Breeding priorities

Prof. Diego RUBIALES
>250 SCI publications with IF h-index 32

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Legumes are multifunctional crops with extraordinary importance for the agriculture, environment and culture.

Key role in animal feed.

Being particularly important in the Mediterranean diet.

However, acreage in Europe and North Africa is continuously decreasing and we are importing legumes for food and feed.
## Acreage of most legumes continuously decreasing in Europe

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**WHY?**

**Is it the same elsewhere?**
At word level acreage of most cool-season legumes is decreasing whereas it is remarkably increasing for most warm-season legumes.

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**Remarkable increase in countries with little tradition of legume cultivation or consumption:** Canada and Australia

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Canadians and Australians showed us that also lentil, pea or lupine can be successfully cultivated even in marginal areas.

**Why this was not possible in Europe? Are the cultivars the limiting factor?**
Major limitations for legume cultivation/breeding:

Relatively low yield potential-stability

Numerous species multiplying breeder’s investments

Breeding priorities:

Increased yield and yield stability
Addressing markets demands

Sustainability of the system:

Improving the cv registration system
Use of certified seeds

• Grower satisfaction:
Good yield, disease resistance, lodging, herbicide tolerance, high prize

• Consumer satisfaction
colour, size, appearance, nutrition, ….. low cost

Increased yield and yield stability

Enlarging cropping area and stabilizing performance:
Genotype, Environment, Management, and their interactions

tolerance to stresses (drought, freezing, salinity, pest and diseases) combined with phenologies allowing escape

Important to develop adaptation to short spring cycles or long winter cycles to diverse geographical zones

Additional demands arising for environment-friendly and food security
- resource use efficiency including symbiotic performance
- resilient production in the context of climate change
- adaptation to sustainable cropping systems
- diverse uses: feeds, foods, non-food, forage or green manure
- Increased biodiversity, ecological services
Major needs in breeding for stress resistance:

- gain knowledge about stresses
- identify, share and preserve sources of resistance
- develop faster and more reliable screening procedures for both phenotyping and MAS
- better understanding of the genetics and physiology of resistance
- translate molecular and genomic information into tools useful for MAS
- integrate MAS to compliment classical breeding

Priorities change with the crop, the region and the cropping system.
The bad news: just as one of the possible examples, *O. crenata* is the major constraint for legume production in Mediterranean countries.

The good news: resistance has been identified now in all legume crops.

Resistance complemented with a number of management practices: Intercropping, suicidal germination, rotation, …
The good news: resistance to most biotic and abiotic stresses has been identified now in all legume crops.

Sources of resistance available to ascochyta

Sources of resistance available to rusts
Resistance to *insect pests* available.

Example: *aphids and weevils in pea*

- **APHID INFESTATION** (visual scale, 1-4):
  
  1. No colony
  2. Colonization start
  3. 30% plant area covered
  4. +50% plant area covered
Resistance to **drought** available. Example: pea, QTLs identified.
Nutritional quality: chemical composition and antinutritional factors

**Vicia faba:**
- **Low tannin** for monogastric animals: but more susceptible to some diseases
- **Low vicine-convicine** for favism in human and poultry: no negative impact on yield with low v-c gene

**Lathyrus sativus**
- **Low ODAP:** impact on resistance to drought and insects?

**Gaps to fill:**
Focus in improving nutrition-related chemical composition, while somehow neglecting sensory or processing important traits

- Vaz Patto et al., 2015. *Achievements and Challenges in Improving the Nutritional Quality of Food Legumes.* Critical Reviews in Plant Sciences, 34: 105-143
Consumers are increasingly discriminating and health conscious: efforts should focus on developing attractive convenient ready-to-eat and tasty legume-based food formulations, contributing to the diversification of healthier and more nutritional diets with high protein and fiber content, gluten free status, low glycemic index, antioxidant potential, as well as functional properties like water binding capacity and fat absorption.

- **adaptation to transformation:**
  Processing (‘canning’) quality of kabuli chickpea

  Overall quality: (1-5 scale)
  - Seed breakage
  - Seed colour
  - Brine colour

- **dehulling efficiency:**
  Important for Desi chickpea

**Other uses:** functional compounds, bioplastics, bioenergy,
Relevant EU research projects covering (partly) legume breeding activities

**FP5**

**FP6**: LEGRESIST

**FP7**

As well as other projects (INTERCROP, LEGUME FUTURES, EUROLEGUMES) covering agronomics aspects and others on nutrition

H2020: a topic launched in 2013, contract in negotiation

Was this sufficient? Did this impact the legume industry? What else is needed?
European Association for Grain Legumes Research

President

Vice-president

Grain legume Magazine
Quarterly, 28 p, 50 issues, 800 readers
International Legume Society
http://ils.nsseme.com/

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Legume Perspectives

http://www.ias.csic.es/grainlegumesmagazine/

Several issues being currently edited
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SERBIA, 2013

2ND International Legume Society Conference
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LISBON, OCTOBER 2016