Focus Group ‘Production of protein crops under climate change’

Sevilla, Spain
27-28 May 2025

Mini Paper 2: Crop options and their needs for improvement to increase plant protein production

Donal MURPHY-BOKERN
Fokion Papathanasiou, Mathijs Hast, Fred Stoddard

Focus Group 'Production of protein crops under climate change' 2nd meeting | Sevilla, Spain | 27-28 May 2025

Legume Generation

Crop options and their need for improvement to increase plant protein production

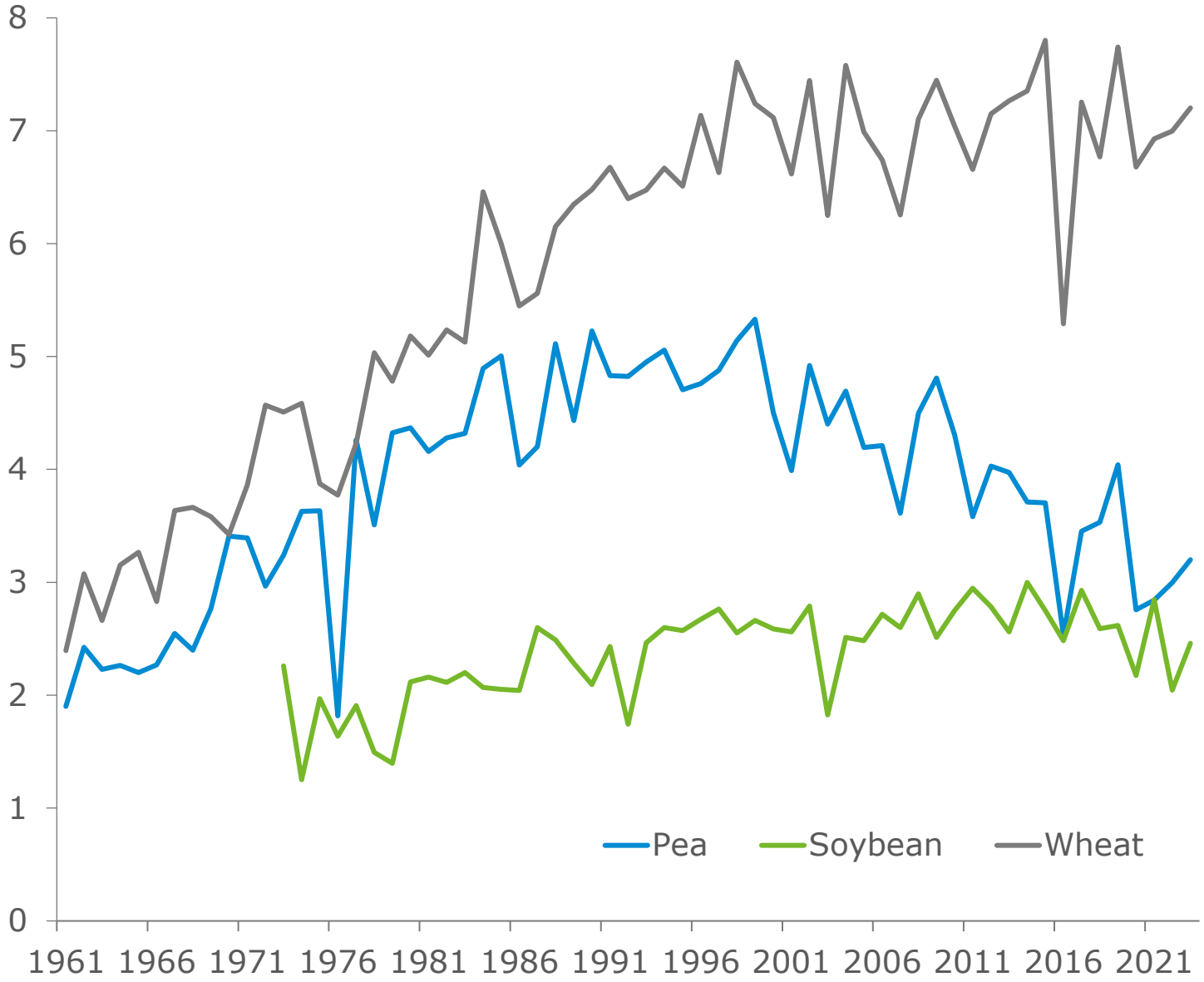
European CAP Network

Focus Group: Production of protein crops under climate change

Donal Murphy-Bokern, Fokion Papathanasiou, Mathijs Hast, and Fred Stoddard

Funded by the European Union

Changes in the average grain yield (t/ha) of wheat, pea and soya bean in France, 1961 to 2023



From FAOSTAT

What is the theme of the Focus Group?

Protein crops (plants) or crop (plant) protein?

We assume the theme is protein crops (not plant protein).

In line with the CAP, we regard legumes as the protein crops.

We have followed the framework we outlined at first FG meeting.

‘Protein’ is a mass noun:
Protein crops are rich in protein, they are not ‘proteins’
‘A protein’ is a pharmaceutical product

EU CAP Network Focus Group

Production of protein crops under climate change

Mini Paper 2

Characterisation and genetic improvement of protein crops

Donal Murphy-Bokern
Fokion Papathanasiou
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Fred Stoddard

May 2025

Legume Generation

Boosting innovation in breeding for the next generation of legume crops for Europe

Characterisation and genetic improvement of protein crops

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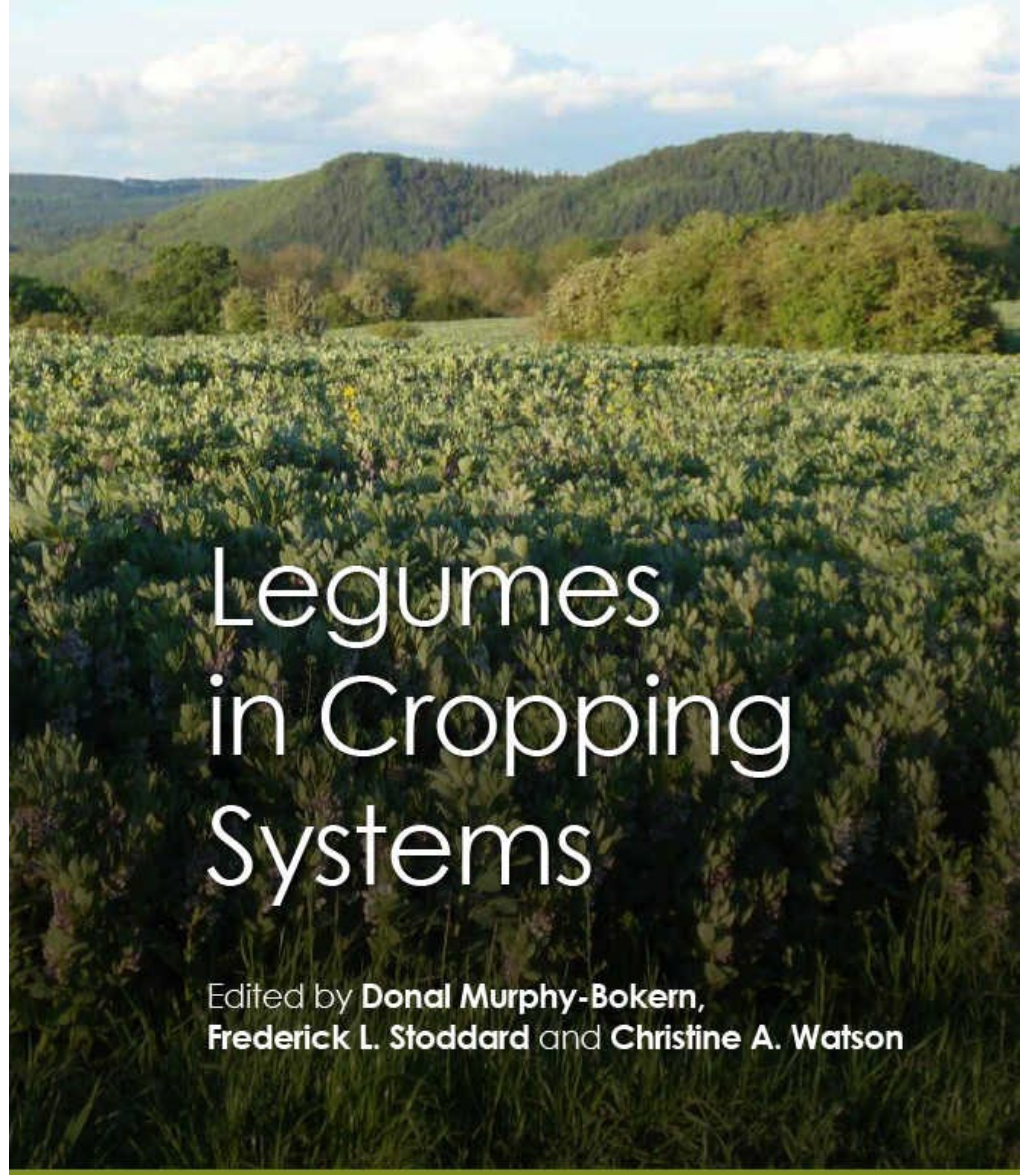
Legume Generation Report 8

Legume Generation (Boosting innovation in breeding for the next generation of legume crops for Europe) has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No.101081329. It also receives support from the governments of the United Kingdom, Switzerland and New Zealand.



Legumes in Cropping Systems

Edited by **Donal Murphy-Bokern**, **Frederick L. Stoddard** and **Christine A. Watson**

CABI

Contents

Characterisation of legume crops

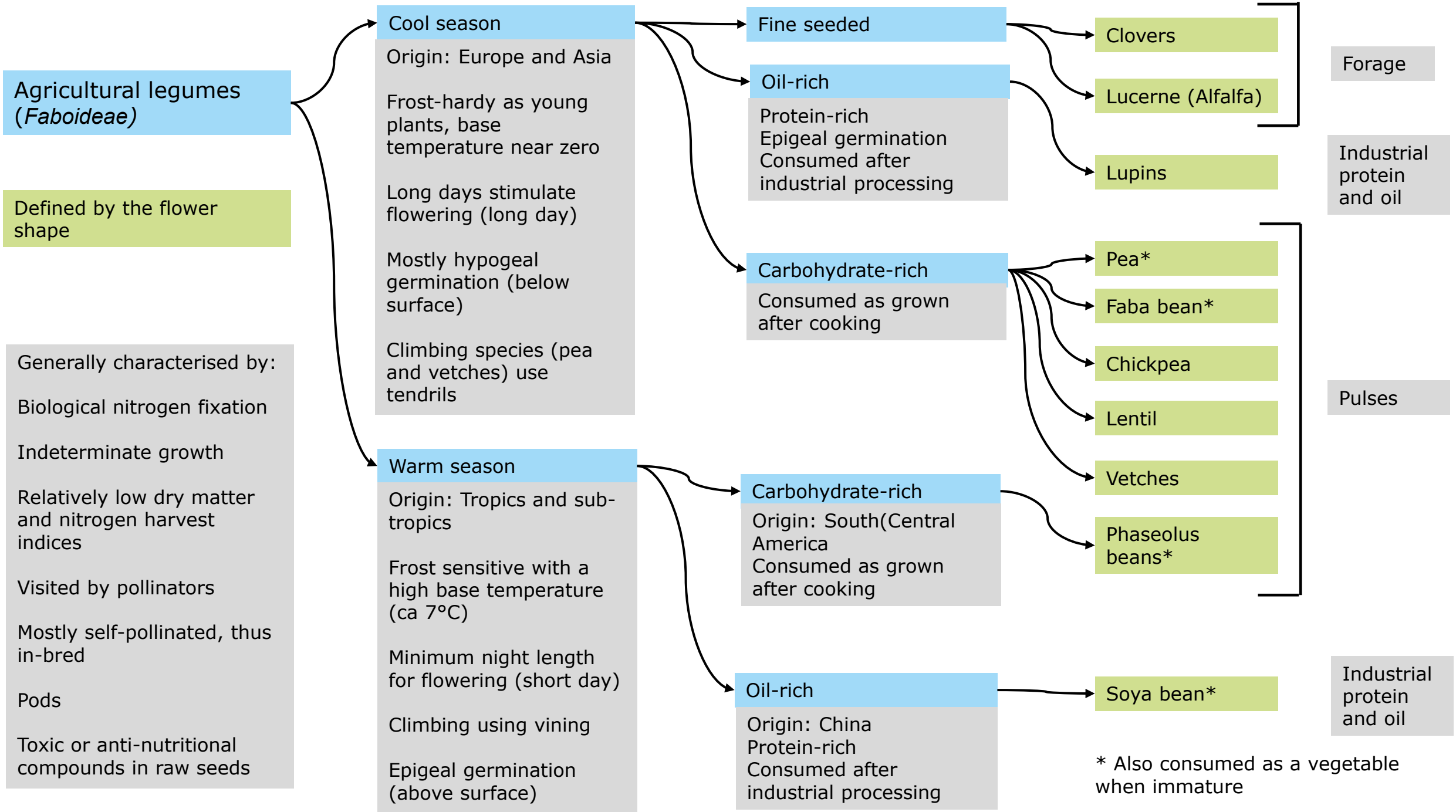

Agricultural legumes (*Faboideae*)
Defined by the flower shape
Generally characterised by:
Biological nitrogen fixation
Indeterminate growth
Relatively low dry matter and nitrogen harvest indices
Visited by pollinators
Mostly self-pollinated, thus in-bred
Pods
Toxic or anti-nutritional compounds in raw seeds
Cool season
Origin: Europe and Asia
Frost-hardy as young plants, base temperature near zero
Long days stimulate flowering (long day)
Mostly hypogeal germination (below surface)
Climbing species (pea and vetches) use tendrils
Warm season
Origin: Tropics and sub-tropics
Frost sensitive with a high base temperature (ca 7°C)
Minimum night length for flowering (short day)
Climbing using vining
Epigeal germination (above surface)
Fine seeded
Oil-rich
Protein-rich
Epigeal germination
Consumed after industrial processing
Carbohydrate-rich
Consumed as grown after cooking
Carbohydrate-rich
Origin: South(Central America
Consumed as grown after cooking
Oil-rich
Origin: China
Protein-rich
Consumed after industrial processing
Clovers
Lucerne (Alfalfa)
Lupins
Pea*
Faba bean*
Chickpea
Lentil
Vetches
Phaseolus beans*
Soya bean*
Forage
Industrial protein and oil
Pulses
Industrial protein and oil
* Also consumed as a vegetable when immature

Photo: Fred Eickmeyer

The top ten legume crops

Faba bean

Photo: Carola Blessing, The Legume Hub

Pea

Photo: AgroBioInstitute (Bulgaria),
The Legume Hub

Photo: Carol Blessing, LTZ
Semi-leafless pea

Soya bean

Photos: Donal Murphy-Bokern,

Lupins

Photo: Moritz Reckling, ZALF

Chickpea

Photo: Donal Murphy-Bokern

Lentil

Photo: Elizabeth Ninou

Photo: Pulse Australia

Phaseolus beans

Michigan Dry Bean Classes

P

Vetches

Photo: Thuenen Institute

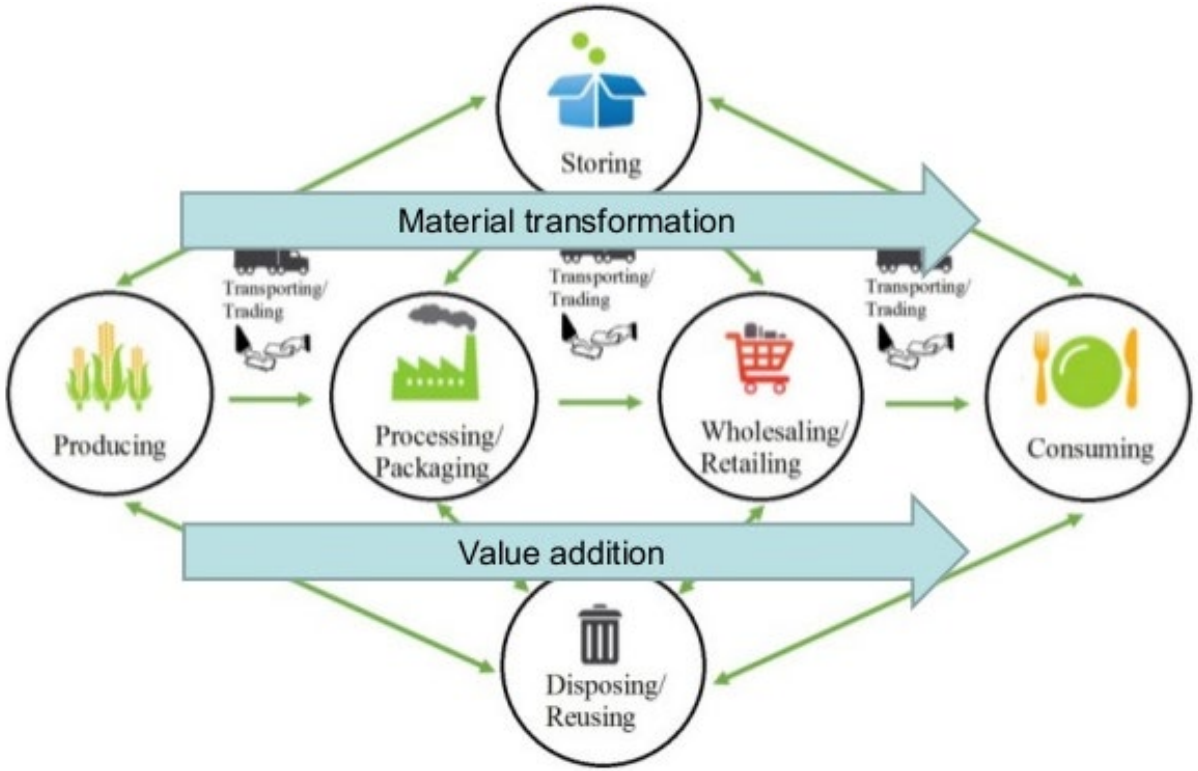
Lucerne

Photos: Bernadette Julier, INRAE

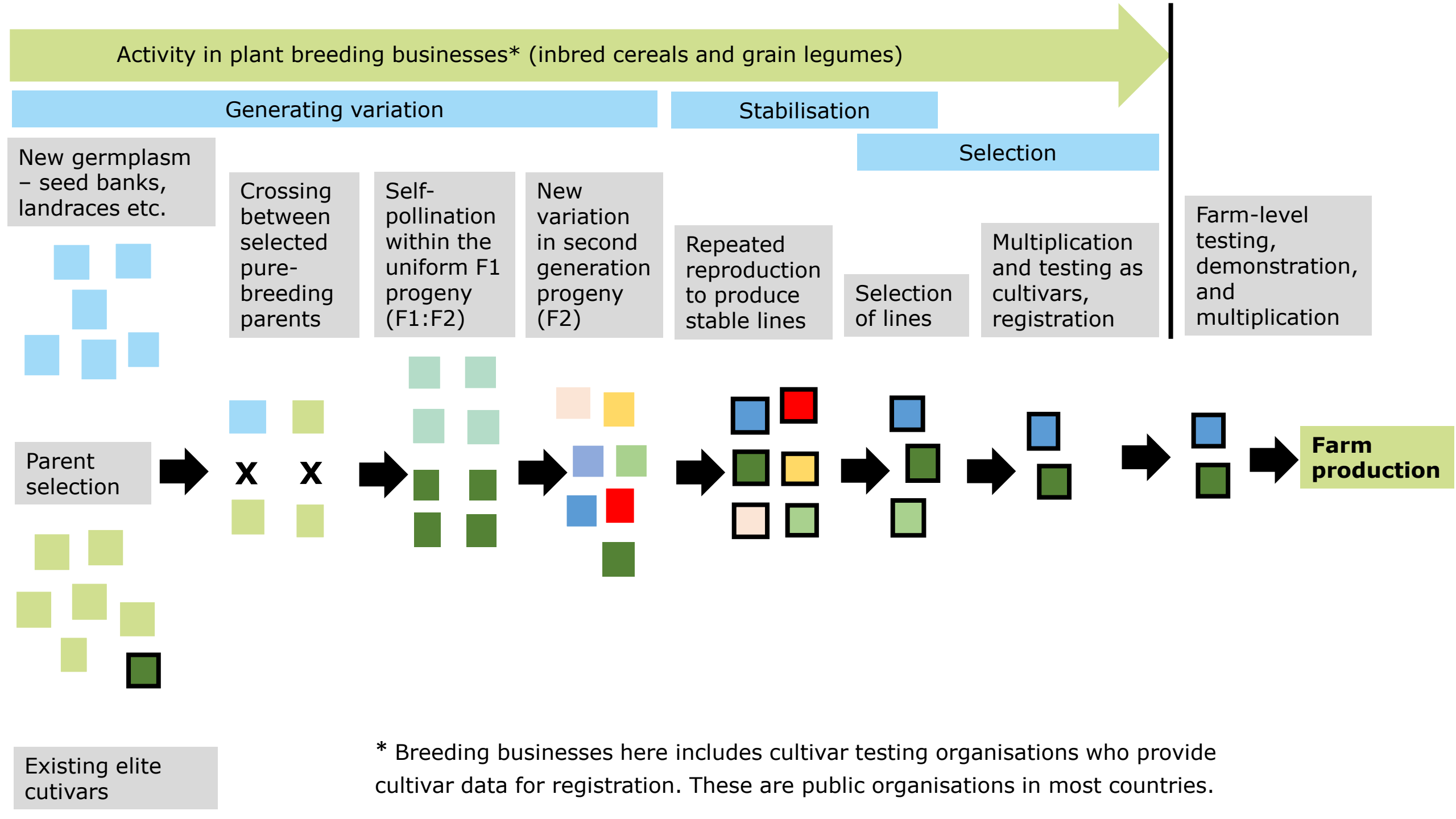
Clovers

The position of plant breeding in agri-food value chains

Plant breeding → Seed multiplication → Farm inputs →

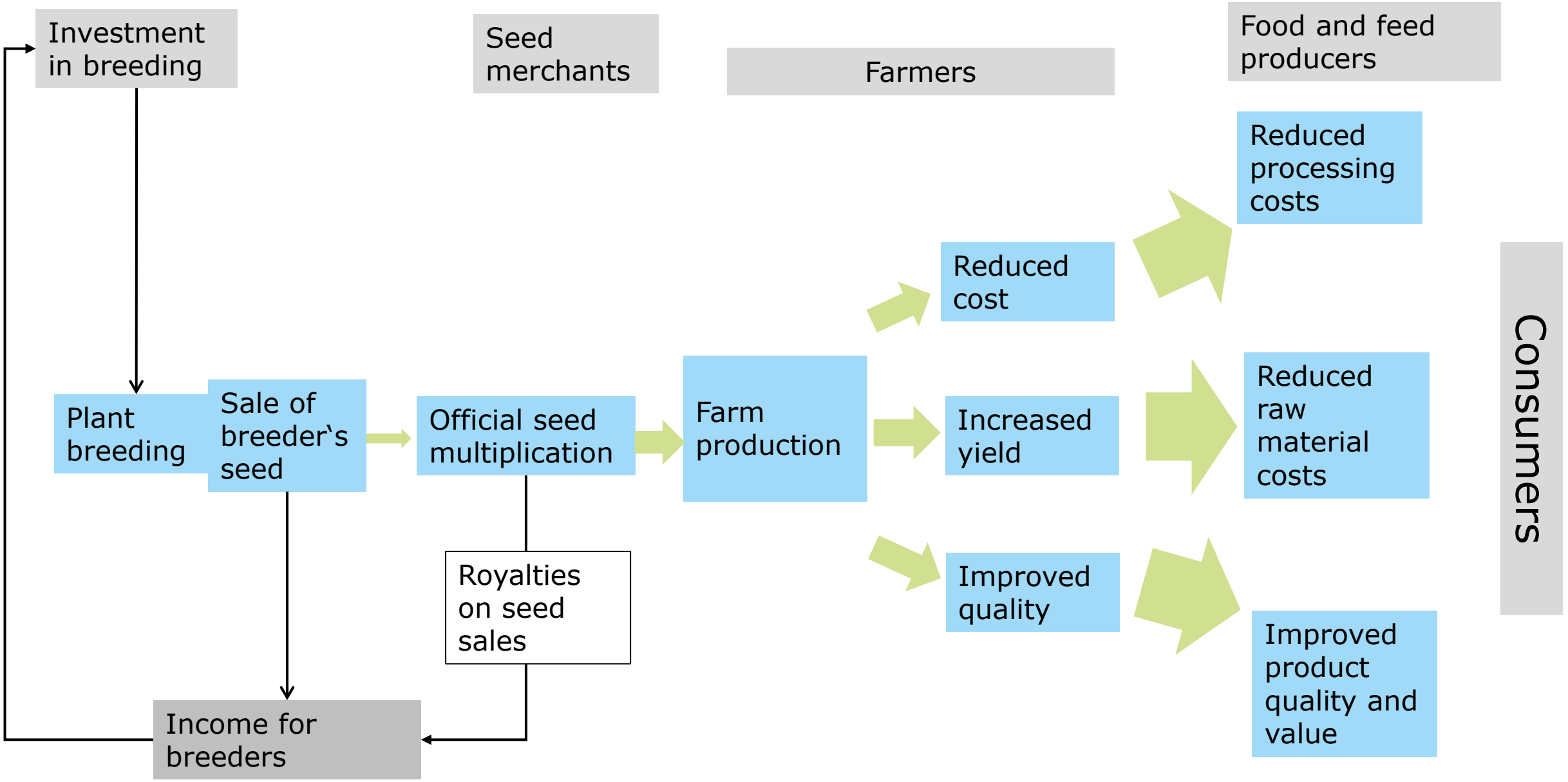


From John Ingram, University of Oxford (adapted)



* Breeding businesses here includes cultivar testing organisations who provide cultivar data for registration. These are public organisations in most countries.

The generation and distribution of value from plant breeding



Euphytica 17 (1968): 385–403

THE BREEDING OF CROP IDEOTYPES

C. M. DONALD

Waite Agricultural Research Institute,
The University of Adelaide, South Australia

Received 17 November, 1967

SUMMARY

Most plant breeding is based on "defect elimination" or "selection for yield". A valuable additional approach is available through the breeding of crop ideotypes, plants with model characteristics known to influence photosynthesis, growth and (in cereals) grain production. Some instances of the successful use of model characters of this kind are quoted.

Priority 1 Breeding for yield

Fundamental rather than incremental change needed

Extending the growing season – frost tolerance

Harvest index

Canopy function

Breeding for climate change

How does climate change affect plants

These are annual plants: climate and weather

Warmer or colder?

Drier or wetter?

Breeding targets (traits) for climate change

Earliness of harvest

Insensitivity to long days

Frost tolerance for autumn sowing

Early growth and vigour under cool conditions: reduced base temperature

Tolerance of summer chilling

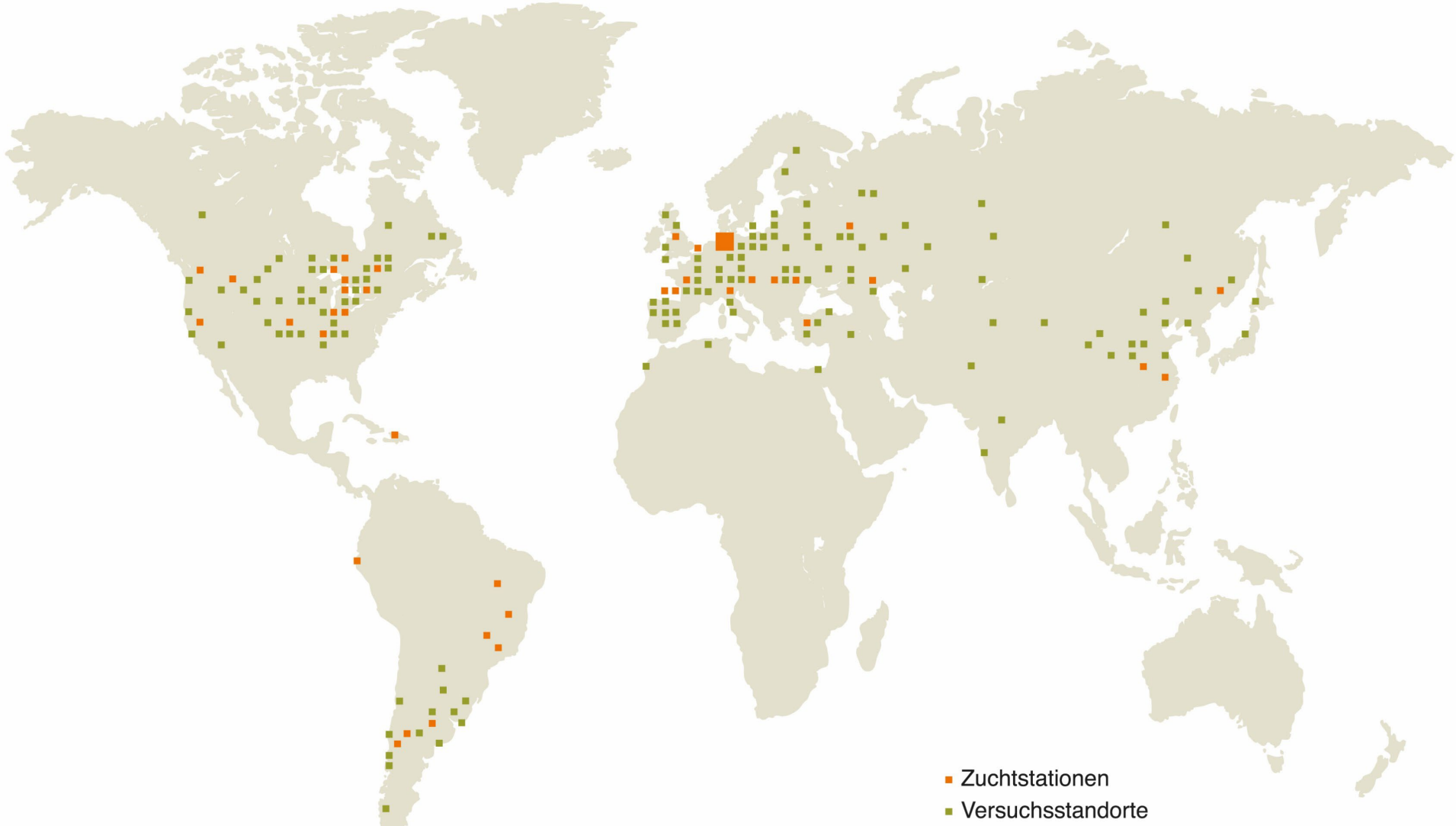
Tolerance and survival of heat stress

Tolerance of drought and water-logging

Breeding for climate change

KWS

Züchtungs- und Vertriebsaktivitäten der KWS Gruppe in über 70 Ländern



Participatory breeding

Participatory plant breeding

and

Participatory varietal selection

Organic breeding

‘Organic’ provides a particular selection environment

Unlike with cereals, nitrogen scarcity not an issue for legumes

Phosphorous uptake

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All information on the Focus Group is available on the webpage:
https://eu-cap-network.ec.europa.eu/events/focus-group-production-protein-crops-under-climate-change-2nd-meeting