



Centro de Genómica Nutricional Agroacuícola
MEJORES ALIMENTOS MEJOR SALUD

***Lupinus luteus* breeding in Chile: An opportunity for sustainable agriculture and the development of new products for healthy food and feed industries**

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Outline

1

Introduction

2

L. luteus breeding in Chile: general goal and genetic strategies

3

Some achievements so far

3.1

Mapping and yield potential in advanced lines

3.2

Technological products for healthy food industry and aquaculture

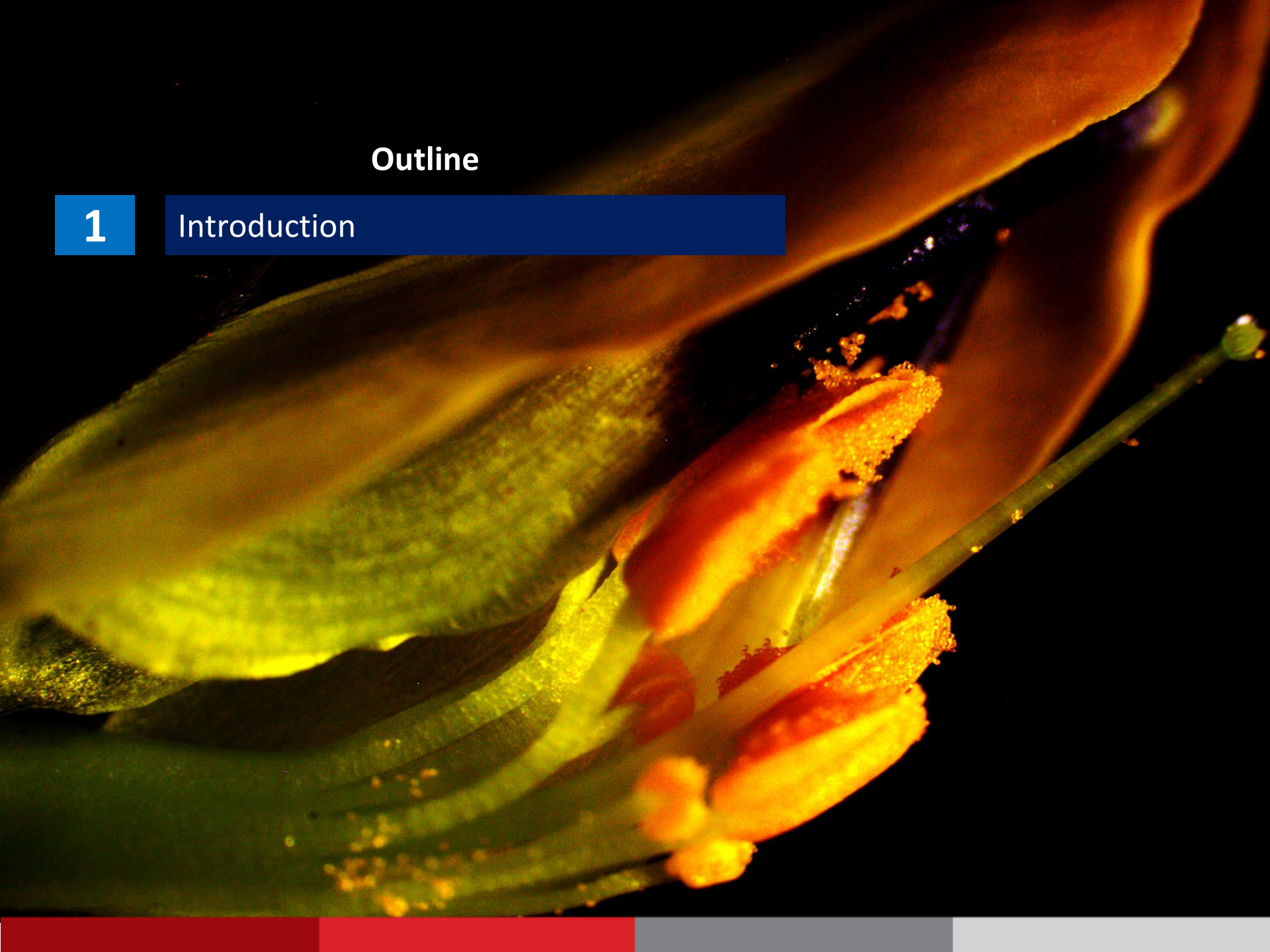
4

Conclusions / Projections

Outline

1

Introduction



Strategy of mission oriented science in Chile

Shared budget, central and regional government

Financiamiento basal



Our focus: three core areas



Plant Science



Science and Food Technology



Development and technology transfer

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Why plant proteins ?



Source: Innova Market Insights, 2017

Outline

2

L. luteus breeding in Chile: General goal and genetic strategies

General goal of *L. luteus* breeding:

- To better adapt *L. lutes* in Chile in order to contribute to plant protein production, sustainable agriculture and the development of new products for healthy food and feed industries with added value.
 - Improve yield and seed protein content, specially under small farmer producer.
 - Flowering time and resistance to anthracnose, are ones of the key traits under studies
 - Piloting and packaging of technological products with added value: Healty food industries and aquaculture.

Which are our Genetic strategies ?

- Germplasm collections to explore genetic variability
- Development of magic population to explore important QTLs related to agronomic, food and feed quality traits, at different locations
- Development of mapping populations to study and map important genes and to assist breeding.
- Mutation breeding

Outline

3

Some achievements so far

3.1

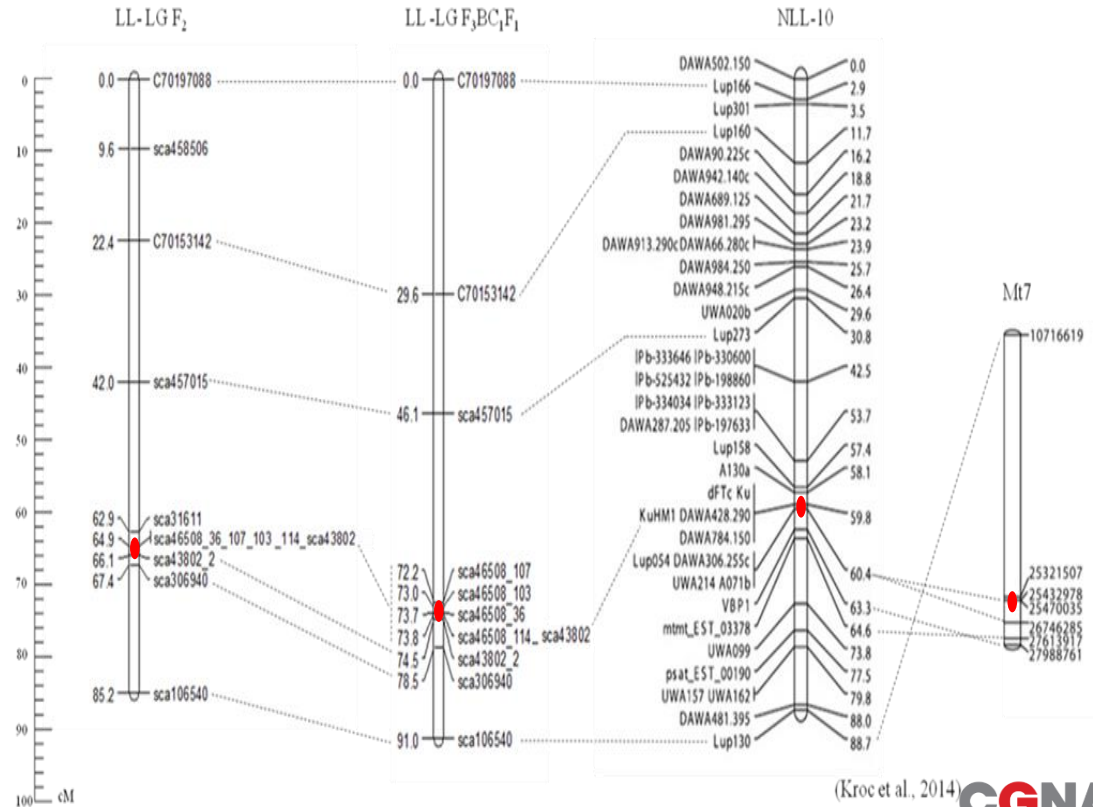
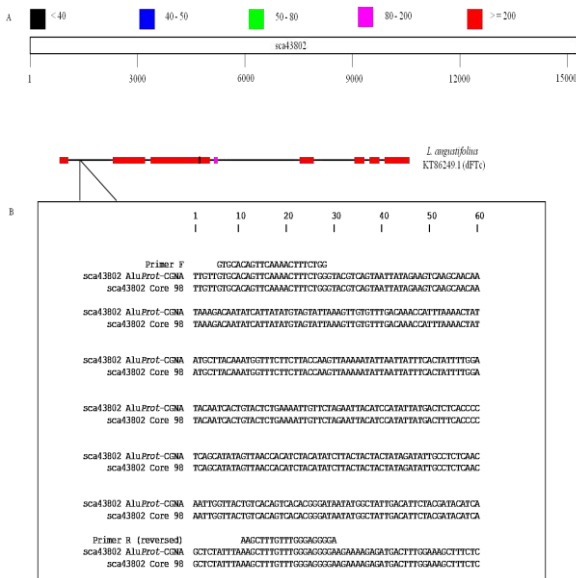
Mapping and yield potential in advanced lines

DTF genes in *L. luteus* is controlled by *Flowering Locus T* homologous

Blast result showed that marker **SCA 43802** was homologous to the FT genes from *L. angustifolius* (e-Value: 0,0) (NCBI).

To confirm the presence of this homologous FT genes, a set of markers mapped on the LG of *L. angustifolius* ligated to DTF QTL were mapped on an F₂ *L. luteus* population of 190 individuals to develop the *L. luteus* LG.

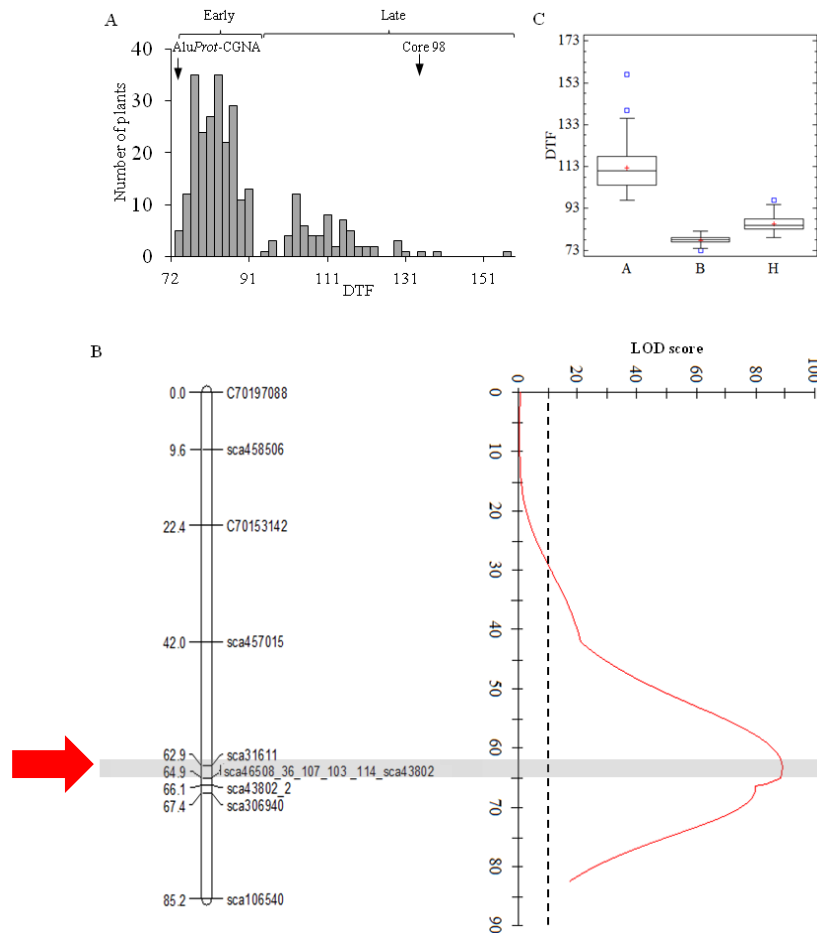
High collinearity was observed



DTF genes in *L. luteus* is controlled by *Flowering Locus T* homologous

A single DTF QTL was mapped and the highest LOD score (88) was at the locus **SCA 43802**, confirming that DTF is controlled by same gene in *L. luteus* and *L. angustifolius*.

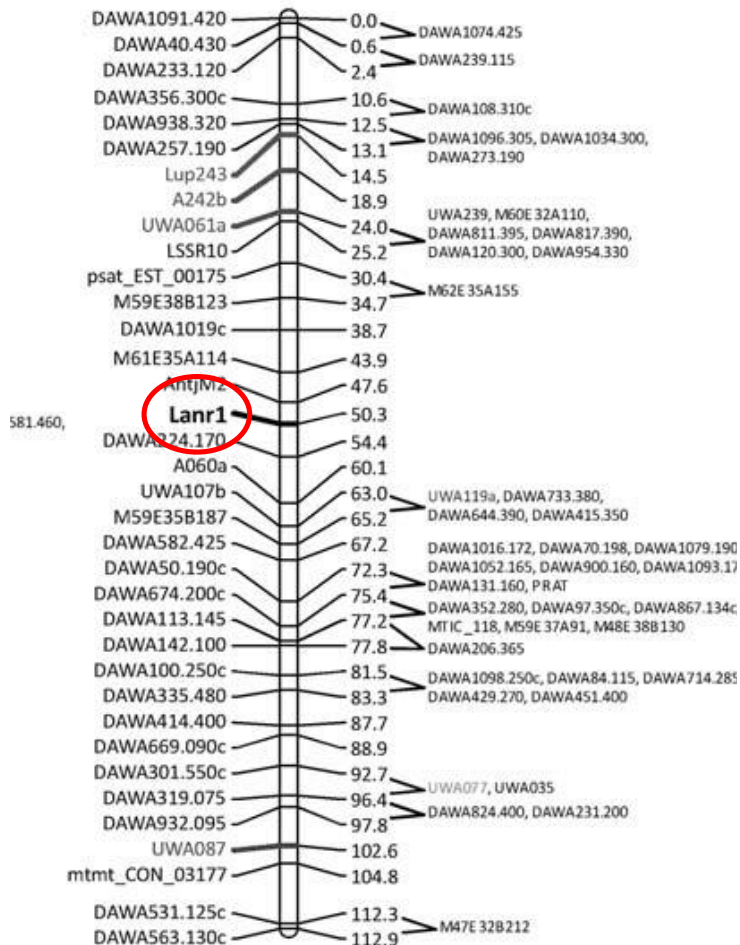
This marker co-segregate with the trait



Anthracnosis resistance

- To evaluate and map anthracnose resistance genes in *L. lutes*, same approach of DTF was carried out.

NLL-11

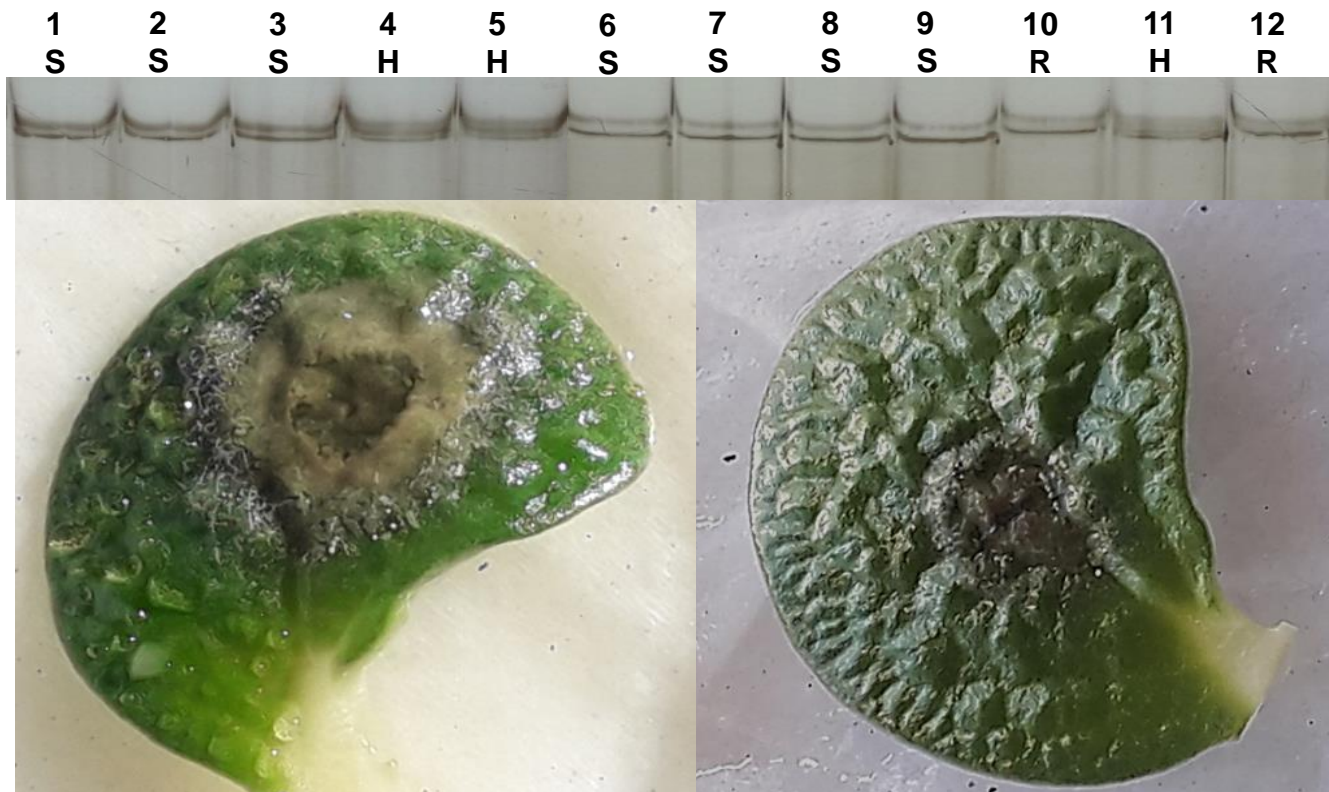


Blast results showed that the **SCAFFOLD 82470** from *L. luteus* is homologous to Lanr1 of *L. angustifolius* (e-value: 0.0; NCBI).



Anthracnosis resistance

- To evaluate gene function same F_2 population of 290 individuals was genotyped with the marker sca82470.
- Each F_2 individual was inoculated at *in vitro* condition (Muñoz, 2011) to evaluate resistance to anthracnose. Detailed information is showed in the poster section.
- The anthracnose resistance segregated 3:1, indicating a strong genetic effect associated to this trait in this population.
- The marker sca82470 co-segregated with the trait, indicating that *L. luteus* and *L. angustifolius* share same genes for anthracnose resistance.



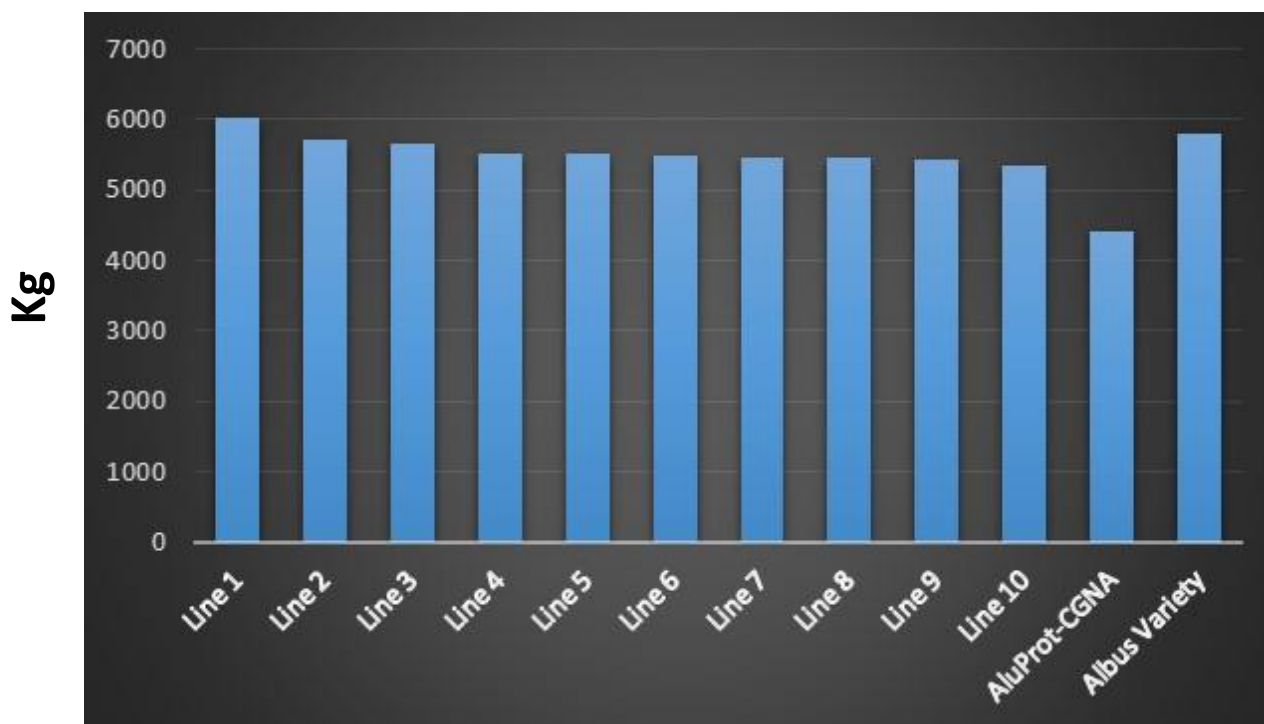
High yielding advanced lines

- To evaluate yield potential, advanced lines are evaluated under randomized experimental design at different locations



High yielding advanced lines

Mean yield 2017/2019 (kg/ha)



Advanced lines and controls

Dehulled seed protein content: 61 - 64% (DM)

Industrial yield: 78% a 80%

A close-up, microscopic view of a plant stem, likely a banana, showing several yellowish, fuzzy growths (possibly fungal or bacterial) along its length. The stem is green and has a textured surface. The background is dark, making the stem and growths stand out.

3

Some achievements so far

3.2

Technological products for healthy food industry and aquaculture

Piloting and packaging of technological products with added values for a healthy food industry and aquaculture

Specification	Unit	Value*
Energy	kcal/kg	3.443
Protein content	%	60,0 (± 2)
Soluble protein	%	83,8
Amino acid profile		
Aspartic acid	%	5,09 (± 0,31)
Glutamic acid	%	11,4 (± 0,8)
Alanine	%	1,56 (± 0,09)
Arginine	%	5,87 (± 0,35)
Phenylalanine	%	1,86 (± 0,11)
Glycine	%	1,88 (± 0,13)
Histidine	%	1,35 (± 0,14)
Isoleucine	%	1,84 (± 0,15)
Leucine	%	3,78 (± 0,30)
Lysine	%	2,38 (± 0,19)
Proline	%	1,94 (± 0,16)
Serine	%	2,45 (± 0,17)
Tyrosine	%	1,40 (± 0,15)
Threonine	%	1,55 (± 0,09)
Valina	%	1,73 (± 0,14)
Cysteine + Cystine	%	1,03 (± 0,10)
Methionine	%	0,251 (± 0,025)
Tryptophan	%	0,377 (± 0,029)
Total carbohydrate		
Total carbohydrate	%	30,0
Total dietary fibre	%	17,0
Crude fibre	%	8,0
Total fat	%	5,5
Ashes	%	4,5
Total alkaloids	%	0,0036 – 0,038
Total carotenoids	mg/100 g	10 – 12

Aquaculture and other uses



Grit AluProt-CGNA

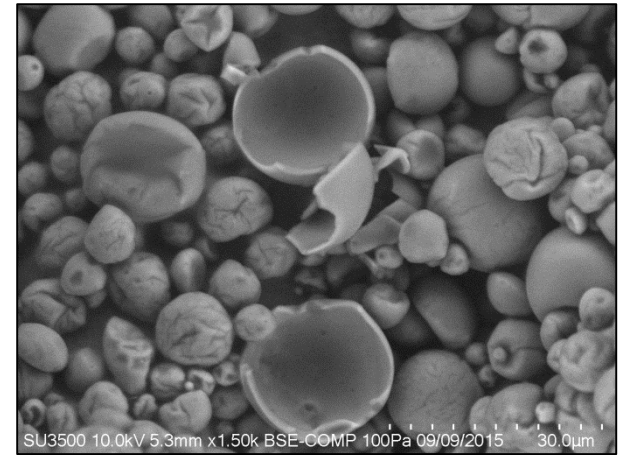
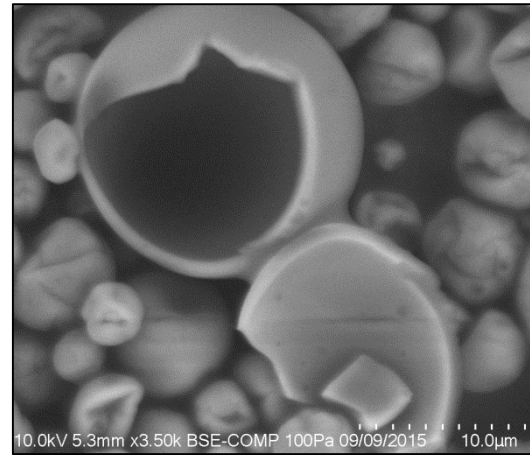
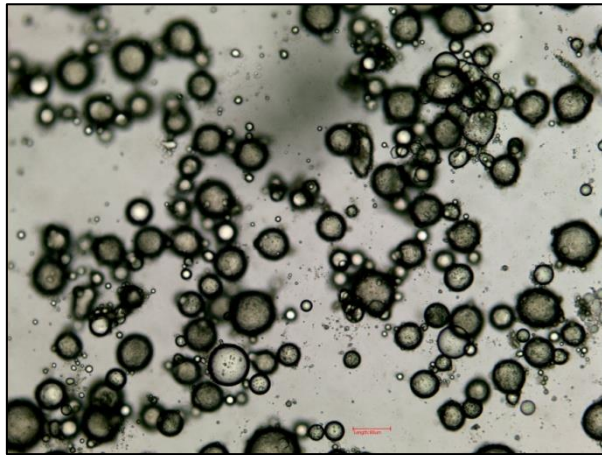
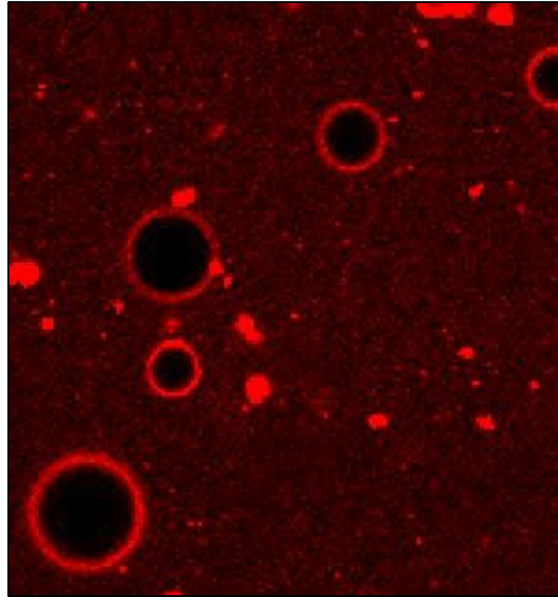
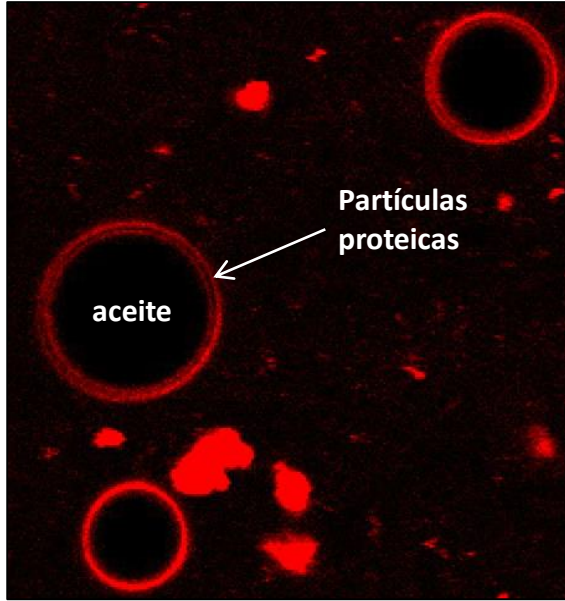
Aminoacids profile

UltraProt-CGNA®



Componentes	(%)
Humedad	4,8
Proteína	91-95
Fibra dietaria	0,1
Materia grasa	4,8
Cenizas	3,5
Hidratos de Carbono	0,1
Energía (Kcal/kg)	4016,0

Imágenes de microscopía de micro-capsulas



(Burgos-Díaz et al., 2015; 2017)

SustiLact-CGNA® : Non-dairy drink for the feeding of dairy calves

Contains

Extruded grit AluProt-CGNA

Low fiber cereals

Plant oil

Vitamin core

It is made up via cavitation technology.

A Start-Up company is on the way...

Reduces the cost of food by 30%

Specification	Unit	Value*
Energy	kcal / kg	4,852
Protein content	%	29,5
Total carbohydrate	%	44,7
Fibre crude	%	1,0
Total fat	%	22,0
Ashes	%	3,8

*: Dry matter



Outline

4

Conclusions / Projections

Conclusions/Projections

- Important agronomic traits have been identify and mapped in *L. luteus* genome, which has been crucial to better adapt it in Chile. A GBS is nearly finished with focus in 15,000 polymorphic SNPs.
- A new variety is nearly there. We are quite optimistic of its agronomic and industrial projections.
- 15 technological products have been developed. Four are already in the market (three are food matrix protein base, like Premix). One of them is for people with celiac disease.
- A project is being carried out to deliver textured “lupine meat” and a cereal bar with high protein content.
- Our food science people are struggling to deliver a non-dairy protein drink with lupin protein isolate together with microencapsulated fucoxanthin from brown seaweed.

Healthy food industry + Aquaculture : Is our goal for science & technology !



All of this is possible with public and private sector support

And collaboration from many people and Institutions

And our CGNA people

Many thank indeed !!!!