dietary and health-inducing properties. **Nature Biotechnology** 26, 1301 – 1308
3. Keurentjes, J.J.B., Fu, Y, De Vos C.H.R., Lommen, A, Hall, R.D., Bino, R.J., Van Der Plas, L.H.W., Jansen R.C., Vreugdenhil, D, Koornneef, M. (2006). The genetics of plant metabolism. **Nature Genetics** 38, 842-849.
4. Rein, D., Schijlen, E.G.W.M., Kooistra, T., Herbers, K., Verschuren, L., Hall, R.D., Sonnewald, U., Kleeman, R. (2006) Tomato intake reduces markers of cardiovascular risk in human CRP transgenic mice: Additional benefits from transgenic flavonoid tomato. **The Journal of Nutrition** 136 :2331-2337
5. Bovy, A., Schijlen, E.G.W.M., Hall, R.D. (2007). Metabolic engineering of flavonoids in tomato (*Solanum lycopersicum*): the potential for metabolomics. **Metabolomics** 3: 399-412
6. Mihaleva, V.V., Verhoeven, H.A., De Vos, C.H.R., Hall, R.D., Van Ham, R.C.H.J. (2009) Automated procedure for automated candidate compound selection in GCMS metabolomics, based on prediction of Kovats retention index. **Bioinformatics** 25: 787-794.

For more details see:

<http://www.pri.wur.nl/UK/research/research+themes/Food+and+health/Metabolomics/>
<http://www.cbsg.nl>

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Dr Ton den Nijs:

Manager Business Unit Biodiversity and Breeding at Plant Research International.

Expertise within the group: traditional and molecular breeding, biotechnology, (Alternative) GM technologies; Molecular markers; breeding for abiotic / biotic stress, yield and quality.

For more details see:

<http://www.pri.wur.nl/UK/research/biodiversity/>

http://www.plantbreeding.wur.nl/UK/research_groups.html

Dr Roeland van Ham:

Group Leader Applied Bioinformatics (PRI) and Senior Lecturer (W University).

Expertises within the group: (Full) genome sequencing / assembly / annotation; Next generation sequencing; databasing / data analysis pipelines (proteomics / metabolomics); algorithm design / software design / general programming

For more details see:

<http://www.pri.wur.nl/UK/research/research+facilities/Wageningen+Genomics+Facility/Bioinformatics>

<http://www.bioinformatics.nl/>

Dr Siert Wiersema:

Senior advisor supply chain development, potato expert and coordinator capacity development projects in horticulture at Wageningen International, Wageningen UR.

For more details on Wageningen International see: www.wi.wur.nl

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Background information sources Chilean delegation

Carlos Munoz

A. Personal Information

LAST NAME	SECOND LAST NAME	FIRST AND MIDDLE NAMES
Muñoz	Schick	Carlos Esteban

RUT	DATE OF BIRTH (DD/MM/YYYY)	SEX (M OR F)	NATIONALITY
4.857.095-K	06/01/1948	M	Chileno

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INSTITUTION AND POSITION (In the case of a University, indicate Faculty, School, Department, etc.)
Researcher at the Breeding and Biotechnology Department, La Platina Regional Research Center (CRH-La Platina), Chilean Institute for Agricultural Research (INIA).

POSITION AT THE CENTER
Researcher

B. Academic Formation

ACADEMIC DEGREES AND PROFESSIONAL STUDIES	UNIVERSITY	COUNTRY	YEAR
Professional Titles			
Ingeniero Agrónomo	University of Chile	Chile	1971
Academic Degrees			
Master of Science	University of Florida	USA	1982
Doctor of Philosophy	University of Florida	USA	1984

C. Academic and Work Activities

POSITION	INSTITUTION (indicate university, faculty, school, department)	TYPE OF CONTRACT	HOURS PER WEEK
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Researcher	Chilean Institute for Agricultural Research (INIA)	Permanent	44
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D. Research lines

Fruit Breeding , Genetic Resources, Marker assisted selection

E. Publications

BARTICEVIC, M.; K. ZAVALA; S. DE FELICE; J. VALENZUELA; **C. MUÑOZ**, P. *HINRICHSEN* R. 2004.

Caracterización fenotípica de segregantes identificados con marcadores de microsatélites, con énfasis en apirenia y respuesta a ácido giberélico en crecimiento de bayas de uva. *Agricultura Técnica* 64(1):3-16. (ISI)

HINRICHSEN, P., REYES, M.A., CASTRO, A., BLANCHARD, E., ARAYA, S., GARNIER, M., REYES, F., DELL'ORTO, P., MOYNIHAN, M., *PRIETO, H.* and **MUÑOZ, C.** 2005. Genetic transformation of grapevines with *Trichoderma harzianum* and antimicrobial peptide genes for improvement of fungal tolerance. *Acta Horticulturae* 689:469-474. (SCIELO)

HEWSTONE, N.; J. VALENZUELA Y **C. MUÑOZ**. 2006. Efecto de la variedad en el desarrollo de embriones in vitro de vides estenospermocárpicas. *Agric. Téc. (Chile)* 66(2):124-131. (ISI)

HINRICHSEN, P., HEWSTONE, N., VALENZUELA, J., *PRIETO, H.* y **MUÑOZ, C.** 2006. Mejora de la Calidad en Uva de Mesa. Capítulo 20 en "Mejora Genética de la Calidad", M.J. Díez, J.M. Carrillo M.L. Badenes y G. Llácer, (Eds.) Sociedad Española de Genética y Mejoramiento.

SALAZAR, E., LEÓN, P., ROSAS, M. y **MUÑOZ, C.** 2006. Estado de conservación ex situ de los recursos filogenéticos cultivados y silvestres en Chile. Santiago de Chile, Instituto de Investigaciones Agropecuarias. Boletín INIA Nº 156, 180p.

MUÑOZ, C. 2007. Asociaciones empresariales para el desarrollo tecnológico de la fruticultura Chilena. pp183-191. En: Lionel Gil y Marta Adonis (Eds.), *Gestión, Innovación y Comercialización en Biotecnología*. Editorial Universitaria, 290p. ISBN 978-956-11-1956-7.

MEJÍA, N., GEBAUER, M., MUÑOZ, L., HEWSTONE, N., **MUÑOZ, C.** and *HINRICHSEN, P.* 2007. Identification of QTLs for seedlessness, berry size and ripening date in a seedless x seedless table grape progeny. *Amer.J.Enol.Vitic.* 58:499-507. (ISI)

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Manuel Pinto Contreras

A. Personal Information

LAST NAME	SECOND LAST NAME	FIRST AND MIDDLE NAMES	
PINTO	CONTRERAS	MANUEL - ENRIQUE	
RUT	DATE OF BIRTH (DD/MM/YYYY)	SEX (M OR F)	NATIONALITY
6205819-6	16/06/1949	M	CHILEAN

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INSTRITUTO DE INVESTIGACIONES AGROPECUARIAS, CENTRO "LA PLATINA", DEPARATAMENTO DE MEJORAMIENTO GENETICO Y BIOTECNOLOGIA	

POSITION AT THE CENTER
RESEARCHER

This field is only for the Director of the Center. (maximum 1 page)

B. Academic Formation

TITLES AND DEGRESS	INSTITUTION	COUNTRY	YEAR
B. Sc.	Univ. of Chile	Chile	1972
Agronomist	Univ. of Chile	Chile	1973
M.Sc.	Univ. of Chile	Chile	1975
Dr.	Inst. Nat. Agronomique, Paris	France	1981

C. Academic and Work Activities

POSITION	INSTITUTION	TYPE OF CONTRACT	HRS/WEEK
Researcher	Universidad del Norte (1974 – 1976)	Permanent	44
Assistant Professor	Universidad de Chile (1976- 1987)	Permanent	44
Associated Professor	Universidad de Chile (1987- 2007)	Permanent	44

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Associated Professor	Universidad de Chile (1987- 2007)	Part time	10
Researcher	Instituto de Investigaciones Agropecuarias (INIA)	Permanent	44

D. Research lines

Plant Physiology: abiotic stress, plant growth regulation, photosynthesis,

E. Publications (last 5 years)

Journals

Author(s) and	Publication title	Journals
Horton P., Pinto M & Murchie E.,. 2009.-	Energy, Agriculture and the new chalanges for Photosynthesis Research	New Phytologist, 181: 532 – 552, 2009
Cardemil, L., Pinto, M. & Delatorre, J. 2008.-	Effects of water stress and high temperature on photosynthesis rate of two species of Prosopis	J. Photochem & Photobiol 92: 67 – 76, 2008
Analía Espinoza, Ramón Pérez, Carlos Aguirre David Contreras, Marcelo Orellana, Álvaro Castro, Patricio Hinrichsen, Alejandro Riquelme, Tomás Fichet and Manuel Pinto	Modulation by Gibberellic Acid of Aquaporin Genes Expression during Berry Development of Grapevine (<i>Vitis vinifera</i> L.)	Acta Horticulturae ,(in press) 2008
Ramón Pérez, Analía Espinoza, Carlos Aguirre Patricio Hinrichsen David Contreras, Marcelo Orellana, Alejandro Riquelme, Tomas Fichet and Manuel Pinto	Functional Genomic Analysis of Table Grape (<i>Vitis vinifera</i> L.) Associated to Gibberellic Acid Treatment	Acta Horticulturae(in press) , 2008
Alejandro Riquelme, Eckard Wellman and Manuel Pinto , 2007.-	Effects of ultraviolet-B radiation on common bean (<i>Phaseolus vulgaris</i> L.) plants grown under nitrogen deficiency.	Environmental and Experimental Botany 60 (3):360-367, 2007
Martínez J.P., Silva H., Lundent J.F. and Pinto M. 2007.-	Effect of drought stress on the osmotic adjustment, cell wall elasticity and cell volume of six cultivars of common beans (<i>Phaseolus vulgaris</i> L.) Ref.:	European Journal of Agronomy 26 (1):30 -38, 2007
Carolina Lizana ¹ , Mark Wentworth ² , Juan P. Martinez ¹ , Daniel Villegas ¹ , Rodrigo Meneses ³ , Erik H. Murchie ² , Claudio Pastenes ¹ , Bartolomeo Lercari ⁴ , Paulo Vernieri ⁴ , Peter Horton ² and Manuel Pinto ¹ 2006.-	Differential adaptation of two varieties of common bean to abiotic stress. I. Effects of drought on yield and photosynthesis.	Journal of Experimental of Botany, 57 (3): 685 –697. 2006
Mark Wentworth ¹ , Erik H. Murchie ¹ , Julie E. Gray ¹ , Claudio Pastenes ² , Manuel Pinto ² and Peter Horton ¹ 2006.-	Differential adaptation of two varieties of common bean to abiotic stress. II. Acclimation of photosynthesis.	Journal of Experimental of Botany 57 (3): 699 –709. 2006

García de Cortazar V.,	Canopy structure and photosynthesis	Australian Journal of
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Córdova C., y Pinto M. 2005.-	modeling of grapevines cv Sultana conducted under overhead trellis system.	Viticulture and Enology, 11: 328-338. 2005
Hugo Peña-Cortés ¹ , Alvaro Cuadros ¹ , Tomas Fichet ² , Danilo González ³ , Enrique González ³ , Patricio Hinrichsen ⁵ , Matilde Jashes ⁴ , Manuel Pinto ² , Humberto Prieto ⁵ , Ingrid Ramírez ¹ , Alejandro Riquelme ² , Marlene Rosales ⁵ , Simón Ruiz ³ and Jorge Valdés ¹ . 2005.-	Chilean Effort for Improving Fruit Quality in Grapevine: A Genomic Approach to Understand Seed Formation, Fruit Ripening and Pathogen Response	Acta Horticulturae 689: 505-512. 2005
Pinto M. , Edwards G, Riquelme A. and Ku MSB. 2003.-	Enhancement of Nodulation in Bean (<i>Phaseolus vulgaris</i> L.) by Ultraviolet-B Irradiation.	Functional Plant Biology (29): 1189 – 1196. 2003

Book Chapters

Author(s) and title	City, year, page number
Lee A. Meisel, Daniela C. Urbina y Manuel Pinto 2008.- Fotorreceptores y respuestas de las plantas a señales lumínicas. In Fisiología Vegetal, Cardemil y Squeo (eds). (aceptado, en edición)	Santiago, Chile (in press),2008, 15 p
Pinto M. 2006.- Bioquímica de la producción de biocombustibles. In: Acevedo E. (Ed) Bioenergía, una alternativa para Chile	Santiago, Chile, 2006, 20 p
Pinto M. , y Acevedo E. 2006.- Cultivos Bioenergéticos. In: Acevedo E. (Ed) Bioenergía, una alternativa para Chile.	Santiago, 2006, 20 p
Pinto M. y Lizana C. 2004- Respuestas y Mecanismos de Protección en Plantas a la Radiación Ultravioleta–B In: Fisiológica Ecológica en Plantas Merino H. (ed.)	Ediciones Universitarias de Valparaiso, Pontificia Univ. Católica de Valparaiso, Chile, 2004
Pinto M. , y Riquelme A. 2003.- Fotosíntesis, In: Riquelme A. y Galleguillos M. (eds.), Bioenergética y Organelos.	Material Multimedia en Disco Compacto, Proyecto Mecesup, Campus Sur Univ. de Chile, 180 p
Gonzalez E. y Pinto M. 2003 .- Bioenergética, In: Riquelme A y Galleguillos M (eds.)Bioenergética y Organelos.	Material Multimedia en Disco Compacto, Proyecto Mecesup, Campus Sur Univ. de Chile, 180 p

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EDUCATION

Degree	Discipline	Institution	Country	Date
Ph.D	Horticulture-Plant Physiology	Oregon State University	USA	2006
B.Sc. (Agr.)	Agronomy	Universidad de la Frontera	Chile	1993

RESEARCH EXPERIENCE

Position	Institution	Period
Research Scientist, Biotechnology & Plant stress Physiology	Institute of Agricultural Research of Chile (INIA)	1993 to present

RELEVANT PUBLICATIONS (2006 -up)

María-Teresa Pino, Jeffrey S. Skinner, Guo X, Zoran Jeknić, Patrick M. Hayes, Michael F. Thomashow, and Tony H.H. Chen (2008) Differential over expression effects of three Arabidopsis CBFs on freezing tolerance and cold acclimation capacity of *Solanum commersonii*, a hardy and cold acclimation-competent species. *Journal of Experimental Botany (JEXBOT/2008/030916)*.

María-Teresa Pino, Jeffrey S. Skinner, Zoran Jeknić, Patrick M. Hayes, Alfred H. Soeldner, Michael F. Thomashow, and Tony H.H. Chen (2008) Ectopic AtCBF1 over-expression enhances freezing tolerance and induces cold acclimation- associated physiological modifications in potato. *Plant Cell & Environment* **31:393-406**.

María-Teresa Pino, Jeffrey S. Skinner, Eung-Jun Park, Zoran Jekniæ, Patrick M. Hayes, Michael F. Thomashow, and Tony H.H. Chen (2007). Use of a stress inducible promoter to drive ectopic *atcbf* expression improves potato freezing tolerance while minimizing negative effects on tuber yield. *Plant Biotechnology Journal* **5**, 591–604.

Eung-Jun Park, Zoran Jekni, **María-Teresa Pino**, Norio Murata, and Tony Hwei-Hwang Chen (2007). Glycinebetaine accumulation is more effective in chloroplasts than in the cytosol for protecting transgenic tomato plants against abiotic stress. *Plant, Cell and Environment* **30**, 994–1005.

Carvallo, M., **Pino, MT.**, Skinner, J., Wilkerson, C., Chen, T., and Thomashow, M.F (2006) Conservation of the cold-responsive pathway in freezing sensitive and freezing tolerant solanaceous plants. Poster: Temperature responses in APBS meeting, Boston, Massachusetts August 5-9

Pino, M.T., J. S. Skinner, Z. Jeknić, E.J. Park, P.M. Hayes, and T.H.H. Chen. (2006) Chapter 8: Ectopic Overexpression of AtCBF1 in Potato Enhances Freezing Tolerance. In: T.H.H. Chen, M. Uemura, and S. Fujikawa (Eds.), *Cold Hardiness in Plants: Molecular Genetics, Cell Biology, and Physiology*. CABI International, Oxon, UK. Page 103- 123.

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Resent Congress

Carvallo, Marcela., Zou, Cheng., **Pino, M.T.**, Jeknic, Z., Shiu, S., Chen, Thomashow, M.F. 2008. Conservation of the cold-responsive pathway in freezing sensitive and freezing tolerant Solanum plants. Poster: 19th New Phytologist Symposium Physiological sculpture of plants: new visions and capabilities for crop development. Timberline Lodge, Mount Hood, Oregon, USA. September 17-20. Pag31.

Carvallo, M., **Pino, MT.**, Skinner,J., Jeknić, Z., Shiu, S., Chen, T., and Thomashow, M.F. (2007). Conservation of the cold- and CBF-transcriptomes in Arabidopsis and Solanum species. Poster: Gordon Research Conferences: Temperature Stress In Plants. Four Points Sheraton: Harbortown Ventura, CA. January 21-26.

Patricio Hinrichsen Ramírez

A. Personal Information

LAST NAME	SECOND LAST NAME	FIRST AND MIDDLE NAMES
HINRICHSEN	RAMÍREZ	PATRICIO VICENTE

RUT	DATE OF BIRTH (DD/MM/YYYY)	SEX (M OR F)	NATIONALITY
8.939.396-5	27/01/1961	M	Chilean

ADDRESS (for correspondence)
Santa Rosa 11.610

REGION	CITY	PROVINCE
RM	Santiago	La Pintana

E-MAIL ADDRESS	TELEPHONE NUMBERS (Indicate area code)
phinrichsen@inia.cl	(02) 757 5110

INSTITUTION AND POSITION (In the case of a University, indicate Faculty, School, Department, etc.)
Researcher at the Breeding and Biotechnology Department, La Platina Research Center (CRI-La Platina), Chilean Institute for Agricultural Research (INIA).

POSITION AT THE CENTER
Researcher, Head of Molecular Genetics Group.

B. Academic Formation

ACADEMIC DEGREES AND PROFESSIONAL STUDIES	UNIVERSITY	COUNTRY	YEAR
Professional Titles			

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Biochemist	Universidad de Concepción	Chile	1985
Academic Degrees			
BA Biochemistry	Universidad de Concepción	Chile	1983
Doctor in Biological Sciences	P. Catholic University	Chile	1993

C. Academic and Work Activities

POSITION	INSTITUTION <i>(indicate university, faculty, school, department)</i>	TYPE OF CONTRACT	HOURS PER WEEK
Researcher	Chilean Institute for Agricultural Research (INIA)	Permanent staff	44
Assistant Professor	Universidad de Chile, Faculty of Agronomy	Ad honorem	ND

D. Research lines

Genetics and genomics on fruit crops and other species of agronomical interest
Agricultural Biotechnology
Plant & microbial gene expression

E. Publications

- * Mejía, N., Soto, B., Guerrero, M., Rojas, G., Le Cunff, L., Boursiquot, J.-M., Adam-Blondon, A.-F. & **Hinrichsen, P.** Integration of genomic tools with QTL approaches to accelerate the identification of a major gene involved into grapevine seed and berry development. BMC Plant Biology, submitted may 2008, ID 1601638513201074.
- * Araya, S., Prieto, H. and **Hinrichsen, P.** An efficient buds culture method for the regeneration via somatic embryogenesis of table grapes cvs. Red Globe and Flame Seedless. Vitis 2008, in press.
- Arnao, E., Jayaro, Y., **Hinrichsen, P.**, Ramis, C., Marín, C. & Pérez-Almeida, I. Marcadores AFLP en la evaluación de la diversidad genética de variedades y líneas élites de arroz en Venezuela. Interciencia 2008, 33:359-364.
- Fuentes, F.F., Martínez, E.A., **Hinrichsen, P.**, Jellen, E.R. and Maughan, P.J. Assessment of genetic diversity patterns in Chilean quinoa (*Chenopodium quinoa* Willd.) germplasm using multiplex fluorescent microsatellite markers. Conservation Genetics 2008, DOI 10.1007/s10592-008-9604-3.
- Moncada, X. and **Hinrichsen, P.** Limited genetic diversity among clones of red wine cultivar 'Carmenère' as revealed by microsatellite and AFLP markers. Vitis 2007, 46:174-180.
- * Mejía, N., Gebauer, M., Muñoz, L., Hewstone, N., Muñoz, C. and **Hinrichsen, P.** Identification of QTLs for seedlessness, berry size and ripening date in a seedless x seedless table grape progeny. Amer. J. Enol. Vitic. 2007, 58:499-507.
- Milla-Tapia, A., Cabezas, J.A., Cabello, F., Lacombe, T., Martínez-Zapater, J.M., **Hinrichsen, P.** & **Cervera, M.T.** Determining the Spanish origin of representative ancient American grapevine varieties. Amer. J. Enol. Vitic. 2007, 58:242-251.
- * Costantini, L. Grando, M.S., Feingold, S., Ulanovsky, S., Mejía, N., Hinrichsen, P., Doligez, A., This, P., Cabezas, J.A. & **Martínez-Zapater, J.M.** Generation of a common set of mapping markers to assist table grape breeding. Amer. J. Enol. Vitic. 2007, 58: 102-111.
- Moncada, X., Pelsy, F., Merdinoglu, D. and **Hinrichsen, P.** Genetic diversity and geographical dispersal in grapevine clones revealed by microsatellite markers. Genome 2006, 49:1459-1472.
- Aguirre, C., Alvarado, R. e **Hinrichsen, P.** Identificación de variedades y líneas de mejoramiento de arroz de Chile mediante análisis de fragmentos de ADN de largo variable amplificados por PCR (AFLP). Chilean Jour Agric Sci 2006, 65:356-369.

- González-Techera, A., Jubany, S., Ponce de León, I., Boido, E., Dellacasa, E., Carrau, F.M., Hinrichsen, P. & **Gaggero, C.** Molecular diversity within clones of cv. Tannat (*Vitis vinifera*). *Vitis* 2004, 43:179-186.
- * Barticevic, M., Zavala, K., De Felice, S., Valenzuela, C., Muñoz, C. e **Hinrichsen, P.** Caracterización fenotípica de segregantes identificados con marcadores de microsatélites, con énfasis en apirenia y respuesta a ácido giberélico en crecimiento de bayas de uva. *Chilean Jour Agric Sci* 2004, 64:3-16.
- * Gebauer, M., Mejía, N., Muñoz, L., Hewstone, N. and **Hinrichsen, P.** A genetic linkage map of seedless table grapes (*Vitis vinifera* L.) developed for the analysis of seedlessness and fruit quality QTLs. *Acta Hortic.*, in press.
- * Pérez, R. Espinoza, A., Aguirre, C., Contreras, D., Orellana, D., Riquelme, A., Fichet, T., Pinto, M. and **Hinrichsen, P.** Functional genomic analysis of table grape (*Vitis vinifera* L.) associated to gibberellic acid treatment. *Acta Hortic.*, in press.
- * Espinoza, A., Pérez, R., Aguirre, C., Contreras, D., Orellana, M., Castro, A., Riquelme, A., Fichet, T., Pinto, M. and **Hinrichsen, P.** Modulation by gibberellic acid of aquaporin genes expression during berry development of grapevine (*Vitis vinifera* L.). *Acta Hortic.*, in press.
- * Peña-Cortés, H., Fichet, T., González, D., González, E., **Hinrichsen, P.**, Jashes, M., Pinto, M., Prieto, H., Riquelme, A., Rosales, M., Ruiz, S. and Valdés, J. Chilean effort for improving fruit quality in grapevine: A genomic approach to understand seed formation, fruit ripening and pathogen response. *Acta Hortic.* 2005, 689:505-512.
- * Mejía, N. & **Hinrichsen, P.** A new, highly assertive SCAR marker potentially useful to assist selection for seedlessness in table grape breeding programmes. *Acta Hortic.* 2003, 603:559-664.

Book Chapters

- Hinrichsen, P.** 2008. "Estado del arte en el desarrollo de productos transgénicos en Chile, con énfasis en plantas de valor agrícola", p. 181-193. In "Seminario Internacional sobre organismos genéticamente modificados (GMOs) y el mercado europeo". Ed., Depto. Laboratorios y Estaciones Cuarentarias Agrícolas y Pecuarias, SAG. Santiago, Chile. November 2006.
- Hinrichsen, P.**, Hewstone, N., Valenzuela, J., Prieto, H. y Muñoz, C. (2006). "Mejora de la calidad de la uva de mesa", p. 497-522. In "Mejora genética de la calidad en plantas". Llácer, G., Díez, M.J., Carrillo, J.M. y Badenes, M.L., eds. Soc. Española de Ciencias Hortícolas, Soc. Española de Genética & Univ. Politécnica de Valencia. Valencia, Spain. September 2006.
- Hinrichsen, P.**, Moncada, X., Muñoz, L & Merdinoglu, D. (2003). „Clonal diversity of cv. Cabernet Sauvignon using molecular markers". p 6-9. Lonvaud-Funel, A., de Revel, G., et Darriet, P., Eds. *Oenologie* 2003. 7th Intl. Symp. Oenology. Bordeaux, France. July 2003.

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Mauricio González Agüero

A. Personal Information

LAST NAME	SECOND LAST NAME	FIRST AND MIDDLE NAMES
GONZÁLEZ	AGÜERO	MAURICIO ALFREDO

RUT	DATE OF BIRTH (DD/MM/YYYY)	SEX (M OR F)	NATIONALITY
14.436.447-3	04/04/1976	M	CHILEAN

ADDRESS (for correspondence)
SANTA ROSA 11610, CASILLA 439-3,

REGION	CITY	PROVINCE
METROPOLITANA	SANTIAGO	LA PINTANA

E-MAIL ADDRESS	TELEPHONE NUMBERS (Indicate area code)
MAUGONZALEZ@INIA.CL	56 2 7575161

INSTITUTION AND POSITION (In the case of a University, indicate Faculty, School, Department, etc.)
AGRICULTURAL RESEARCH INSTITUTE (INIA-LA PLATINA)

POSITION AT THE CENTER
RESEARCHER

B. Academic Formation

ACADEMIC DEGREES AND PROFESSIONAL STUDIES	UNIVERSITY	COUNTRY	YEAR
Professional Titles			
INGENIERO EN BIOTECNOLOGÍA MOLECULAR (<i>SPANISH DEGREE</i>)	UNIVERSITY OF CHILE	CHILE	2002
Academic Degrees			
LICENCIADO EN INGENIERIA EN BIOTECNOLOGÍA MOLECULAR (<i>SPANISH DEGREE</i>)	UNIVERSITY OF CHILE	CHILE	2001
DOCTOR EN CIENCIAS SILVOAGROPECUARIAS Y VETERINARIAS (<i>SPANISH DEGREE</i>)	UNIVERSITY OF CHILE	CHILE	2006

C. Academic and Work Activities

POSITION	INSTITUTION (indicate university, faculty, school, department)	TYPE OF CONTRACT	HOURS PER WEEK
RESEARCHER	AGRICULTURAL RESEARCH INSTITUTE (INIA-LA PLATINA)	PERMANENT STAFF	44

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D. Research lines

POSTHARVEST PHYSIOLOGY AND BIOCHEMISTRY IN FRUIT CROPS.

MOLECULAR AND GENETICS ASPECTS OF FRUIT RIPENING.

E. Publications

* Defilippi, B.G., Manríquez, D., Luengwilai, K., **González-Agüero, M.** 2008. Aroma Volatiles: Biosynthesis and Mechanisms of Modulation during Fruit Development. *Advances in Botanical Research(Accepted)*.

* **González-Agüero, M.**, Troncoso, S., Gudenschwager, O., Campos-Vargas, R., Moya-León, M.A., Defilippi, B.G. 2008. Differential expression levels of aroma biosynthetic genes during ripening of apricot (*Prunus armeniaca* L). *Journal Plant Physiology and Biochemistry (Accepted)*

* **González-Agüero, M.**, Pavez, L., Ibáñez, F., Pacheco, I., Campos-Vargas, R., Meisel, L., Orellana, A., Retamales, J., Silva, H., González, M., Cambiazo, V. 2008. Identification of woolliness response genes in peach fruit after post-harvest treatments. *Journal of Experimental Botany* 59: 1973-1986.

* Prieto, H., Utz, D., Castro, A., Aguirre, C., **González-Agüero, M.**, Valdes, H., Cifuentes, N., Defilippi, B.G., Zamora, P., Zúñiga G., Campos-Vargas R. 2007. Browning in *Annona cherimola* Fruit: Role of a polyphenol oxidase (PPO) and characterization of a coding sequence of the enzyme. *Journal of Agricultural and Food Chemistry* 55: 9208-9218.

González-Agüero, M., Zuñiga, A., Pottstock, H., del Pozo, T., González M., Cambiazo, V. 2005. Identification of genes expressed during *Drosophila melanogaster* gastrulation by using subtractive hybridization. *Gene* 345(2): 213-224.

Tapia, L., **González-Agüero, M.**, Cisternas, M., Suazo, M., Cambiazo, V., Uauy R., González, M. 2004. Metallothionein is key for safe intracellular copper storage and cell survival at normal and supra-physiological exposure levels. *Biochemical J.* 378(2): 617-624.

Arredondo M., Cambiazo V., Tapia L., **González-Agüero M.**, Nunez M.T., Uauy R., Gonzalez M. 2004. Copper overload affects copper and iron metabolism in HepG2 cells. *Am. J. Physiol. Gastrointest. Liver Physiol.* 287(1): G27-32.

Andres Aravena:

Mathematical Engineer, Group Leader of Lab. of Bioinformatics and Mathematics of Genome at Center for Mathematical Modelling, Universidad de Chile. <http://www.cmm.uchile.cl/~genoma/>

Expertises:

Bacterial genome assembly and annotation, metabolic reconstruction, production and exploit of metabolic models, metabolic engineering analysis, metabolomic analysis based on mass spectrometry.

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DNA probe design for large scale bioidentification and metagenomic projects (PCR, qPCR, oligos for chips, etc). Statistical analysis for large-scale hybridizations (micro-arrays, bioidentification chips) and other experiments providing high loads of data.

Several years experience in producing tailored need solutions for data intensive projects in Biology and Genomics, relying essentially on open source software and standards.

Main experience on extremophile bacteria related to copper mining (www.biosigma.cl)