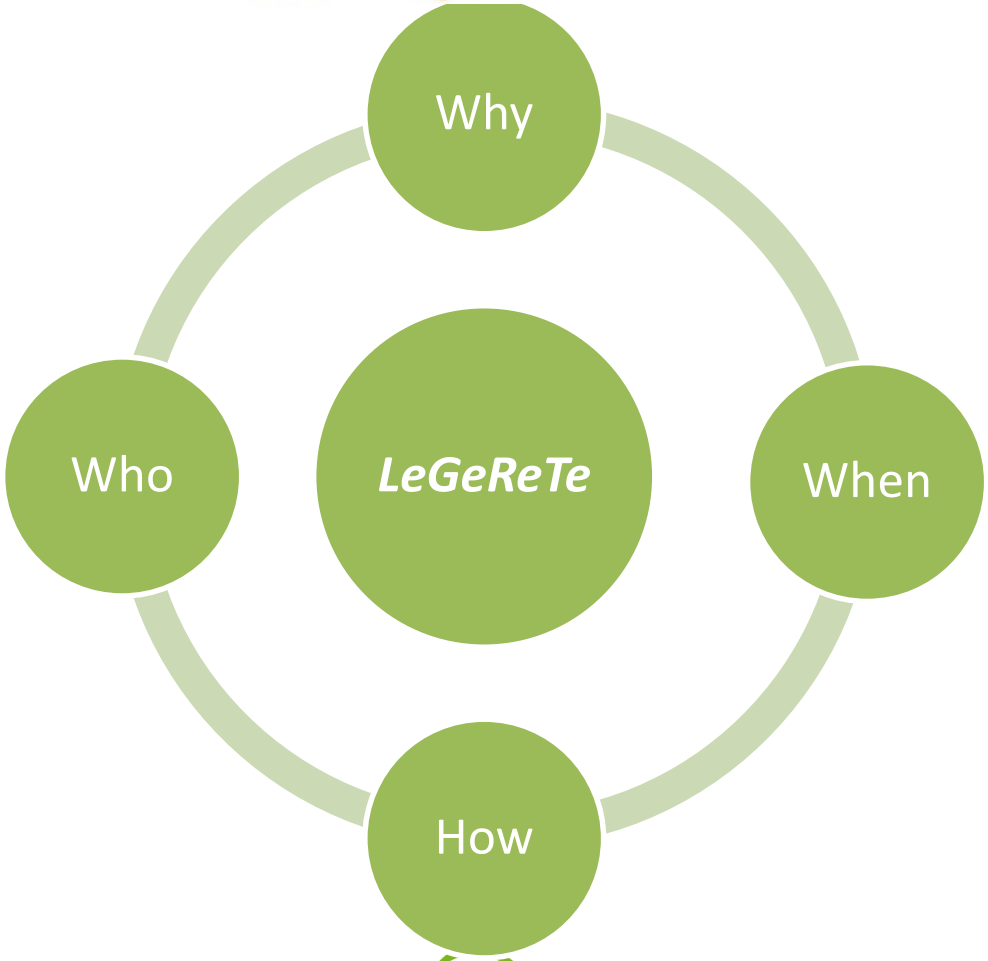
LEgume GEnetic REsources as a tool for the development of innovative food TEchnological system

LeGeReTe

THOUGHT FOR FOOD INITIATIVE TRANSDISCIPLINARY RESEARCH TOWARDS MORE SUSTAINABLE FOOD SYSTEM - 1-3 FEBRUARY 2017, MONTPELLIER, FRANCE

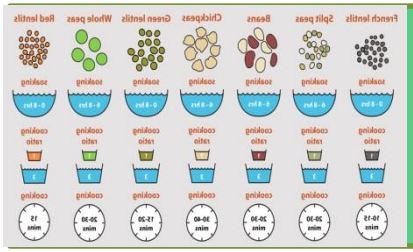

Why
Who
LeGeReTe
When
How

Why?

LeGeReTe

PULSES
GOOD FOR PLANET AND GOOD FOR THE PEOPLES

ABOUT OF 1.1 MILION PULSES ACCESSIONS PRESERVED IN VARIOUS GENE BANKS MOST OF THEM STILL NOT CHARACTERIZED



LONG TIME FOR PREPARATION AND COOKING

2016 INTERNATIONAL YEAR OF PULSES

LeGeReTe

1

They have a long shelf life

When stored in airtight containers, pulses can last months, even years, without spoiling.

2

Are good for you!

Pulses are high in dietary fibre thus, they can help prevent obesity, reduce blood pressure and reduce the risk of heart disease.

3

Good news for poor farmers

Pulses' many advantages mean that in times of poor harvest or natural disasters pulses can provide a buffer for farmers.

4

Help other crops to grow

Crops planted alongside pulses reap the benefits and grow faster. Pulses are also deep rooting, which means they do not compete with other crops for water.

5

Cost less to grow

Pulses represent a substantial cost savings for the farmer as they don't have to buy nitrogen fertilizers.

6

'Clean' crops: do not emit greenhouse gases

Pulses have been shown to emit hardly any greenhouse gases (lentils emit 0,9%).

7

Help fertilize soil

Pulses help nitrogen accumulate in the soil. They also release hydrogen gas into the soil, another positive impact on soil biology.

8

Pulses = Zero Waste

Every part of the pulse can be used: the pods can feed people, the shoots used for animal feed or left on the soil as green manure.

9

Need less water to grow

Pulses need 20 times LESS water than animal products to grow.

Source: FAO, 2016

LeGeReTe aims

- Preserve and study legume biodiversity
- Identify legume genotypes suitable for low-input farming systems and characterized by superior traits (agronomical, nutritional, technological)
- Provide useful genomic information to breeders
- Develop novel technological applications for legumes, ultimately leading to innovative legume-based foods and food ingredients so as to increase legume consumption
- Improve economic and environmental sustainability through life cycle assessment (LCA) and Life Cycle Costing (LCC) indicators

Who

LeGeReTe

New partner

Cannone

A&Q
Polo per la Qualificazione del Sistema Agro-Industriale

consorzio PUGLIA NATURA
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News
Gruppi d'acquisto bio-solidale
Area riservata

IANNONE ANNA
azienda agricola

EQUAL TIME

LeGeReTe flowchart

WP0: Coordination and Project management

WP1: Set-up and genetic analysis of the project core collection

WP2: Identification and selection of valuable legumes accessions characterized by high nutritional and technological value

Accessions with high nutritional value

WP3: Assessment of the potential beneficial effect of the selected legume accessions by "in vitro" and "in vivo" approaches

Accessions with high technological value

WP4: Development of technological applications of the selected legume accessions

WP5: Economic and Environmental Sustainability assessment for semi-industrial scale up

WP6: Educational and Results dissemination

Who

LeGeReTe

Two Departments:

1. *Agricultural and Environmental Sciences (DiSAA)*
2. *Economics, Management and Quantitative Methods (DEMM)*

General Coordinator
LEGERETE
Prof. R. Guidetti

Researchers involved:
Prof. A. Banterle, Dr. R. Beghi, Dr. E. Ricci.

Work Packaged engaged:

WP0: Coordination and Project management
WP5: Economic and Environmental Sustainability assessment for semi-industrial scale up
WP6: Educational and Results dissemination

Who

LeGeReTe

Two Departments:

1. Soils, Plant and Food Science" (DISSPA)
2. Biosciences, Biotechnologies and Biopharmaceutics" (DBBB)

Scientific Coordinator LEGERETE

Dr. C. Summo

Researchers involved: Prof. A. Pasqualone, Dr. S. Pavan, Dr. G. Tamma.

Work Packaged engaged:

WP0: Coordination and Project management

WP1: Set-up and genetic analysis of the project core collection

WP2: Identification and selection of valuable legumes accessions characterized by high nutritional and technological value

WP3: Assessment of the potential beneficial effect of the selected legume accessions by "in vitro" and "in vivo" approaches

WP4: Development of technological applications of the selected legume accessions

WP6: Educational and Results dissemination

Who

LeGeReTe

Department of Agrarian, Food and Environmental Science

Work Packaged engaged:

WP1: Set-up and genetic analysis of the project core collection
WP6: Educational and Results dissemination

Researchers involved:
Prof. C. Lotti

Fields: agronomical competences

Work Packaged engaged:

WP0: Coordination and Project management
WP2: Identification and selection of valuable legumes accessions characterized by high nutritional and technological value
WP6: Educational and Results dissemination

People involved:
Dr. F. Colamussi

Who

LeGeReTe

The Gastronomic laboratory

Work Packaged engaged:

WP4: Development of technological applications of the selected legume accessions
WP6: Educational and Results dissemination

People involved:
Mr. V. Abrusci

Industrial transformation

New partner

Work Packaged engaged:

WP4: Development of technological applications of the selected legume accessions
WP5: Economic and Environmental Sustainability assessment for semi-industrial scale up
WP6: Educational and Results dissemination

People involved:
Dr. D. Petrolla

Who

LeGeReTe

The Communications Plan

New partner

Work Packaged engaged:

WP6: Educational and Results dissemination

People involved:
Dr. L. Paparella

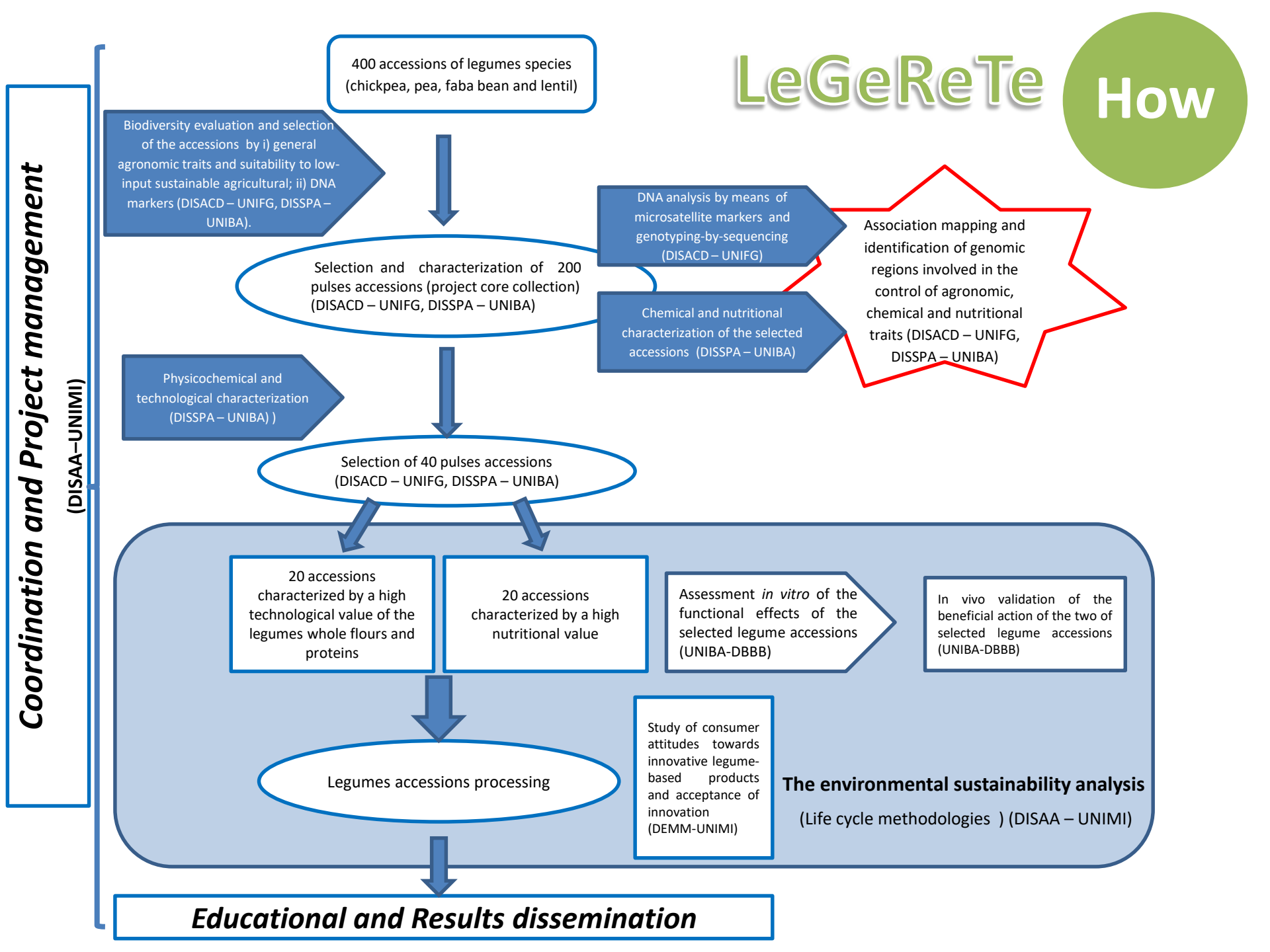
BRC, IFS, ISO 22000 assessment.

New partner

Work Packaged engaged:

WP4: Development of technological applications of the selected legume accessions
WP5: Economic and Environmental Sustainability assessment for semi-industrial scale up
WP6: Educational and Results dissemination

People involved:
Dr. E. Ferrari


LeGeReTe
How
Coordination and Project management
(DISAA–UNIMI)
400 accessions of legumes species (chickpea, pea, faba bean and lentil)
Biodiversity evaluation and selection of the accessions by i) general agronomic traits and suitability to low-input sustainable agricultural; ii) DNA markers (DISACD – UNIFG, DISSPA – UNIBA).
Selection and characterization of 200 pulses accessions (project core collection) (DISACD – UNIFG, DISSPA – UNIBA)
DNA analysis by means of microsatellite markers and genotyping-by-sequencing (DISACD – UNIFG)
Chemical and nutritional characterization of the selected accessions (DISSPA – UNIBA)
Association mapping and identification of genomic regions involved in the control of agronomic, chemical and nutritional traits (DISACD – UNIFG, DISSPA – UNIBA)
Physicochemical and technological characterization (DISSPA – UNIBA))
Selection of 40 pulses accessions (DISACD – UNIFG, DISSPA – UNIBA)
20 accessions characterized by a high technological value of the legumes whole flours and proteins
20 accessions characterized by a high nutritional value
Assessment in vitro of the functional effects of the selected legume accessions (UNIBA-DBBB)
In vivo validation of the beneficial action of the two of selected legume accessions (UNIBA-DBBB)
Legumes accessions processing
Study of consumer attitudes towards innovative legume-based products and acceptance of innovation (DEMM-UNIMI)
The environmental sustainability analysis
(Life cycle methodologies) (DISAA – UNIMI)
Educational and Results dissemination

LeGeReTe starting material

DISSPA-UNIBA germplasm collection

- Chickpea (*Cicer arietinum* L.),
- Lentil (*Lens culinaris* M.)
- Faba bean (*Vicia faba* L.)
- Pea (*Pisum sativum* L.)

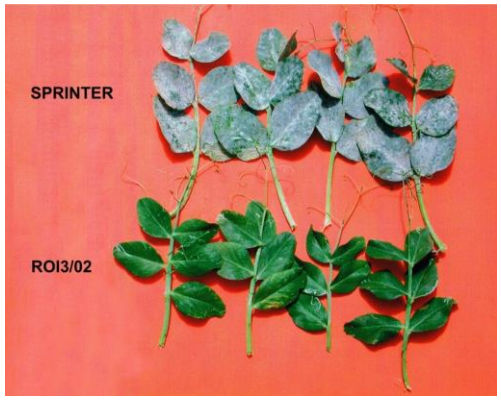
The DISSPA-UNIBA collection

Theor Appl Genet (2011) 123:1425–1431
DOI 10.1007/s00122-011-1677-6

ORIGINAL PAPER

Pea powdery mildew *er1* resistance is associated to loss-of-function mutations at a *MLO* homologous locus

Stefano Pavan · Adalgisa Schiavulli · Michela Appiano · Angelo R. Marcotrigiano · Fabrizio Cillo · Richard G. F. Visser · Yuling Bai · Concetta Lotti · Luigi Ricciardi



MPMI Vol. 29, No. 10, 2016, pp. 743–749. http://dx.doi.org/10.1094/MPMI-07-16-0134-R

Characterization of Low-Strigolactone Germplasm in Pea (*Pisum sativum* L.) Resistant to Crenate Broomrape (*Orobanche crenata* Forsk.)

Stefano Pavan,[1] Adalgisa Schiavulli,[2] Angelo Raffaele Marcotrigiano,[1] Nicoletta Bardaro,[1] Valentina Bracuto,[1] Francesca Ricciardi,[2] Tatsiana Charnikhova,[3] Concetta Lotti,[2] Harro Bouwmeester,[3] and Luigi Ricciardi[1]

WP1

Set-up and genetic analysis of a project core collection

Aims:

- Selection of a highly variable legume collection (project core collection)
- Characterization of the core collection for agronomic traits, including suitability to low input farming systems
- Merge DNA and phenotypic information to identify genomic regions underlying agronomic traits

From 1st to 33th Month

WP1

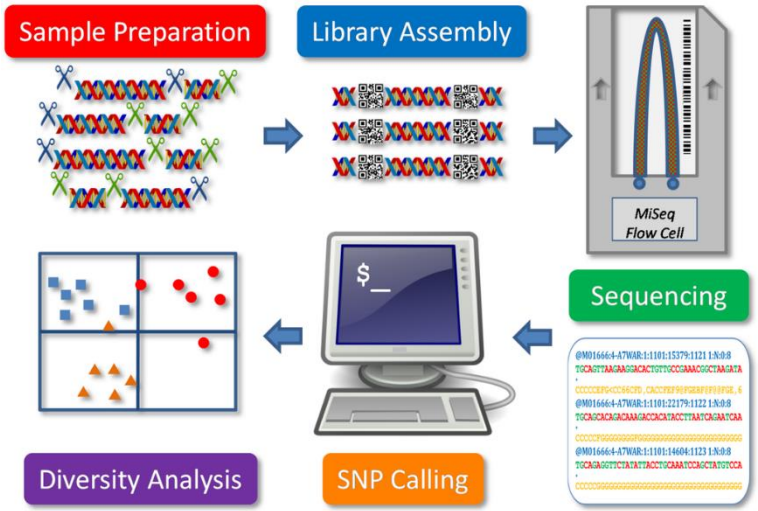
Genetic characterization of the legume collection

OPEN ACCESS Freely available online

PLoS one

A Robust, Simple Genotyping-by-Sequencing (GBS) Approach for High Diversity Species

Robert J. Elshire[1], Jeffrey C. Glaubitz[1], Qi Sun[2], Jesse A. Poland[3], Ken Kawamoto[1], Edward S. Buckler[1,4], Sharon E. Mitchell[1]*



Peterson et al. 2014

Pavan et al. BMC Genomics (2017) 18:59
DOI 10.1186/s12864-016-3429-0

BMC Genomics

RESEARCH ARTICLE Open Access

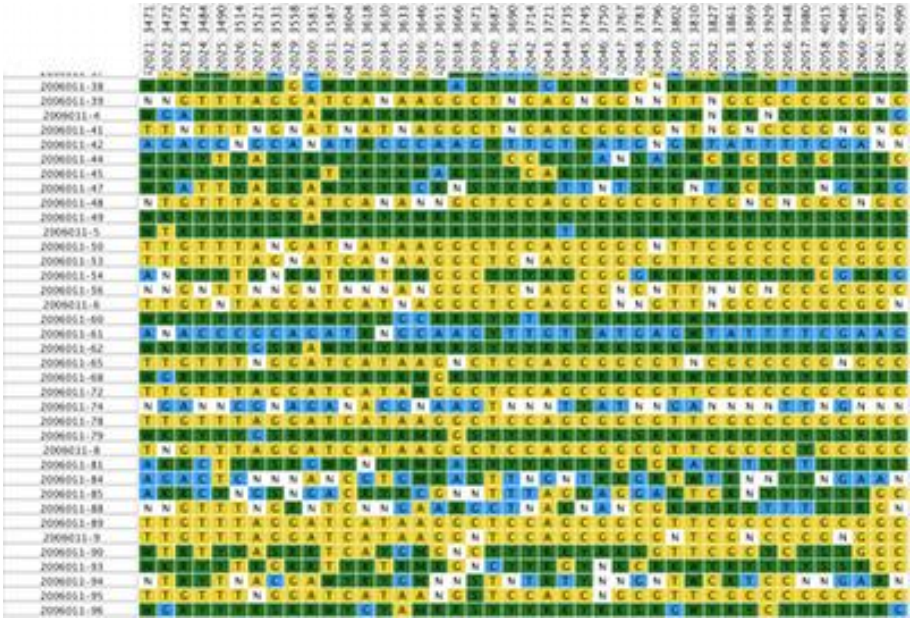
Genotyping-by-sequencing of a melon (*Cucumis melo* L.) germplasm collection from a secondary center of diversity highlights patterns of genetic variation and genomic features of different gene pools

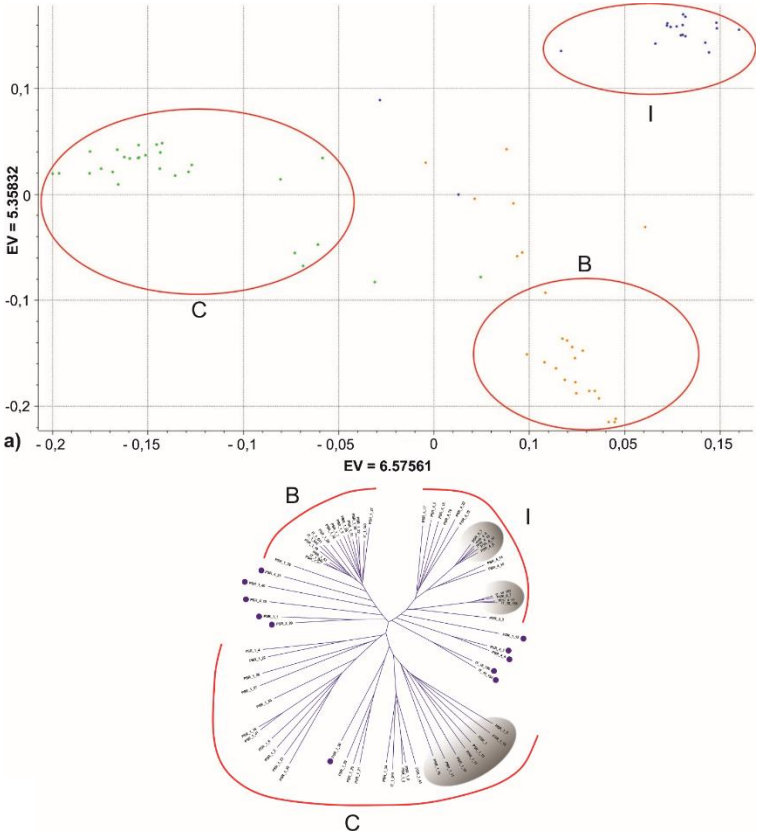
Stefano Pavan[1*], Angelo Raffaele Marcotrigiano[1], Elena Ciani[2], Rosa Mazzeo[1], Vito Zonno[1], Valentino Ruggieri[3], Concetta Lotti[4] and Luigi Ricciardi[1]

From 5th to 20th Month

WP1

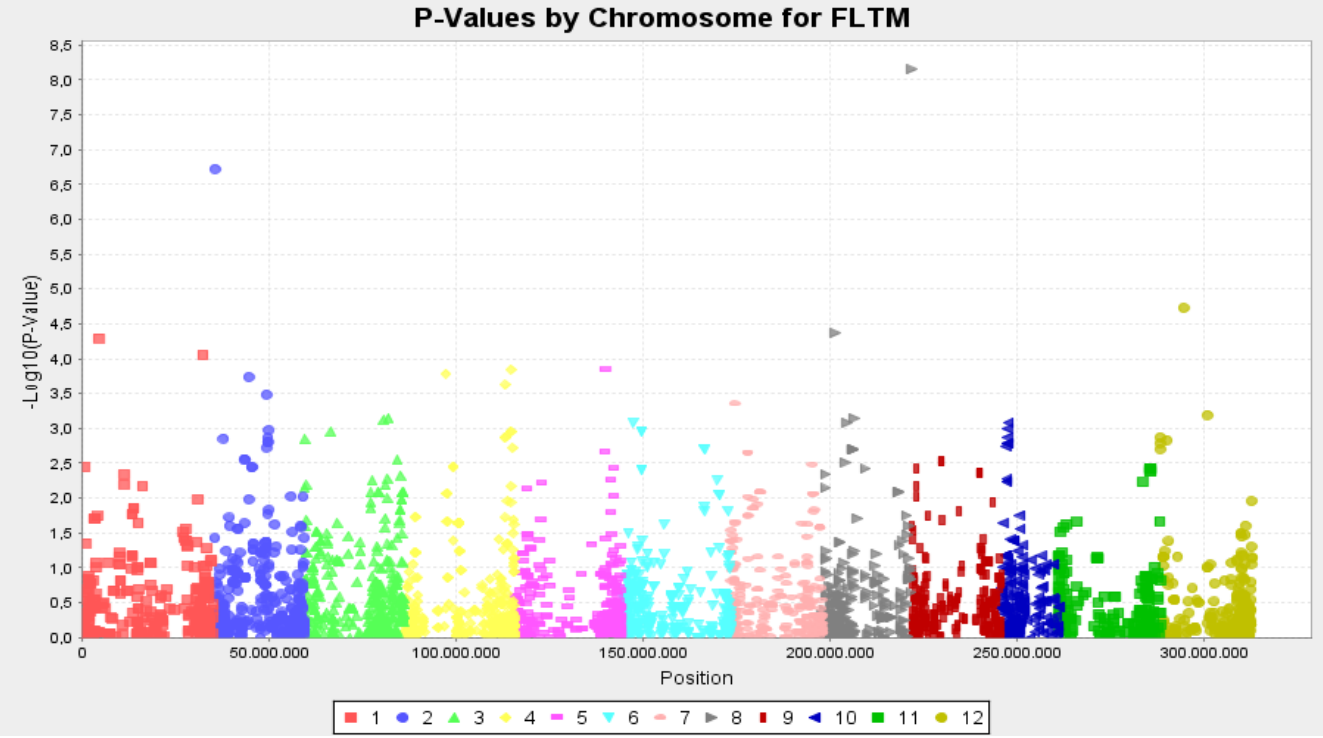
DNA data analysis and selection of the project core collection





WP1

Identification of genomic regions underlying phenotypic traits



Pavan et al. 2017

WP2

Selection of legume accessions with high nutritional and processing value

Aims:

- To determine the nutritional and physico-chemical features of the core collection and present data in the LeGeReTe Cardbook
- To identify the accessions whose wholemeals and/or protein extracts have the best nutritional and technological value in food processing

From 5th to 20th Month

WP2

Chemical and nutritional characterization of the selected accessions

- Proximate composition
- Total dietary fiber
- Beta-glucans
- Fatty acid and aminoacid profile
- Bio-functional compounds (phenolics and carotenoids)
- Antinutritional factors (tripsin inhibitor activity and phytic acid content)

International Journal of Food Microbiology 196 (2015) 51–61

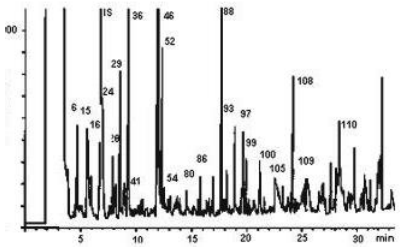
Contents lists available at ScienceDirect

International Journal of Food Microbiology

journal homepage: www.elsevier.com/locate/ijfoodmicro

Exploitation of the nutritional and functional characteristics of traditional Italian legumes: The potential of sourdough fermentation

José Antonio Curiel [a], Rossana Coda [b], Isabella Centomani [a], Carmine Summo [a], Marco Gobbetti [a], Carlo Giuseppe Rizzello [a,*]



WP2

Assessment of the properties of wholemeal flours and protein extracts

- Production of wholemeal flour and protein extracts
- Physico-chemical properties (water absorption index, water solubility index, oil absorption capacity, bulk density)
- Functional properties (emulsion activity, stability and pasting properties)

Shuang-kui Du et al., 2014; Klupsaité et al., 2015

WP3

Assessment of potential beneficial effect of selected legume accessions

Aims:

- To test the effect on health of a panel of accessions in terms of antioxidant and anti-inflammatory activity

From 13th to 32nd Month

WP3

Assessment of potential beneficial effect of selected legume accessions

Selected legume accessions

***In vitro* studies**

Evaluation of the antioxidant and anti-inflammatory effects of selected legume water extract in a human hepatocyte Hep-G2 cell line

Legume accessions displaying the best response *in vitro* will be evaluated *in vivo*

***In vivo* studies**

Evaluation in a murine model of Non-Alcoholic Fatty Liver Disease (NAFLD)

WP4

Development of technological applications of the selected legume accessions

Aims:

- Production of the “LeGeRe” burger and the “LeGeRe” sauce
- Use of legume flours and protein extracts as additives or food ingredients in one vegetable-based food and in one meat-based food

From 12nd to 32nd Month

WP4

Set up of innovative legume-based foods: burger

- Raw material preparation
- Ingredient weighting
- Mixing (5 min at 60 rpm) and dough-making
- Shaping (7cm diameter; 1.5cm thickness)
- First baking (130°C for 15 min)
- Cooling (4°C in blast chiller)
- Rolling in breadcrumbs (2 mm thickness)
- Final baking (210°C for 15 min)

LWT - Food Science and Technology 65 (2016) 290–296

Contents lists available at ScienceDirect

LWT - Food Science and Technology

journal homepage: www.elsevier.com/locate/lwt

The effects of the type of cereal on the chemical and textural properties and on the consumer acceptance of pre-cooked, legume-based burgers

Carmine Summo*, Isabella Centomani, Vito M. Paradiso, Francesco Caponio, Antonella Pasqualone

Cannone

IANNONE ANNA azienda agricola

WP4

Set up of innovative legume-based foods: sauce

Different formulations of ready-to-eat or ready-to-cook preparations will be considered, such as those recalling the traditional Apulian dish “chicories with fava bean purée”

Cannone

IANNONE ANNA azienda agricola

WP4

Use of legume flours and protein extracts as food ingredients and additives

Legume flours and protein extracts will be used as additives or food ingredients in at least one vegetable-based food and one meat-based food

WP5

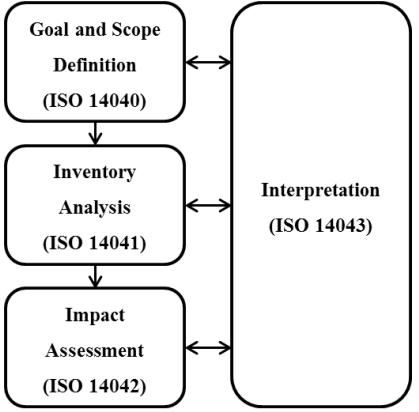
Economic and Environmental Sustainability assessment for semi-industrial scale-up

- Life Cycle Assessment (LCA)
- Study of consumer attitudes towards innovative legume-based products and acceptance of innovation

From 2nd to 35th Month

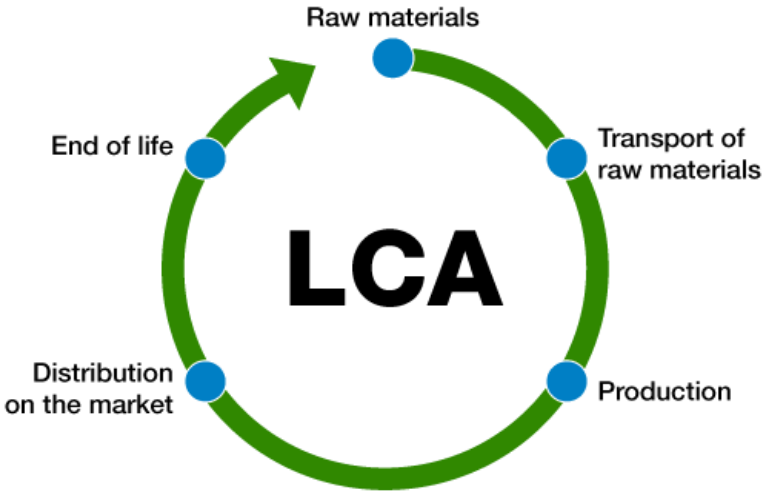
WP5

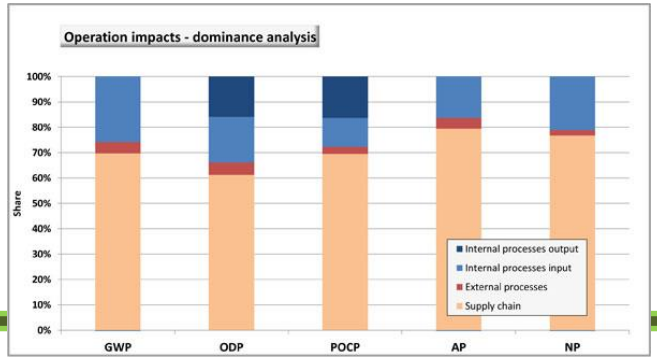
Environmental Sustainability assessment



Based on the ISO standards 14040, 14041, 14042, 14043 and 14044, the LCA will be developed in four phases:

- Phase 1: purpose of the analysis and functional unit
- Phase 2: inventory
- Phase 3: analysis
- Phase 4: mitigation proposals





WP5

Economic Sustainability assessment

Two different levels of analysis towards innovative legume-based products and acceptance of innovation:

1. Small group of people with the aim of developing a questionnaire for 500 people, grounded in the Theory of Planned behaviour (Ajzen, 2005).
2. A sample of 1000 consumers in Italy, France and Spain to evaluate their interest for the developed products; the study will be performed applying choice experiment theory (Hensher, et al., 2005).

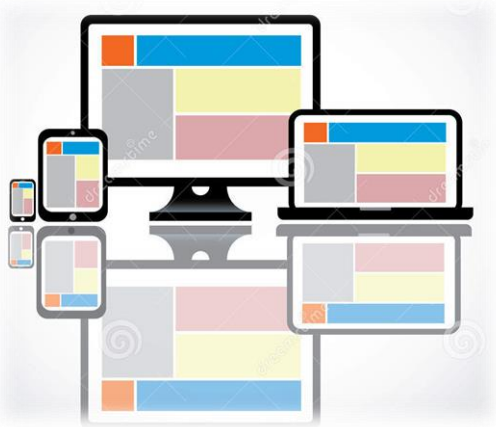
Results will support market strategies and positioning of the innovative products developed.

MADE WITH PULSES

WP6

Educational and Results dissemination

- Website and social networks
- Scientific publications
- Presentations in national and international congresses and exhibitions (TuttoFood, etc.)
- Demonstration days (including schools)
- LeGeReTe cardbook about legume accessions
- Final event



Scientific publications and Congress communications

External dissemination

Demostration day

Demostration day

Demostration day

FINAL EVENT

T0

T6 *Partners meeting*

T12 *Partners meeting*

T18 *Partners meeting*

T24 *Partners meeting*

T30 *Partners meeting*

T36 *Partners meeting*

Website

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1st Inter-TFF Meeting

2nd Inter-TFF Meeting

3rd Inter-TFF Meeting

Internal monitoring and dissemination

Conclusions

The synergistic cooperation among Partners will hopefully increase legume consumption