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Enhancing of legumes growing in Europe through sustainable cropping for protein supply for food and feed

FP7 Research Project № 61378

How to make protein crops profitable in the EU
EUROLEGUME Project contribution

EIP-AGRI Workshop 'How to make protein crops profitable in the EU'

26-27th SEPTEMBER 2014

BUDAPEST

Funded by the 7th Research Framework Programme of the European Union

www.eurolegume.eu

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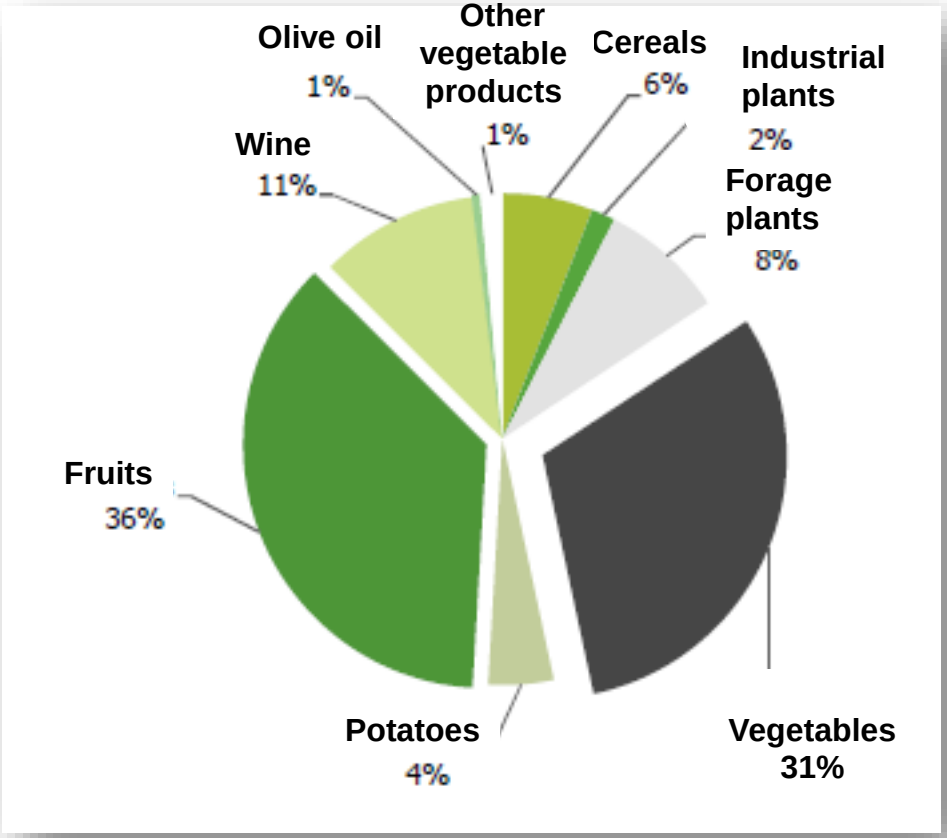
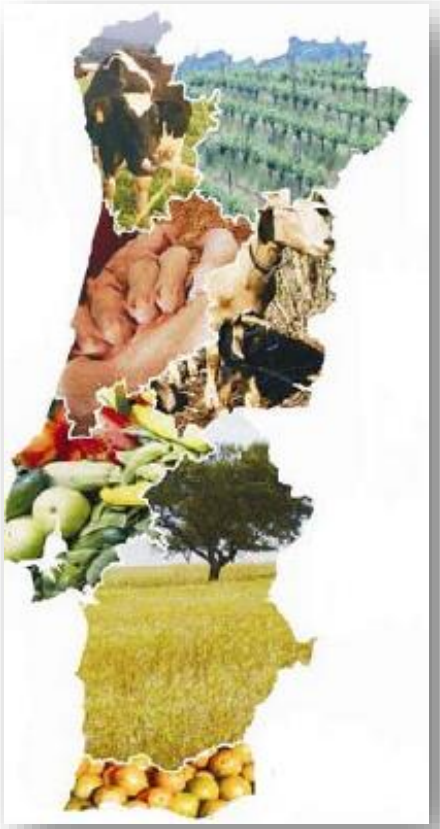
PORTUGUESE VEGETABLE VS ANIMAL PRODUCTION

Agriculture Production (10^6 E) (2010-2012)			
	2010	**2011**	**2012**
Vegetable production	3 448	3 278	3 243
Animal production			
Meat	1 914	1 998	2 053
Milk	675	720	745

Portuguese crop production breakdown





***Source**: INE; ES Research 2013.*

PORTUGUESE CROP PRODUCTION

Major crops production

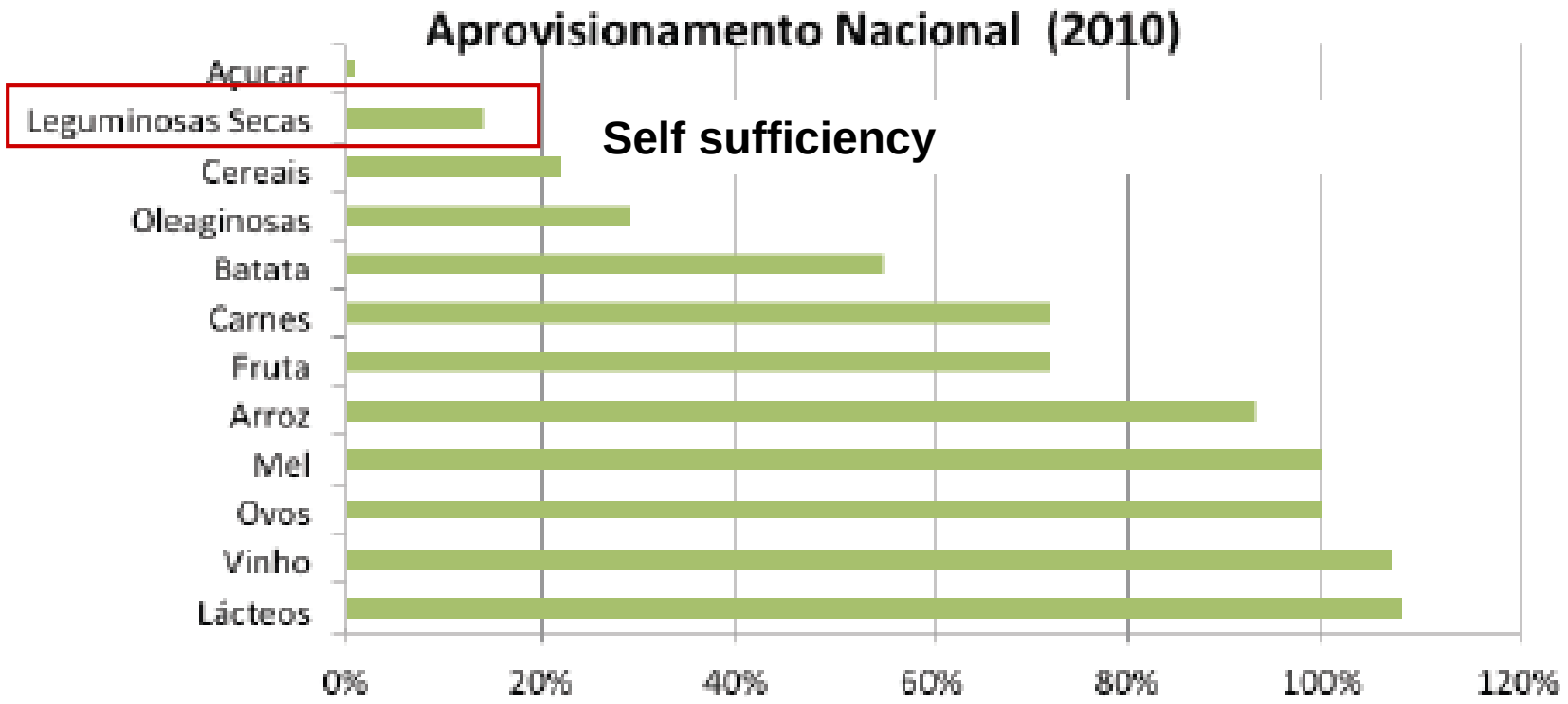
Crops	Area (ha)			Production (t)		
	2010	2011	2012	2010	2011	2012
ANNUAL CROPS						
CEREALES						
Wheat	48610	39628	51081	66962	47096	54722
Wheat (durum)	9117	2868	3712	15615	3907	4268
Maize	90371	99983	102196	626222	810267	848665
Rye	20441	19719	19508	17553	18388	14784
Triticale	24487	20485	20807	25871	23492	17019
Rice	29120	31436	31174	170216	184087	187028
Oat	61748	52351	41122	66145	48255	30506
Barley	20224	16627	18342	30620	21000	21151
LEGUMES (GRAIN)						
Beans	3509	3511	3402	2042	2058	1932
Chick-peas	1074	1010	1159	605	680	634
Green beans	---	---	2509	---	---	54974

PORTUGUESE CROP PRODUCTION

Major crops production

Crops	Area (ha)			Production (t)		
	2010	2011	2012	2010	2011	2012
POTATO						
Potato	25531	26501	25052	383835	289800	445649
CULTURES FOR INDUSTRY						
Tomato	16640	15359	13895	1406084	1150827	1298902
Sunflower	14003	22418	18030	7611	12572	9624
OTHER CROPS						
Oranges	16303	16374	16544	193885	228101	208980
Apples	12450	12539	12902	212902	247229	220761
Pears	10954	10971	11226	176764	230447	116287
Peaches	3711	3711	3783	33000	34520	30157
Wine	177661	176988	176985 Po	6961	5479	6162
Olive/oil	335586	338048	338562	435009	510733	404626

Self sufficiency of agriculture products



INE inAgroCluster do Ribatejo. Levantamento dos fatores diferenciadores do setor na região e de posicionamento do Cluster, 2012.

***Source**: Research and Innovation National Strategy for a Smart Specializations 2014-2020, Working document nº 2, 2014.*

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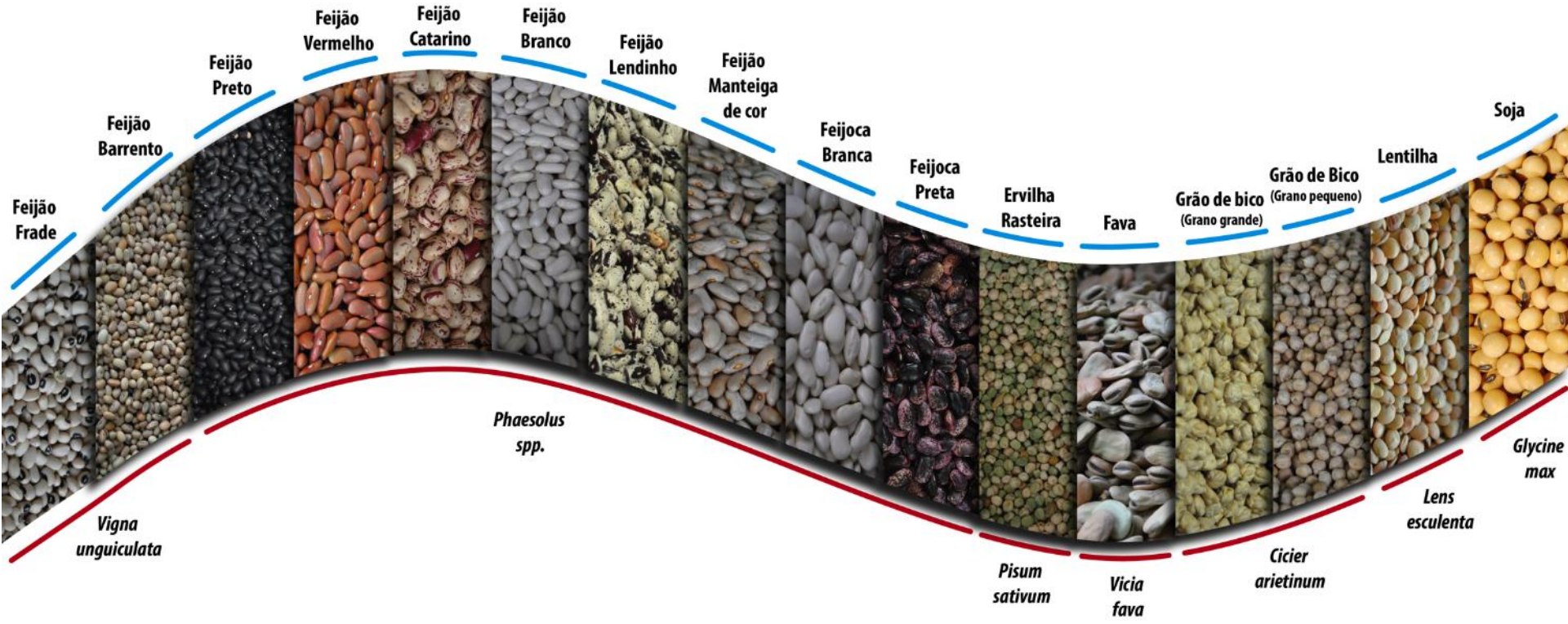
Portugal a centre of biodiversity for legumes



Portugal a centre of biodiversity for legumes

Species	Number of accessions
Beans	1542
Lupinus	743
Chickpea	384
Broad bean	313
Pea	191
Lathyrus	119
Black-eyed bean	56

***Source**: INE; ES Research 2013.*

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THE TOP TENDENCIES FOR 2013/2014

Top 10 trends for 2013

1- THE RESPONSIBLE CONSUMER

2- THE FOCUS ON HEALTH

3- HEALTHIER SENIOURS

4- “FREE FROM” FORMULATIONS

5- NATURAL “ALLEGATIONS”

6- HIGHER PROTEIN CONTENT

7- FIGHTING THE “DEVIL” OF SUGAR

8- SENSORIAL EXPERIENCES

9- MORE WITH LESS

10- INTEREST IN THE EXTREMES

Top 10 trends for 2014

1. Waste not want not
2. You can trust us
3. Simpler pleasures
4. Look out for the small guy
5. Health is more holistic
6. “New” superfoods
7. Rise of the hybrid
8. **The protein horizon**
9. New stealth strategies
10. Alternative alternatives

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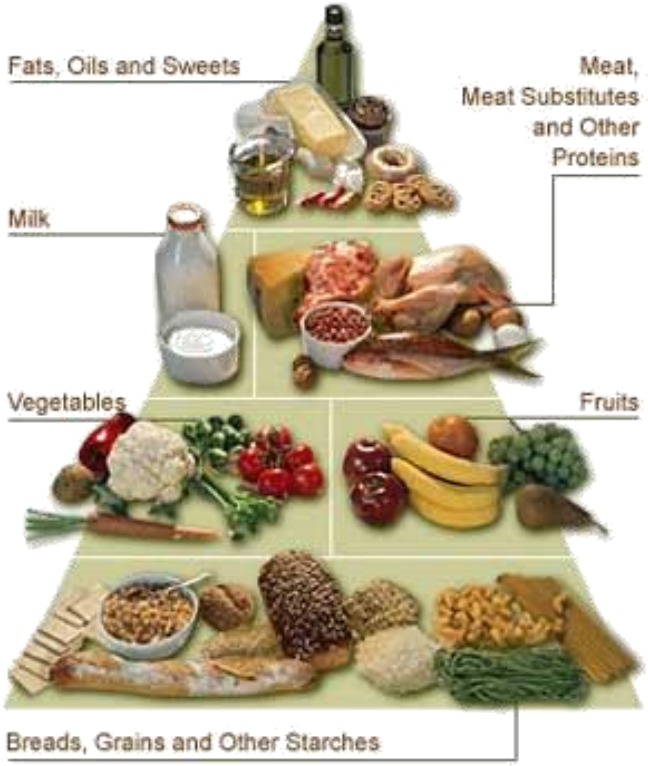
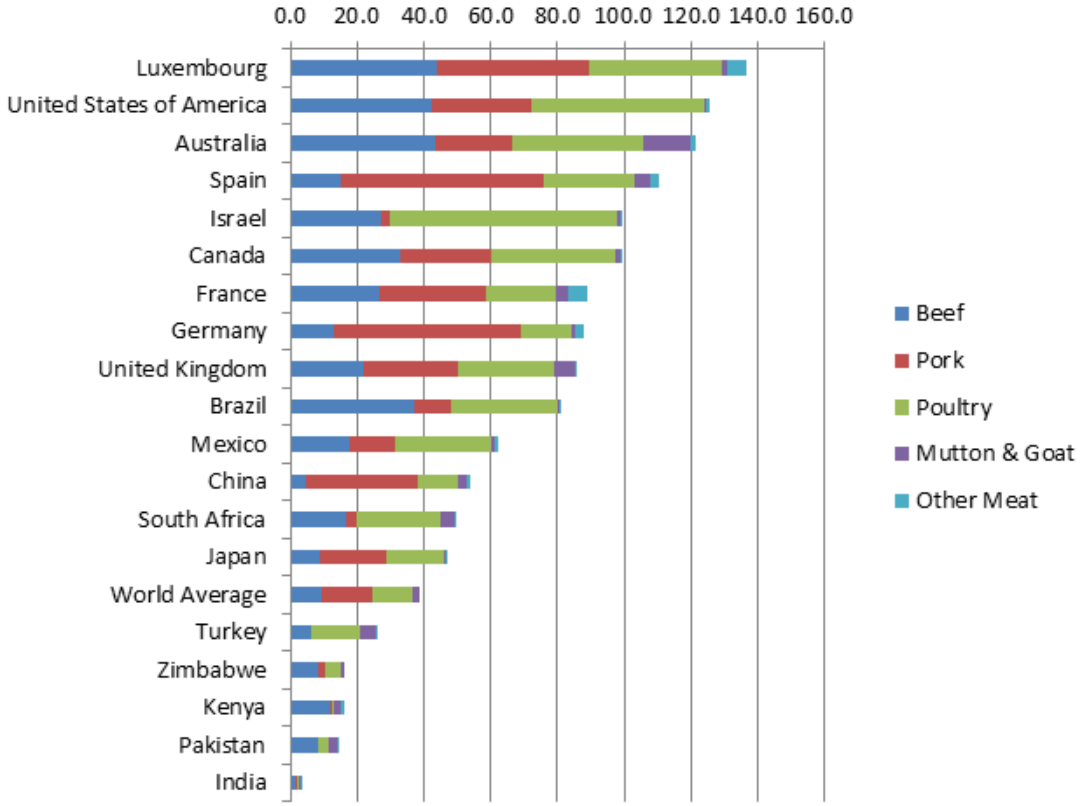
Legumes- a drive to change our diet





http://globalfoodpolitics.wordpress.com/2013/04/14/speculative-investment-the-missing-factor-in-global-food-price-increases/

Legumes- a drive to change our diet

Food consumption of meat

	1964/66	1974/76	1984/86	1994/96	1997/99	2015	2030
	Kg per capita, carcass weight equivalent						
World	**24.2**	**27.4**	**30.7**	**34.6**	**36.4**	**41.3**	**45.3**
Developing countries	10.2	11.4	15.5	22.7	25.5	31.6	36.7
excl. China	11.0	12.1	14.5	17.5	18.2	22.7	28.0
excl. China and Brazil	10.1	11.0	13.1	14.9	15.5	19.8	25.1
Sub-Saharan Africa	9.9	9.6	10.2	9.3	9.4	10.9	13.4
Near East/North Africa	11.9	13.8	20.4	19.7	21.2	28.6	35.0
Latin America and the Caribbean	31.7	35.6	39.7	50.1	53.8	65.3	76.6
excl. Brazil	34.1	37.5	39.6	42.4	45.4	56.4	67.7
South Asia	3.9	3.9	4.4	5.4	5.3	7.6	11.7
East Asia	8.7	10.0	16.9	31.7	37.7	50.0	58.5
excl. China	9.4	10.9	14.7	21.9	22.7	31.0	40.9
Industrial countries	61.5	73.5	80.7	86.2	88.2	95.7	100.1
Transition countries	42.5	60.0	65.8	50.5	46.2	53.8	60.7

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Legumes- a drive to change our diet

Food consumption of meat							
	1964/66	1974/76	1984/86	1994/96	1997/99	2015	2030
	Kg per capita, carcass weight equivalent						
Memo item							
World excl. China	28.5	32.6	34.3	34.1	34.2	36.9	40.3
World excl. China and transition countries	26.5	29.0	30.6	32.4	33.0	35.6	39.1
	Meat consumption by type (kg per capita, carcass weight equivalent)						
World							
Bovine meat	10.0	11	10.5	9.8	9.8	10.1	10.6
Ovine and caprine meat	1.8	1.6	1.7	1.8	1.8	2.1	2.4
Pig meat	9.1	10.2	12.1	13.7	14.6	15.3	15.1
excl. China	9.7	10.8	11.3	10.4	10.3	9.9	9.7
Poultry meat	3.2	4.6	6.4	9.3	10.2	13.8	17.2

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Legumes- a drive to change our diet

Glycemic Indices of various beans		
	GI $_{\text{White Bread}}$*	GI $_{\text{Glucose}}$*
Pinto beans	55	39
Kidney beans	42	27
Baked beans, canned	57	40
Dried beans	40	29
Black-eyed peas	59	42
Butter beans	44	31
Chick peas	47	33

* Calculated glycemic index when either white bread or glucose were used as the reference food. Expressed as a percentage of the reference food.

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Human consumption of pulses[1] in the EU, 2004-2008, in 1,000 tonnes				
	2004	2006	2008	Average anual change
Spain	235	n.a.	n.a.	n.a.
United Kingdom	210	n.a.	n.a.	n.a.
Italy	163	162	n.a.	n.a.
Poland	109	116	103	-1,4%
Romania	122	93	81	-9,6%
Greece	75	81	n.a.	n.a.
Bulgaria	81	78	n.a.	n.a.
The Netherlands	53	52	53	0%
France	111	47	37	-24%
Germany	n.a.	n.a.	36	n.a.
Hungary	33	35	36	1,9%
Lithuania	20	16	17	-4,1%
Slovakia	15	n.a.	n.a.	n.a.
Latvia	4,0	9,9	7,6	17%
Ireland	6,0	6,0	n.a.	n.a.
Austria	5,0	3,2	5,9	4,2%
Estonia	2,6	2,2	3,6	8,5%
Malta	n.a.	3,4	1,8	n.a.
Luxemburg	0,2	0,3	n.a.	n.a.

Source: Eurostat (2009)

[1] Data include: dried pulses, peas (incl. Chickpeas), broad and horse beans

[2] Data for Belgium, Cyprus, Czech Republic, Denmark, Finland, Portugal, Sweden and Slovenia were unavailable

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The legumes key advantages/focus

. Plasticity (climate changes)- climate and soil adaptations

. Biodiversity- still to be explored

. Biotechnology

- **Genes regulating yield**
- **Identify genes to disease & pest resistance**

. Abiotic stress resistance- drought and heat

. NBF- Rhyzobium + Mycorrhiza (inoculation)

. Product quality and health effects

- **Protein**
- **Glycemic index**

. New foods and feeds (also from co-products)

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The legumes value chain

Turn biodiversity into business

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The legumes value chain- **Turn biodiversity into business**

Black-eye bean

Soya

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The legumes value chain- **Turn biodiversity into business**

Recent cooperation Brazil

Black-eye bean

Accession from Covilhã

- Semi-prostrate
- White flower
- Green medium pod
- Beige grain colour

Accession from Azores- Faial

- Climbing
- Purple flower
- 1m pod of purple colour
- Black grain colour

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The legumes value chain- **Turn biodiversity into business**

Black-eye bean

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The legumes value chain- **Turn biodiversity into business**

Faba bean

Fungi- Mycorrhiza

Black-eye bean

Growth and isolation of rhyzobium

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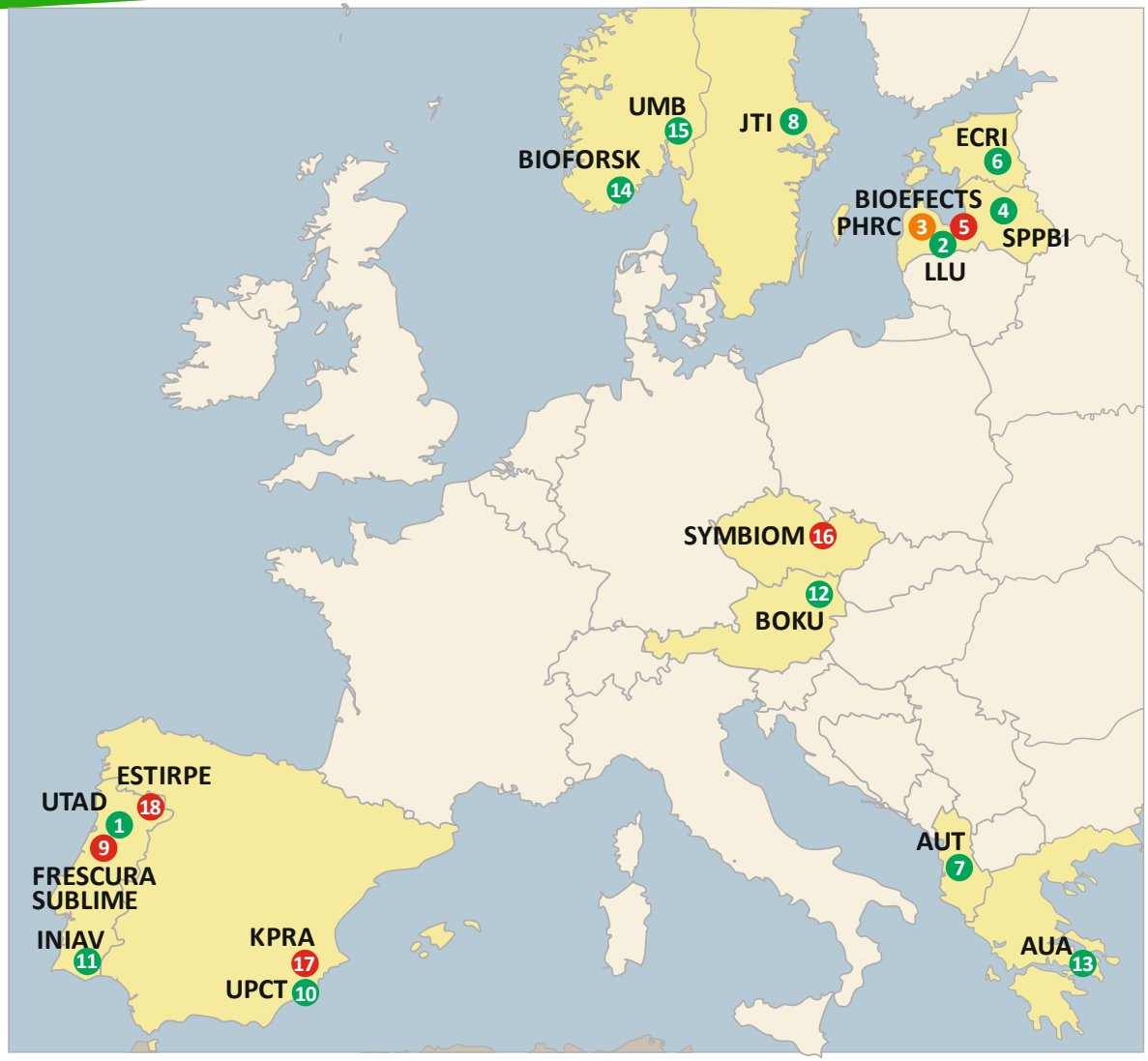
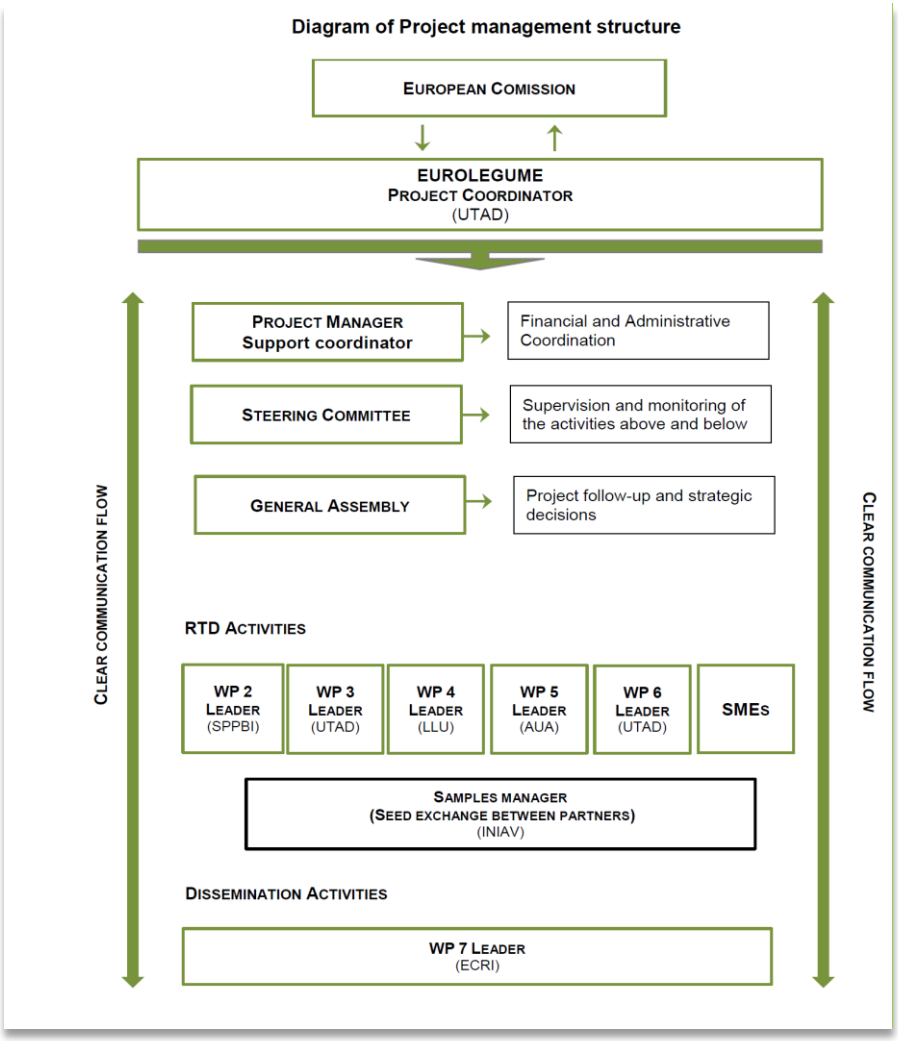
1. PROJECT PARTNERS



PARTNERS

1. UTAD - Portugal
2. LLU - Latvia
3. PHRC - Latvia
4. SPPBI - Latvia
5. BIOEFECTS - Latvia
6. ECRI - Estonia
7. AUT - Albania
8. JTI - Sweden
9. FRESCURA SUBLIME - Portugal
10. UPCT - Spain
11. INIAV - Portugal
12. BOKU - Austria
13. AUA - Greece
14. BIOFORSK - Norway
15. UMB - Norway
16. SYMBIOM - Czech Republic
17. KPRA - Spain
18. ESTIRPE - Portugal

2. PROJECT MANAGEMENT & ADMINISTRATION



Governance structure

The **General Assembly** has representatives of all partners and is the main decision-making forum for the project.

The **WP Leaders** (and team) are responsible for managing the research work as planned.

The **Steering Committee** has a major role to supervise and monitor the planned activities, assuring the implementation of the provisions contained in the Consortium Agreement .

The **Project coordinator** assures linkage between the General Assembly and the Steering Committee, reports to EC and will respond to the duties as described in the Grant Agreement. He is assisted by the **Project Manager**, that is responsible for the administrative and financial management.

3.PROJECT AIMS & OBJECTIVES

General objective

- **IMPROVE THE SUSTAINABLE PRODUCTION OF LEGUME CROPS, ENSURING NEW VARIETIES AND INNOVATIVE FOODS AND FEEDS, AND TURNING EU MORE COMPETITIVE/SUSTAINABLE.**

Specific objectives

- Description of Biochemical/morphological features of pea, faba bean, and cowpea/black-eye-bean genotypes to develop varieties for food/feed and use in breeding (WP2);

- Develop foods and feeds based on the nutritive value from European varieties of pea, faba bean, and cowpea (WP4);

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3. PROJECT AIMS & OBJECTIVES

- Selection of the most appropriate *Rhizobium* and arbuscular *mycorrhizae fungi* to support nitrogen fixation. Development of new commercial inoculants (WP3);

- Introduce pea, faba bean, and cowpea in production schemes to enhance the sustainability of agricultural systems and improve the yield and economical benefit (WP5, WP6);

- Give an added-value (as feeds) to products from legume grain production residues (WP6).

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PROGRESS BEYOND THE STATE-OF-ART REGARDING EVALUATION OF GENETIC RESOURCES AND BREEDING

State-of-art	Limitations	Progress within EUROLEGUME	WORK PACKAGES INVOLVED
Significant number of accessions of European pea, faba bean and cowpea germplasm	- Incomplete geno-phenotyping - Availability of local genotypes not included in breeding programmes	**Sourcing and characterization of genetic and phenotypic diversity of local genetic resources**	**WP2** (Leader: A. Kronberga) **WP5** (Leader: D. Savvas)
Root system architecture/development has received an increased attention due to advances in phenotyping capabilities	Low focus on belowground characteristics of legumes in plant breeding	**Evaluation of currently available genotypes and their environmental constraints adaptive plasticity**	**WP2** (Leader: A. Kronberga)

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PROGRESS BEYOND THE STATE-OF-ART REGARDING EVALUATION OF GENETIC RESOURCES AND BREEDING

State-of-art	Limitations	Progress within EUROLEGUME	WORK PACKAGES INVOLVED
Developed modern and traditional cultivars of narrow genetic diversity	Limited number of cultivars with resistance to abiotic/biotic stresses	**Diversified gene-pool for further pre-breeding and breeding activities towards cultivars of plasticity/multipurpose use**	**WP2** (A. Kronberga) **WP5** (D. Savvas)
Broad spectrum of phenotypical, yielding and nutritional parameters of legumes	Long breeding process	**Acceleration of genotypes selection by NIR and genotyping by SSR**	**WP2** (A. Kronberga)

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PROGRESS BEYOND THE STATE-OF-ART REGARDING NUTRITIONAL VALUE AND INNOVATIVE FOOD AND FEED

State-of-art	Limitations	Progress within EUROLEGUME	WORK PACKAGES INVOLVED
Lack of information on nutritional value of local legumes	Deficit of high value protein and healthy compounds from local genotypes	**The local genotypes and varieties with high nutritional value for food/feed processing**	**WP2** (A. Kronberga)
Pea and faba bean produced in broad scale in Europe	Lack of food and feed legume products of local origin	**Inovative food and feed products from local legumes** **Development of processing packaging technologies and materials**	**WP2** **WP4** (R. Galoburda)

PROGRESS BEYOND THE STATE-OF-ART REGARDING NITROGEN FIXATION AND DEVELOPMENT OF INOCULANTS

State-of-art	Limitations	Progress within EUROLEGUME	WORK PACKAGES INVOLVED
Broad diversity of Rhizobia and AMF in the nature and collections is referred	Lack of evaluation of BNF efficiency in diverse agro-ecological conditions	**New rhizobial strains/arbuscular mycorhizal fungi for BNF in different agro-ecological conditions**	**WP3** (G. Marques)
	Minor evaluation/genotypic characterization of diversity within Europe	**Rhizobium leguminosarum and Bradyrrhizobium spp. strains described**	**WP3**
		Development of commercial products with rhizobial strains and arbuscular mycorrhizal fungi	**WP3**

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PROGRESS BEYOND THE STATE-OF-ART REGARDING CULTIVATION AND BIOLOGICAL N FIXATION

State-of-art	Limitations	Progress within EUROLEGUME	WORK PACKAGES INVOLVED
Soy and common pea variants has focused research for use in food/feed.	- Not all European local genotypes have been available for testing - Limited information on faba bean and cowpeas	**High valuable genotypes for utilization in food/feed will be detected**	**WP2** (A. Kronberga)
Limited number of legume varieties/cropping systems researched on influence on soil properties.	High cost of long researches on cropping systems and rotations	**Evaluation of leguminous plants influence on soil properties in growing systems**	**WP5** (D. Savvas)
		Improvement of atmospheric N fixation, reducing chemical inputs and increasing competitiveness of EU agriculture	**WP6**

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Enhancing of legumes growing in Europe through sustainable cropping for protein supply for food and feed

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WP4

Nutritional value and innovative food and feed

WP4 leader: **Ruta Galoburda**

(LLU – Latvia)

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WP 4 -Introduction

Nutritional value and innovative food and feed

Task 4.1. - Evaluation of the quality of new feed and food **(month 7-46)**

Task 4.2. - Multiuse of all three species in development of innovative foods/feeds **(month 3-48)**

Task 4.3. - Development of new processing and packaging techniques **(month 3-48)**

Task 4.4. - Economic assessment of new products **(month 13-48)**

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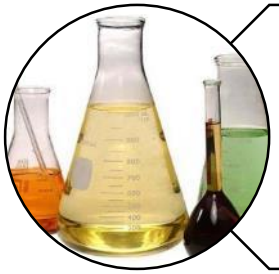
Task 4.1

- **4.1.1** Physical, biochemical and sensory characterisation of legume genotypes (as soon as samples are available from WP2)
- **4.1.2** Digestibility and fermentation
  (in the first year establishment of testing procedure; experiments in second – fourth year, when feed products are developed)
- **4.1.3** New feed products - metabolism, productivity and product quality (in the first year establishment of testing procedure; feeding trials in second – fourth year)
- **4.1.4** Microbiological safety of food/feed (connected to feeding trials and food storage experiments)

Task 4.1.1 Analysis (chemical, biochemical and sensory)

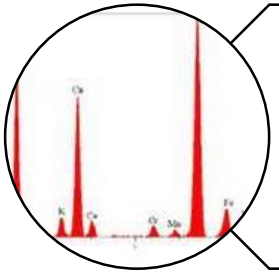


Analysis of commercial samples prior to product development (sample size >500 grams)

Testing procedure: methods?

Data validation

(ring test) – early in the project



Analysis of available genotypes (sample size >100 grams) to be repeated each season - from WP2

- dry matter
- organic matter
- crude protein
- amino acids
- fiber
- vitamins
- minerals
- phenolic compounds
- antioxidant activity
- anti-nutritional compounds

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Task 4.1.2 Digestibility and fermentation

- Digestibility and fermentation analysis for animal feed
- In vitro digestibility evaluation for food
- Rumen degradation studies

Ruminant Feed

- Protein
- Fiber (NDF)
- Starch
- Ash
- Fat
- Soluble carbohydrates
- Rumen degradation

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Task 4.2 Multiuse of all three species in development of innovative foods/feeds

- In the first year, the experiments will be made with commercial genotypes and in the following years with the selected varieties (from WP2)
- Evaluation of key attributes from raw material to final product, in order to assess effect of processing

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Task 4.2 Multiuse of all three species in development of innovative foods/feeds

In the first year available genotypes will be used for technology development

- Cowpeas: pods and beans (freezing) - Portugal
- Broad beans and peas: new products - sweet and salty snacks (extruded), legume pate – Latvia
- Cowpea seeds and pods and immature seeds and pods of pea: postharvest and storage – Greece

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Thank you very much

Contact: Eduardo Rosa

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Funded by the 7th Research Framework Programme of the European Union