Capacity-building for human resources in biotechnology applied to fruit production in Chile

STRATEGY

ideaconsultora
INNOVACION PARA EL DESARROLLO AGRARIO

CONICYT
COMISIÓN NACIONAL DE INVESTIGACIÓN CIENTÍFICA Y TECNOLÓGICA

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Presentation

This Strategy seeks to foster the training of professionals in Chile specializing in biotechnology (on the master's degree, doctoral and postdoctoral levels) to play a leading role in supporting the development and incorporation of technology solutions for the different aspects of the national fruit industry.

The goal of this effort is to contribute to the capacity of the country's fruit sector to deal with the challenges of competitiveness that it currently faces, taking advantage of the multiple tools that modern biotechnology offers in such a way as to consolidate its presence in international markets and to consolidate the growth opportunities that are opened in current and new target markets.

The Strategy was drafted in the context of the Articulation Workshop "Training Advanced Human Capital in Fruit Growing Biotechnology," which the consulting firm Ideaconsultora Ltda. has been undertaking together with Universidad de Chile, Pontificia Universidad Catolica de Valparaiso and the Universidad de Talca since 2008, with financing from the CONICYT's Joint Research Program (Programa de Investigación Asociativa, PIA).

The general objective of the Articulation Workshop was to design, create and follow up on a national strategy, expressed as a Work Agenda that is aimed at "the development of human capacities in Chile specialized in biotechnology for a competitive fruit growing sector," and the implementation of an Articulation Program in the country with participation of scientists, technicians, academics, technology administrators and representatives of the business and public sectors, both domestic as well as foreign.

To this end, the methodology considered the following central aspects:

- Undertaking an assessment of the national university system's capacities to train advanced human capital in the area of biotechnology applied to the fruit growing industry (this assessment is published in an independent document that is complementary to this one)[1].

- The implementation of Articulation Workshops in zones around the country, with participation by Chilean and foreign specialists to identify advanced human

[1] "Formación de Capacidades Humanas en Biotecnología Aplicable a la Fruticultura en Chile: Diagnóstico". Santiago, Chile. Ideaconsultora/CONICYT, 2009.

capital requirements for fruit growing biotechnology from the scientific, academic, technology management, business, and public sectors and to create a strategy on that foundation aimed at overcoming the difficulties identified. These workshops included participation by researchers, academics and representatives of industry and the public sector, in this way ensuring the construction of an agenda that represents the vision of all the people involved in the activity[2].

- The creation of a Public-Private Committee – supported by an International Advisory Council -- with the goal of jointly agreeing on a the Strategy and Work Agenda to be followed, as well as monitoring the progress made on the execution of this agenda. This Council was created with the highest-ranking representatives of the academic, business and public sectors with the objective of having them to contribute their knowledge, experience and diversity of perspectives needed to create the aforementioned strategy and agenda[3].

In addition, this initiative also received fundamental input and support from the three Regional Work Committees[4], that were created to implement this process and which cooperated in designing certain aspects of the assessment and the Articulation Workshops; in addition to a series of specialists in issues related to fruit growing and biotechnology, who were interviewed in depth to obtain their views on diverse aspects of these two sectors.

With the contributions that all of them made, this Strategy is designed to express the shared vision that the fruit industry, companies, universities and research centers and the public institutions involved all have regarding the initiatives that need to be undertaken to enable Chile to have specialized professionals capable of materializing the tremendous contribution that biotechnology can make to the development of an increasingly competitive fruit industry[5].

2 The participants in each Articulation Workshop are listed in Annex 3.
3 The members of the Public-Private Committee and the International Advisory Council are listed in Annex 4.
4 Their members are listed in Annex 2.
5 As background information to enable monitoring this strategy, more elements of the Startegy can be found on the site "Linneo, Observatory for Advanced Human Capital in the Fruit Biotechnology" (www.linneo.cl).

Contents of the document

As a result of the aforementioned process, the current document provides:

- As **Background** for the creation of the strategy:

  - A brief **description** of the contents of the assessment, which constitutes the context for the strategy (the results of the assessment itself will be presented in an independent document that is complementary to this one).

  - A description of the main **needs** that the fruit industry has to deal with in order to strengthen its competitiveness and which could be addressed with the application of biotechnology techniques.

  - Identification of the **skills** that the necessary advanced human capital must have in order to deal with the competitiveness needs presented.

- The **Strategy** as such, which gives a detailed description of the work guidelines and the actions that were identified as needed to promote the training of human capital with the aforementioned skills and to simultaneously favor the environmental conditions to make it possible for these specialists to make an effective contribution to the development of a more competitive fruit industry. Following this description, a schematic summary is offered (in Annex 1) outlining the work guidelines and actions that the Strategy is comprised of.

The purpose of the two complementary documents - Assessment and Strategy - as well as that of the Articulation Workshop is to contribute to training the professionals specializing in biotechnology and related areas. These documents reflect what the companies, universities, research centers, and public institutions in the country said they will require to materialize the contributions that biotechnology techniques can make to improve the competitiveness of the domestic fruit growing industry.

Contents

Background

1. Framework of the Strategy

This Strategy for training advanced human capital in biotechnology applicable to the national fruit industry is based on a diagnosis that --with national and international information-- would provide a vision of the fruit growing industry, the applications of biotechnology techniques to fruit industry, and the training of advanced human capital related to biotechnology applicable to this industry.

The results of the assessment in each of these areas are contained in an independent[6] publication that is complementary to this document and contains:

- An **international overview of strategies applied to strengthening advanced human capital in biotechnology applicable to the fruit industry**, including: :

  - A review of national and regional strategies designed to strengthen specialized human capacities in the area of biotechnology, mainly applied to fruit growing, with particular emphasis on evaluating the status of these strategies and the processes they involve to identify lessons to be learned in Chile.

  - A discussion of the main global trends and scenarios that are affecting or might affect fruit markets, to the extent that the development of human resources might require special adaptations.

  - Identification of the universities and research institutes outside Chile that could represent a significant resource for training Chilean professionals --currently or in the future-- in areas that are important to fruit growing biotechnology; stressing the considerations that are important for quality exchange programs that might be established now or in the future to provide a more ample range of possibilities for the development of human capital in this area.

This vision of the international scenario was undertaken by Fernando Quezada, executive director of the Biotechnology Center of Excellence Corporation (USA), based

[6] "Formación de Capacidades Humanas en Biotecnología Aplicable a la Fruticultura en Chile; Diagnóstico". Santiago, Chile. Ideaconsultora/CONICYT, 2009.

on the review of published reports, articles and other reference sources, in addition to personal experiences and telephone interviews with selected people in the countries being analyzed.

- An **assessment of the human capacities in biotechnology applicable to the fruit growing industry in Chile**, including:

  - An analysis of Chile's position in the world fruit growing context and a general overview of Chile's fruit growing sector in terms of plantations, production, exports and the members and structure of the fresh fruit cluster in Chile.

  - An assessment of the country's existing capacities in biotechnology applied to the fruit growing industry and associated areas in terms of research centers and companies, researchers and projects developed in the sector.

  - A general analysis of the training needs for advanced human capital in biotechnology for the development of a competitive national fruit growing industry.

  - Compilation of information on the policies that the country has implemented with regard to biotechnology and the training of advanced human capital.

  - An assessment of the financing programs available in the country to undertake advanced human capital training programs (that can be used for training in biotechnology applicable to fruit growing) and job placement specialists after their training.

  - An assessment of the training programs available in Chile for advanced human capital in biotechnology and associated areas applicable to the fruit growing industry. This assessment was based on the initial identification of a total of 100 training programs that -from diverse perspectives and disciplines- cover the development of skills, knowledge and technologies that in one way or another can be related to biotechnology with potential application to the fruit growing industry. Based on this universe, an in-depth analysis was undertaken of 25 programs that specifically focus on biotechnology as applicable to fruit growing, systematizing information that describes it in greater detail.

2. National fruit industry requirements that could be dealt with using biotechnology

Certain requirements were prioritized in the framework of this initiative for promoting the competitiveness of the domestic fruit industry. **The country needs to respond to these needs** by making specialized professional and technical capacities available in the following areas of biotechnology applications:

- Genetic improvement of fruit species and the development of new varieties adapted to local production, post-harvest, transformation, conservation, packing and transportation conditions (pome fruits, table grapes, berries, stone fruits, avocadoes, kiwis, nut fruits).

- Improvement of the capacity that fruit species produced in Chile have to resist pests and disease, their resistance to abiotic stress, the capacity to adapt to the conditions created by climate change, early selection and specialization according to agricultural, edaphoclimatic zone, expansion of production periods, and the improvement of functional properties, among others.

- Characterization, preservation, and genetic improvement of wild and native fruit species.

- Adding value to products in a healthy, sustainable way that is respectful of the environment, among others.

- Development of biotechnology solutions that reduce the fruit growing industry's environmental impact, especially in the use of chemical products, the generation of waste, and the use of energy in transportation. In addition, strengthening the capacity to generate and implement biotechnology solutions aimed at a more efficient use of energy throughout the entire value chain of the domestic fruit growing industry and reducing the carbon footprint that the activity generates.

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3. Human capital skills to deal with needs

In the context of the needs that have been identified, the skills required for the development of biotechnology to support the development of the fruit growing industry are mainly as follows:

- Professional human capital with advanced level expertise in different concepts and techniques related to biotechnology, which gain greater importance depending on the phase of the value chain where their application is needed.

  Thus, on the level of **genetic improvement** the need for specialists with adequate command over basic concepts of genetics, genetic improvement, genetic engineering, bioinformatics, functional genomics, markers, plant genetics, biotechnology tools, transgenics, nutritional genomics, functional composites, molecular biology, biochemistry, and physiology is prioritized, along with skills that can be adapted and applied to this productive chain, based on knowledge of molecular physiology and plant sciences.

  With regard to **nurseries**, specialists in molecular genetics are needed to identify the varieties that are registered, to undertake adaptability studies on patterns of resistance to pests and disease, to detect and clean viruses, and to develop phytopathogen' detection kits in nurseries, among others.

  Primary production also requires specialists with knowledge and management of biotechnological tools for the development of bioproducts, such as biopesticides, biofertilizers, among others, and to develop diagnostic kits for pests and diseases that can occur in this phase.

  In terms of **fruit processing**, specialists are needed who are capable of furthering the biotechnological development associated with the addition of value without the use of chemical products, the use of novel enzymes (for juices) and related bioprocesses, among others.

  As far as **preservation and packing** is concerned, there is a need for specialists with solid knowledge of post harvest enzymology and related biotechnology applications to shelf-life of fruits, nanotechnology uses for intelligent packing, and others.

  Other knowledge and skills that have been prioritized deal with risk management, information management, and knowledge management, in addition to agricultural marketing, and tracing techniques and procedures.

The requirements identified include a series of skills and abilities like flexibility and the capacity to adapt, the capacity to develop opportune responses to ongoing changes, the capacity to innovate and to generate new undertakings in fruit growing and to apply biotechnologies in the sector.

In this area, it is also included the capacity for teamwork and working in multidisciplinary groups that contribute to fostering the development of a research system in diverse areas of biotechnology to lay the foundation for generating knowledge and technologies that are applicable to the training system and at the same time capture the advanced human capital required to sustain a science and research platform that is competitive on an international level.

- Professional human capital specialized in regulatory and legal issues, regulatory management for biotechnological production, the adjustment of regulations to new technologies in fruit growing and biotechnology.

- Professional human capital specialized in entrepreneurial issues, intellectual property and in the management capacity of technology based companies.

- Professionals with a management capacity who can generate and lead processes of interaction between universities and companies, as well as between science and companies, so that universities (both in terms of teaching as well as research) can reflect the concerns and needs of the fruit growing industry and support the strengthening of research, development and innovation processes in companies, generating appropriate and opportune responses in productive and technological aspects and facilitating appropriate communication and information transfer.

- Professional human capital with advanced specialization and skills required transversally throughout the chain of value of the fruit growing industry and cluster as a whole. Within these types of skills and knowledge, priority has been given to skills that foster innovation, technological management, entrepreneurship, technology transfer, technology commercialization, intellectual property, patenting, bioethics, technological businesses, and biosafety (risk assessment and analysis).

Strategy

Strategy for training advanced human capital in biotechnology applied to the fruit industry

• Vision

A fruit industry under development with the support of existing and available professional and technical skills in the area of biotechnology on a national level, who will work in the business, research, teaching and state administration sectors.

• Mission

To have specialized professional and technical capacities available --both adequate and sufficient ones-- that are capable of developing technological responses or solutions based on biotechnology to cover the fruit industry's requirements.

• Objective

To promote the training of specialized professionals in the area of biotechnology on the master's degree, doctoral and postdoctoral levels with knowledge and skills that can be applied to the development and incorporation of technology solutions for the different components of the national fruit industry.

In this context, the specific objectives are aimed at:

- Creating incentives that promote the development of a process to specialize human capital driven by an alliance between the business sector, research and teaching centers, and the state, in which all of them play an active role.

- Shoring up the supply of specialization programs offered in the country and the research base that sustains them.

- Making the necessary tools available to take advantage of international specialization opportunities and offers that are of significant interest to Chilean professionals in the area of biotechnology that could be applied to the development of the national fruit industry.

- Concern for the employability of graduates in the areas of specialization that have been promoted, either in companies, research and teaching institutions or in the state administration.

- Creating incentives aimed at bringing foreign specialists to Chile to cover shortfalls that have been identified in the different work areas in the priority thematic issues.

- Actively promoting the strengthening of training in the area of biological sciences in elementary school, high school, and in vocational secondary schools.

- Fostering the creation and maintenance of spaces for encounter between the different actors in the education system, research and the fruit growing industry, both domestically as well as internationally, which allow the strategy to be followed up on and subjected to ongoing revision, as well as promoting new initiatives.

• Lines of action

The proposed initiatives --in a total of seven work guidelines-- are aimed at dealing with the proposed objective in an integrated and complementary fashion and via actions of diverse nature so as to cover the gaps in existing human capital that is specialized in biotechnology applicable to the fruit growing sector in the different components of the fruit industry, from both a qualitative as well as a quantitative perspective.

1. Strengthening the scholarship programs

In addition to improving the design of financing instruments, it is fundamental to coordinate the diverse instruments that support specialized master's degree, doctoral and postdoctoral studies in areas associated with fruit growing activities, be they national or international.

In this context, the following is proposed:

- To amply publicize the specializations required by the fruit industry among the national institutions in charge of administering scholarship programs, so that these priorities can be reflected as areas of interest for national development and so an increase in scholarships aimed in that direction can be favored.

- To favor the creation of a database of institutions and contacts of interest abroad in the area of biotechnology applicable to the fruit growing sector, which could serve as a reference for future efforts for exchange, training for human capital, developing internships and technology transfer, among others. It has been proposed that this database be created using information that Chilean scholarship recipients provide to the institutions financing their scholarships so it can then be channeled toward the institutions responsible for managing this Strategy and the associated institutions.

- To promote the creation and maintenance of ties between scholarship recipients studying in specialization programs abroad or in the country and companies, research institutions, or state organizations, in the context of the areas or the issues that they are developing in their specialization. This relationship could aim at promoting the development of apprenticeships, internships or theses that respond to the interests of both sides.

- To propose to the corresponding public institutions that they incorporate additional financing (in the scholarships financing lines aimed at domestic study programs) for the development of internships in international centers of excellence that conform to the context of the corresponding specialization program.

- To foster the design of financing instruments that integrate financial support from companies for undertaking short-term specialization studies in areas of interest for said companies.

- To foster a better use of the financing instruments for undertaking master's degree, doctoral and postdoctoral specialization studies in Chilean universities in areas and issues related to the development of the fruit industry.

2. Strengthening the supply of postgraduate programs offered by Chilean universities

It is proposed that the postgraduate programs offered in Chilean universities be strengthened in aspects related to their design and to the areas of knowledge and skills that they are oriented toward.

The following actions are proposed with regard to design aspects of national postgraduate programs: :

- Creating a map of the postgraduate programs available in the country that are associated with biotechnology applicable to fruit growing, from those centered on basic sciences to those with an applied nature, so as to support their connection to fruit production activities in the country.

- Boost teacher upgrading in national universities in the areas and subjects that need to be strengthened in the advanced training of professionals in biotechnology that is applicable to the fruit industry.

- Promote the joint work by researchers and teachers from different departments and/or universities in the country and abroad, so as to structure integrated programs that deal with the strengthening of specific and transversal skills.

- Foster the exchange of doctoral and master's degree students with university centers and centers of excellence on an international level to undertake internships and residencies abroad to strengthen the development of skills and to favor the materialization of joint theses.

- Stimulate the development of theses and courses in companies to establish concrete and applied relationships between students, universities and the fruit industry.

- Attract foreign students to national universities.

The following actions are proposed in aspects of the areas of knowledge and skills covered by national postgraduate programs::

- Revising the curriculums of programs whose development leads to a greater natural approach to the fruit industry or those whose contents can be applied in the search for biotechnology solutions that respond to the requirements of the industry, so as to shore up the aspects of contents and skill development in the areas that are identified as the weakest.

- Implementing postgraduate programs aimed at closing the existing gaps in advanced human capital in specific areas. Some examples could be the training of agronomists specializing in molecular biology, the design and implementation of a postgraduate program for the development of fruit plant breeders (to strengthen knowledge and techniques for molecular improvement, intellectual property, among others) and a postgraduate program for people working on the regulatory framework of biotechnology.

- Promoting the design and implementation of short courses aimed at doctoral students that allow the accreditation of skills in areas like technology management, introduction to intellectual property, and interdisciplinary work, among others.

- Fostering the training of university students and professionals from private companies to become leaders in knowledge management and so they can be competent in recognizing, systematizing and sharing institutional knowledge within organizations.

3. Strengthening national research capacities

In the area of research as a source of development for advanced human capital, it has been proposed that the current lines of research, institutions, and research teams be strengthened, seeking to include undergraduate and doctoral researchers from different disciplines and sectors of knowledge to contribute to the search for solutions and answers to the country's fruit industry requirements.

Along these lines, actions are proposed in the following areas:

a) Shoring up the research lines associated with the development of biotechnology and its application to the fruit industry.

- Implementing a nationwide program for the fruit plant genetic breeding that recognizes the specific characteristics and potential of each region in Chile.

- Promoting the creation of a specific work team on research issues related to biotechnology aimed at the development of solutions or answers applicable to the fruit industry, so as to continually review the state of the art and to update national priorities in the matter.

- Incorporating incentives for projects that establish cooperation networks between two or more domestic research centers.

- Incorporating incentives (economic, awards, institutional recognition as a merit in an academic career or otherwise) to the formation of interdisciplinary research groups so that together they analyze problems and propose responses on issues that need to be addressed through diverse areas of knowledge.

b) Support program to strengthen institutions

- Taking advantage of the guiding role represented by the institutional development plans of research centers and universities, in the area of research, so as to target resources to institutions that have a medium- and long-term strategic perspective of the activity.

- Incorporating technological management indicators related to the impact of the activity undertaken by research centers and universities in the area of research to complement the indicators resulting from the number of ISI indexed publications, for example.

- Establishing liaison and scientific management offices in universities and research centers aimed at shoring up ties between research and academic institutions, as well as between them and companies.

- Creating research debate and analysis groups in areas and subjects related to fruit growing biotechnology that could produce initiatives for integration, complementation and cooperation, in addition to generating documents that register and summarize the results obtained.

- Incorporating resources to finance the specialization of advanced human capital into research programs and projects in the context of the areas and the issues that said initiatives are involved in.

4. Insertion of advanced human capital into the workplace

Along with a series of actions aimed at increasing the number of professionals specialized in the area of biotechnology as applicable to the fruit growing industry, there is a need to foster initiatives aimed at inserting this human capital into the workplace. This would simultaneously bolster professionals' interest in specializing in such issues.

According to the requirements expressed by the fruit industry, there is a need to foster initiatives that facilitate the incorporation of advanced human capital into companies, universities, research centers, and specialized public institutions.

In this context, the following actions are proposed:

- Publicizing and promoting the use of existing tools for public support for the insertion of advanced human capital in industry and academia, especially from the perspective of coverage.

- Promoting the creation of a platform that integrates descriptive information, trends, and analysis of the current and future demand of jobs for professionals with advanced training, one that fulfills the requirements of companies, universities and research centers. This platform must be validated in the fruit industry and in the area of science and technology so as to provide guarantees regarding its real contribution to the people who seek to be integrated to the sector and to the institutions that require high-level staff. At the same time, it must reflect the dynamic dimension of the profile that is required (present and future).

- Designing an instrument to support the development of entrepreneurial technology-based activities led by specialized professionals holding master's or doctoral degrees. This would provide financing for the design, feasibility assessment and the implementation of private initiatives, allowing for the application of advanced technological capacities in the area of fruit industry biotechnology.

- Encouraging the development of venture capital funds in their design that cover not only investment associated with the business itself, but also the incorporation of advanced human capital necessary to successfully carry on the business as a way to link directly this human capital with industry.

- Enhancing and promoting the instruments that currently exist to support business innovation, so as to expand private innovation initiatives that represent a space for development that captures the supply of specialized advanced level professionals in the area of fruit biotechnology.

- Creating incentives for specialized professionals who are incorporated into or work in public institutions in the areas requiring specialized skills, so as to motivate said professionals to remain in these institutions.

- Installing an ongoing system to monitor employment, qualifications, and the skills profile of existing specialized professionals and the ones the country needs for fruit biotechnology.

5. Connections with international capacities

There is a need to strengthen the networks for international ties that currently exist in Chile in the framework of research and postgraduate training programs. This is important in order to take advantage of the opportunities for complementing current capacities of the country's universities and research centers.

To achieve this, there needs to be investment in the area of prospective information that accompanies and guides the activities of researchers and professions, in addition to making efforts to favor and intensify ties within international institutional networks. Along these lines, actions are proposed in the following areas:

a) Installation and management of a Technological Antenna for Biotechnology

In this context, the following actions are proposed:

- To design and implement a Technological Antenna for Biotechnology that allows the sector involved --both public as well as private-- to receive support for the research, development and innovation activities articulated with national and international centers, researchers and companies in state-of-the-art lines of research and innovation. This initiative must be built on the knowledge, progress, and networks that currently exist in the country.

- Designing and implementing a system to disseminate the information generated by the Technological Antenna for Biotechnology that would allow the series of research institutions and companies to actively remain informed in the related areas of research, technological development and innovation. The design of this system should consider coordination with the information systems that already exist, their experience and learning processes, so as to establish appropriate articulation mechanisms to achieve the level of effectiveness that the industries and research institutions involved in this strategy require.

b) Create an international articulation network based on the type and the intensity of ties that already exist between domestic research institutions and companies with other similar and complementary ones on an international level

In this context, the following actions are proposed:

- Expanding and intensifying the international support network with centers of excellence that allows the exchange of students, academics and researchers to undertake studies abroad and shared training programs.

- Promoting the creation of exchange and research internship programs, in addition to work apprenticeships abroad in companies, research centers and universities to develop the specialized advanced human capital skills that the country's fruit sector requires in terms of biotechnology. One option, in this sense, could be the formation of groups or post-doctoral students that are entering into a training offer ad-hoc or "customized" created for them by universities abroad, including internships in companies and courses in entrepreneurship, for example (with the advantage for the university that receives them, to create the program for a group, not only individually).

- Promote visits to Chile of professionals who are experts in issues related to biotechnology as applied to the fruit industry so they can take part in the areas of research, production, or public administration.

6. Support for entrepreneurial capacities

In the area of entrepreneurship, it is proposed that favorable conditions be created to implement new commercial initiatives associated with the biotechnology industry by generating services and products for the fruit industry. At the same time, and in the context of this strategy, it has been proposed that such initiatives be led by students and the graduates of national and international postgraduate programs.

In this context, the following actions have been proposed:

- Designing an instrument to support the development of entrepreneurial activities led by professionals who have specialized to the master's degree, doctoral and postdoctoral levels. The instrument will consider the design, feasibility assessment and the implementation of private initiatives that allow the application of advanced level technological capacities in the area of fruit biotechnology.

- Strengthening instruments to support the development of innovation projects on the part of young researchers with advanced level expertise.

- Promoting the holding of business plan contests aimed at advanced level students, with participation on the jury of potential clients and partners of these initiatives. These contests must be complementary and must strengthen the public support of existing instruments. They should also pick up on their experience (in a similar way to the financial instrument for "Support for the creation of Bio-businesses" run by the CORFO's INNOVA Chile).

7. Strengthening of the political and institutional context for promoting the application of biotechnology to the national fruit industry

The implementation of this strategy and achieving its objectives requires that the country strengthen the political and institutional framework, in the sense of facilitating articulation between the development of the fruit growing industry and the biotechnology industry, between training and the insertion of advanced human capital into the workforce.

To this end, actions in the following areas have been proposed:

a) National Biotechnology Policy, with a chapter referring to the fruit industry.

In this context, the following is proposed:

- Promote updating the national biotechnology policy addressing institutional, legal, productive and economical definitions,

- Promote the creation of regional forums led by regional governments for the development of a local expression of the national biotechnology policy.

b) Strengthening the national training system in areas related to fruit biotechnology.

In this context, the following is proposed:

- Designing and implementing an ongoing training system that is integrated both horizontally and vertically in the area of biotechnology with application to fruit growing, which acknowledges the training processes developed via internships, short courses, exchanges, continuing education programs and others.

- In the area of the training and education system, it has been proposed that educational concepts and instruments referring to biotechnology be included in different stages of high school (genetics, modern biotechnology techniques, biology, mathematics, chemistry).

- Strengthening undergraduate programs related to biotechnology and fruit growing in areas associated to the application of this technology in the productive, technological, and research contexts.

- Fostering the development of Entrepreneurs' Clubs or Groups in high school and in undergraduate university education.

- Beyond training for specialists, it is also intended to promote training in these subjects by the people who work (or will work) in science communication, for example through short courses or incorporating specific subjects targeting journalists related to science and technology or journalism students in general.

c) Creation of an institutional structure that is representative of the fruit sector aimed at fostering the development of biotechnology applied to the fruit growing sector.

In this context, the following is proposed:

- Creating a network or a community of actors on a national level dedicated to fruit biotechnology, which promotes forums for analysis and debate on different issues and ideas. This network or community must include or have ties to private enterprise.

- Strengthening the existing spaces for exchange on the level of research, development of applied technology, and technology business deals with international experts, creating teams that are comprised of national and foreign actors and play an advisory role according to fruit species.

- Based on the aforementioned network or community, create a management team that can undertake actions aimed at: coordinating scholarship programs with the requirements of the series of actors involved; managing the information that can be generated in coordination with scholarship recipients, managing networks and national and international advisory teams and monitoring the progress made on the strategy to train advanced human capital in fruit biotechnology.

Appendices

Appendix 1

Territorial Committee members

Central Zone Committee

Rodrigo Infante	Universidad de Chile
Marina Gambardella	Pontificia Universidad Católica de Chile
Rodrigo Cruzat	Aquavita
Plutarco Dinamarca	Agrogestión
Carolina Fredes	Research and Development Program, Functional Foods and Nutraceuticals, Altalena Biotechnologies

Central South Zone Committee

José Antonio Yuri	Universidad de Talca
Claudia Moggia	Universidad de Talca
Valeria Lepe	Universidad de Talca
Sofía Valenzuela	Universidad de Concepción
Cristián Arancibia	POMANOVA

Central North Zone Committee

Sergio Marshall	Pontificia Universidad Católica de Valparaíso
Eduardo Gratacós	Pontificia Universidad Católica de Valparaíso & consultant
Pedro Undurraga	Pontificia Universidad Católica de Valparaíso
María Elvira Zúñiga	Pontificia Universidad Católica de Valparaíso & CREAS Center
Michael Young	Universidad Técnica Federico Santa María

Appendix 2

Participants in the Workshops

Central Zone Workshop

Held in Santiago (12th May 2008)

Institution	Name	Position
Aconcagua Foods S.A.	José Monasterio Muñoz	Agricultural Manager
Aquavita	Rodrigo Cruzat	Manager
Consejo Nacional de Innovación para la Competitividad	Pedro Rosas	
Consorcio Tecnológico de la Industria Hortofrutícola de Exportación	Jaime Kong	Manager
FDF	Edmundo Araya	General Manager
FIA	Carolina Vivanco	Minister of Agriculture's Advisor in Human Resources Formation
Fulbright	José Asturias y Karina Sapunar	
Fundación Ciencia para la Vida	Cristián Hernández	Business Director
INNOVA CHILE	Cecilia Niño de Zepeda	Biotechnology Professional Comité Innova Chile de CORFO
Instituto de Investigaciones Agropecuarias (INIA), Centro Regional de Investigación (CRI) La Platina	Carlos Muñoz	Researcher
Instituto de Investigaciones Agropecuarias (INIA), Centro Regional de Investigación (CRI) La Platina	Patricio Hinrichsen	Researcher
Nevada Export	Ingrid Gazitúa	General Manager
PBCT - CONICYT	Isabel Reveco	Coordinator of the Business - University Linkage of PBCT (CONICYT)
Pontificia Universidad Católica de Chile, Escuela de Ingeniería	Gerard Casaubon	Training Unit Head, Aromas Area - DICTUC S.A.

Institution	Name	Position
Pontificia Universidad Católica de Chile, Facultad de Agronomía e Ingeniería Forestal	Marina Gambardella	Professor
Pontificia Universidad Católica de Chile, Facultad de Ciencias Biológicas	Patricio Arce Johnson	Assistant Professor, Head of the Dept. Molecular Genetics
Servicio Agrícola y Ganadero, División Semillas	Manuel Toro Ugalde	Responsible of the Registration for Protected Fruit Species
Servicio Agrícola y Ganadero, Unidad de Biotecnología	Alejandra Bustos	Head of Biotechnology Unit, Department of Quarantine Laboratories and Stations
Universidad Andrés Bello, Centro de Biotecnología Vegetal	Herman Silva	Assistant Professor
Universidad de Chile, Facultad de Ciencias Agronómicas.	Rodrigo Infante	Assistant Professor
Universidad de Chile, Facultad de Ciencias, Depto. de Biología	Claudia Stange	Assistant Professor
Universidad de Chile, Facultad de Ciencias, Depto. de Biología	Michael Handorf	Academic Instructor

Central-South Zone Workshop

Held in Talca (14th May 2008)

Institution	Name	Position
Agencia Regional de Desarrollo Productivo VII Reg.	Doris Ly	Innovation Executive ARDP VII Región
Consorcio Tecnológico Empresarial de Investigación Biofrutales	Víctor Sierra	Gerente Consorcio
Corporación Pomanova, Syngenta	Cristián Arancibia O.	Pomanova President, Director Syngenta Network for Pest Monitoring
Fulbright	José Asturias	
Gobierno Regional VI Región	Fredy León Neira	Professional Planning Division

Institution	Name	Position
Instituto de Investigaciones Agropecuarias (INIA), Centro Regional de Investigación (CRI) Quilamapu	Mario Paredes	Researcher
Instituto de Investigaciones Agropecuarias (INIA), (CRI) Quilamapu	Viviana Becerra Velásquez	Researcher
Instituto de Investigaciones Agropecuarias (INIA), (CRI) Quilamapu	Eduardo Pérez Torres	Researcher
PBCT–CONICYT	Isabel Reveco	Coordinator of the Business - University Linkage Component of PBCT (CONICYT)
PTI Frutas de Chile 2010	Rodrigo Salazar	Professional
Rohm & Haas Agrofresh	Daniel Manríquez	Research & Development Manager
Universidad Católica del Maule, Facultad de Ciencias Agrarias y Forestales, Depto. de Cs. Agrarias	Cristián Adasme Berríos	Director
Universidad de Concepción, Centro de Biotecnología	Sofía Valenzuela Aguila	Researcher
Universidad de Talca	Mauricio Lolas	Director Graduate Studies of Universidad de Talca & Associate Professor
Universidad de Talca, Depto. de Horticultura	Hermine Vogel	Associate Professor
Universidad de Talca, Dirección de Centros Tecnológicos y TT	Fernando Sánchez	Director
Universidad de Talca, Dirección de Centros Tecnológicos y TT	Patricia Klein	Professional
Universidad de Talca, Facultad de Cs. Agrarias	Jorge Retamales	Associate Professor
Universidad de Talca, Instituto de Biología Vegetal y Biotecnología	Peter Caligari	Director of Instituto de Biología Vegetal y Biotecnología
Universidad de Talca, Instituto de Biología Vegetal y Biotecnología	Alejandra Moya León	Associate Professor
Universidad de Talca, Centro de Pomáceas.	Claudia Moggia	Center Subdirector & Associate Professor
Universidad de Talca, Centro de Pomáceas	Valeria Lepe	Lecturer

Central-North Zone Workshop

Held in Valparaíso (16th May 2008)

Institution	Name	Position
Agencia Regional de Desarrollo Productivo V Reg.	Fernando Aldea Godoy	Director ARDP V Región
Asesora privada	Verena Müller	Technical Advisor of the Chile Trade Association of Fruit Nurseries
CEAZA	Andrés Zurita	Researcher
INIA La Cruz	Fernando Rodríguez	Researcher
PBCT–CONICYT	Isabel Reveco	Coordinator of the Business-University Linkage Component of PBCT (CONICYT)
Pontificia Universidad Católica de Valparaíso	Sergio Marshall	Academic Vice-President
Pontificia Universidad Católica de Valparaíso	Gonzalo Ruiz	Research & Innovation Director
Pontificia Universidad Católica de Valparaíso, Escuela de Alimentos	Jacqueline Reveco	Professor & Advanced Studies Directorate Director
Pontificia Universidad Católica de Valparaíso, Facultad de Agronomía	Nicole Danui	Professor
Pontificia Universidad Católica de Valparaíso, Facultad de Agronomía	José Antonio Olaeta	Professor
PTI Cluster Frutícola V Región	Maritza Troncoso	Professional
PTI Valle del Huasco	Gustavo Díaz	Manager PTI Valle del Huasco
Universidad de Tarapacá	Elizabeth Bastías	Researcher
Universidad Arturo Prat	Francisco Fuentes	Researcher

Appendix 3

Public-Private Coordination Committee

Name	Position / Institution
REPRESENTATIVES OF THE PUBLIC SECTOR	
César Muñoz	Director of the Associative Research Program (PIA) of CONICYT
Gloria Maldonado	CORFO, Subdirector Biotechnology Programs, Comité Innova Chile
José Luis Sepúlveda	Ministry of Education, Executive Secretary of Grant Program MINEDUC
Hugo Martínez	Ministry of Agriculture, Biotechnology and Genetic Breeding Area, Minister Cabinet
Embajador Gabriel Rodríguez García-Huidobro	Ministry of Foreign Affairs, Director of Energy, Science, Technology & Innovation
REPRESENTATIVES OF UNIVERSITIES & RESEARCH INSTITUTES	
Sergio Marshall	Pontificia Universidad Católica de Valparaíso, Research & Advances Studies Vice president
Ernesto Labra	Instituto de Investigaciones Agropecuarias (INIA), Research Director
Jorge Allende	Universidad de Chile, Research Vice president
Luis Huerta	Universidad de Talca, Academic Vice president
REPRESENTATIVES OF TRADE ASSOCIATIONS & RELATED COMPANIES	
Rodrigo Echeverría	FEDEFRUTA, President
Ronald Bown	ASOEX, President
Edmundo Araya	Fundación para el Desarrollo Frutícola (FDF), General Director
Oliver Rickmers	ASEMBIO, Board Representative
Victor Sierra	Consorcio Biofrutales, Manager
Jaime Kong	Consorcio Tecnológico de la Fruta, Manager
REPRESENTANTE DEL CONSEJO ASESOR INTERNACIONAL	
Fernando Quezada	Biotechnology Center of Excellence Corporation (USA), Executive Director

International Advisory Board

Fernando Quezada	Biotechnology Center of Excellence Corporation (USA), Executive Director
Laura Meagher	Technology Development Group (Edimburgo), Main Member
Ned Strong	LASPAU, Harvard University (USA), Executive Director


CONICYT
COMISIÓN NACIONAL DE INVESTIGACIÓN
CIENTÍFICA Y TECNOLÓGICA


ideaconsultora
INNOVACION PARA EL DESARROLLO AGRARIO