High-quality crops for plant-based diets

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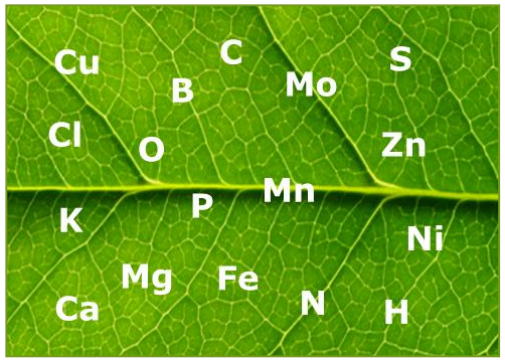
Plant Nutrients and **Food Quality** Research Group



Analytical Chemistry

- Biochemical functions
- Nutrient interactions
- Production systems
- Soil fertility
- Fertilization strategy
- Micro-climate
- Genetics

- Nutrient content
- Nutrient bioavailability
- Protein content
- Amino acid composition
- Heavy metals
- Food safety
- Food authenticity

https://plen.ku.dk/forskning/plante--og-jordvidenskab/plant-nutrients-and-food-quality/

Sustainable crops and production systems

- Improved utilization of light, carbon dioxide, water and nutrients
- Reduced use of non-renewable resources
- Circularity - use of wastes and industrial side streams
- Climate tolerance
- Disease and pathogen resistance
- Stable yields
- Crops for food instead of feed
- Targeted production using less resources

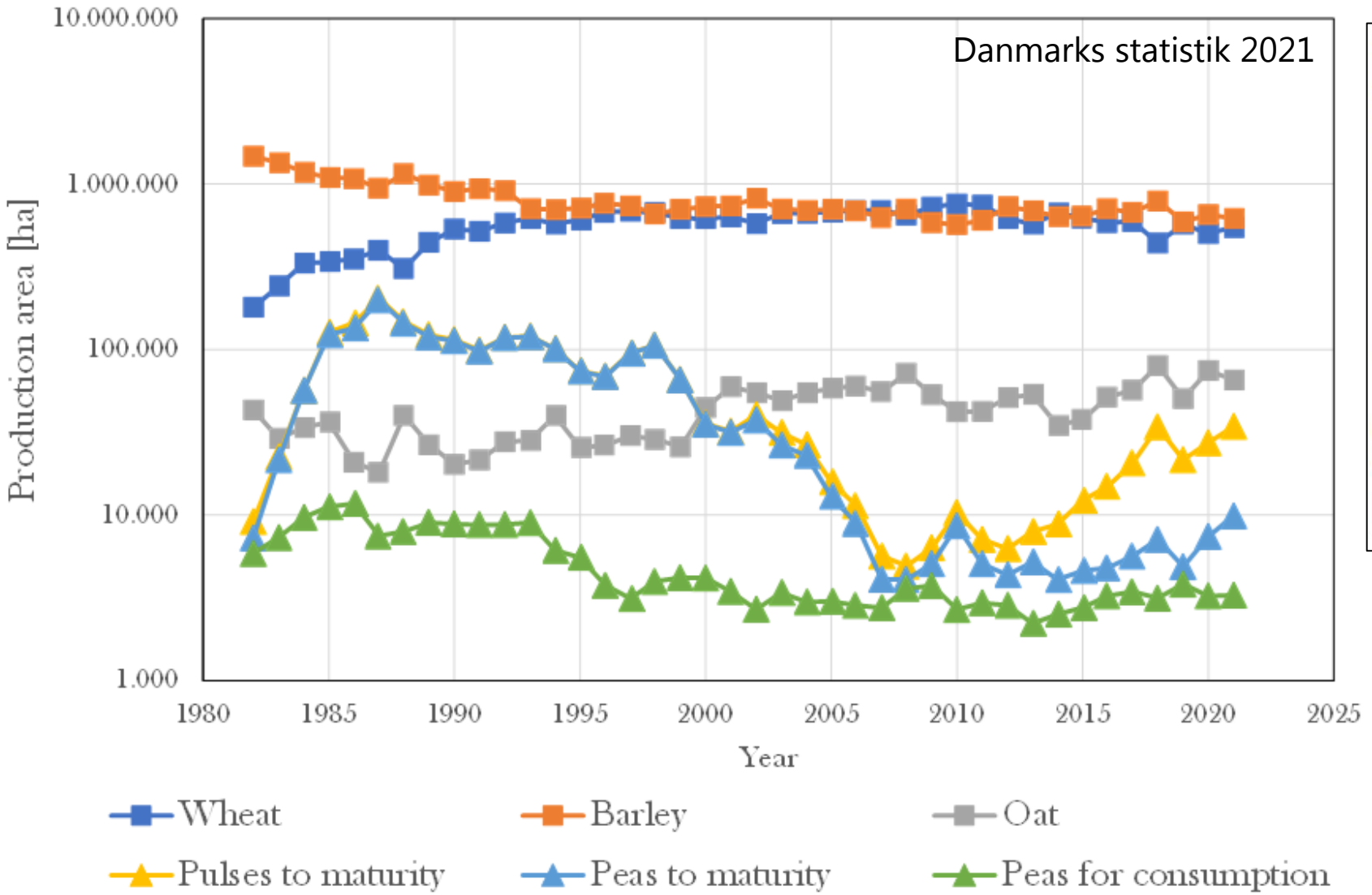
Which crops for a plant-based diet?

- More than 300.000 different plant species
- 150-250 plant species are agriculturally relevant
- ~10 plant species deliver 95% of Worlds food and feed
- Wheat, rice and maize dominate globally (2/3 of the total yield)
- Barley, wheat, maize, grass and rape seed dominate in Denmark
- Urgent need for more protein crops



Source: FAO og LBST

Danish crops in a historical perspective



I 2023 kan landmænd få et ekstra tilskud for at dyrke bl.a. hestebønner, hvis de opfylder betingelserne. Tilskuddet kommer oveni den almindelige landbrugsstøtte og økologitilskuddet. Foto: Marie-Louise Simonsen

Nyt tilskud til protein- og konsumafgrøder: Se listen med afgrøder her

Landmænd kan fra næste år få et ekstra tilskud, hvis de dyrker visse afgrøder til protein og konsum. Landbrugsstyrelsen har lavet en foreløbig liste med tilskudsberettigede afgrøder.

https://okonu.dk/

"Novel" crops for plant-based diets in a Danish perspective

Faba beans

Peas

Lupin

Lentils

Soybean

Oat

Quinoa

Amaranth

Buckwheat

Large differences in:

- Fertilization requirements
- Tolerance to drought, weeds, diseases, pathogens
- Harvest yield
- Functionality
- Taste
- Nutritional value
- Protein content
- Protein quality
- Anti-nutrient content

Yield or quality?

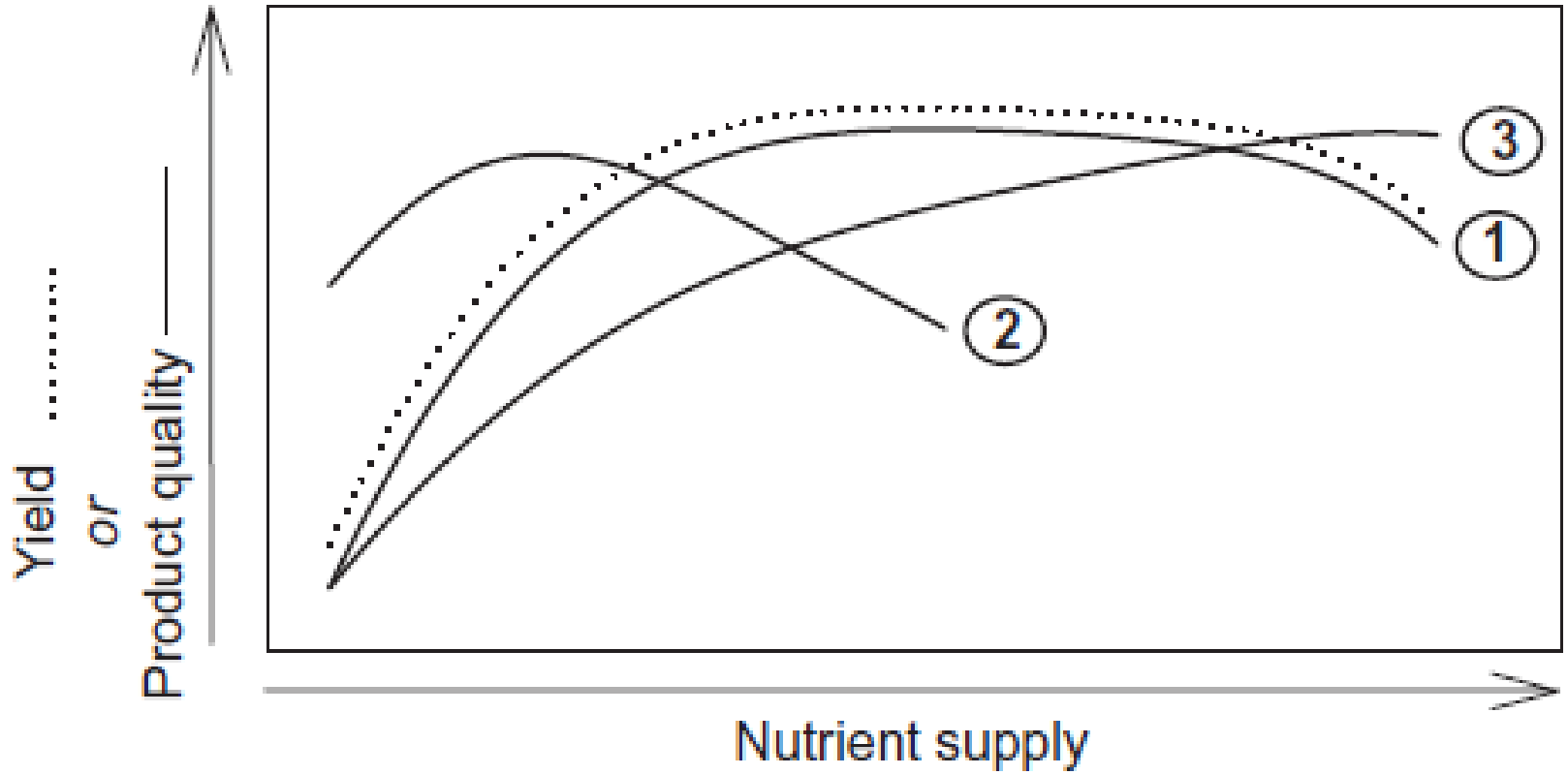


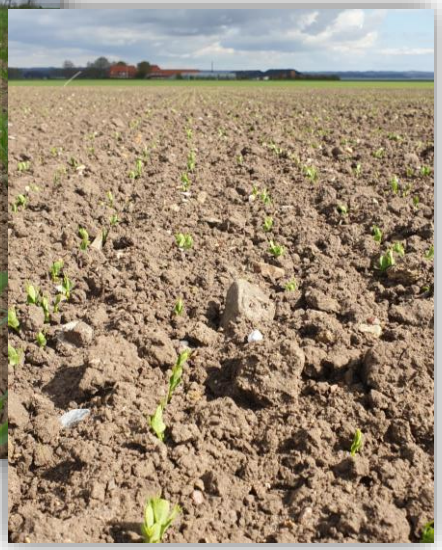
FIGURE 9.1 Nutrient supply and yield (dotted curve) and product quality (curves 1, 2 and 3). For explanation and examples see text. *Based on Marschner (1995).*

AQRIFood (2022-2024)

- Advancing the Quality of plant-based Raw materials and Ingredients for Food applications
- **Project coordinator:** Christian Bugge Henriksen
- **Participants:** See all 19 here www.aqrifood.dk
- **Funding:** Innovation Fund Denmark







Linda K. Nielsen

Individual WPs of AQRIFood Phase I

WP1) Selection and cultivation of relevant cultivars

WP2) **Analysis of nutritional quality of raw materials and ingredients**

WP3) Analysis of functional quality of ingredients

WP4) Analysis of sensory quality of ingredients

WP5) Determination of most important quality parameters

WP6) Extension and preparation of mutant library of faba bean

WP7) LCA pilot study

WP8) Project management and dissemination

WP2) Nutritional quality of raw materials and ingredients

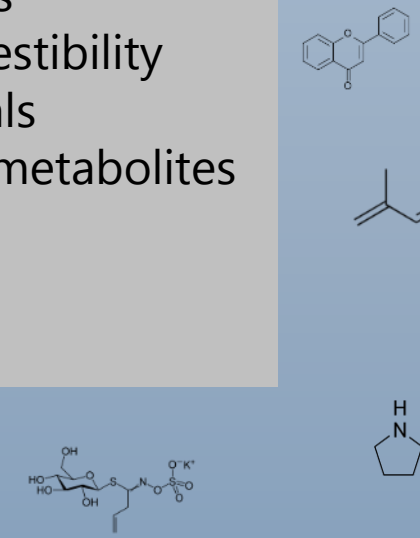
Kristian Holst Laursen (PLEN) and Søren Balling Engelsen (FOOD)

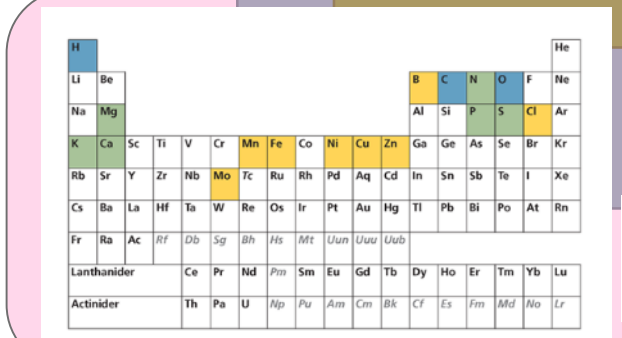
Bulk component

Water
Protein
Lipids
Fiber
Carbohydrate
Minerals

Nutrition and food safety

Amino acids
Protein digestibility
Heavy metals
Secondary metabolites
Saponins
Lectins
Mycotoxins





^{14}N	^{15}N
14.00307	15.0001
99.63%	0.37%

^{12}C	^{13}C
12.00000	13.00335
98.89%	1.11%

Essential plant nutrients N = 17

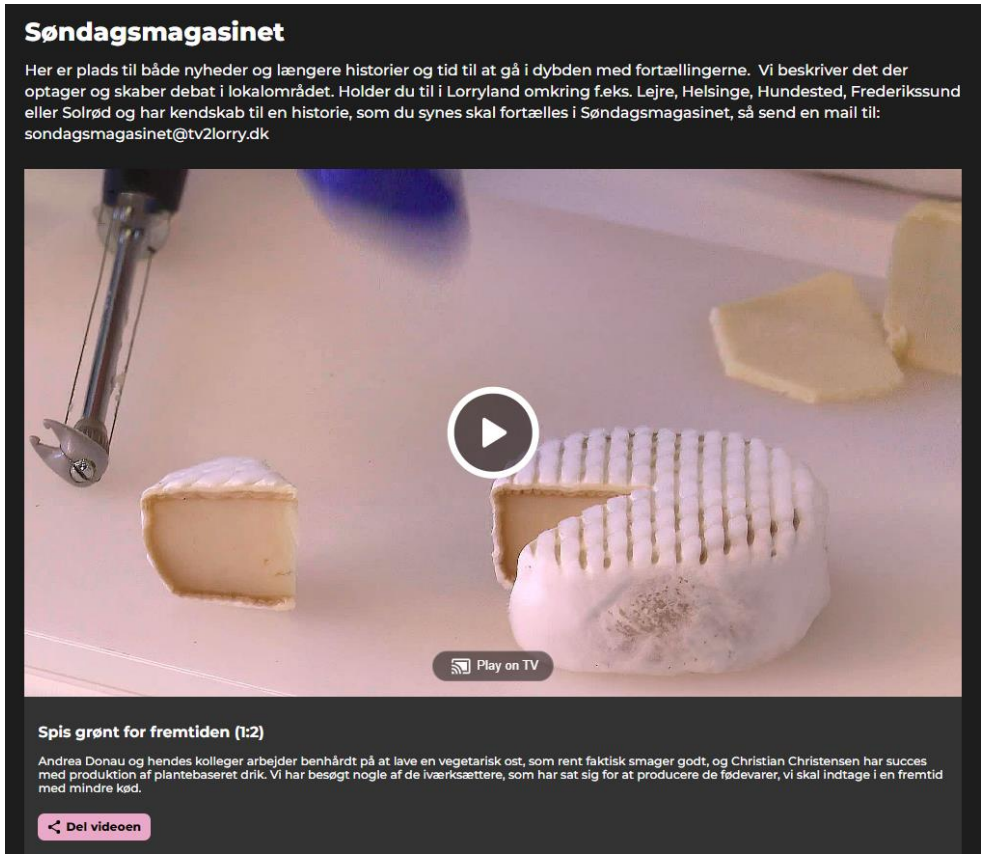
17. juni 2022

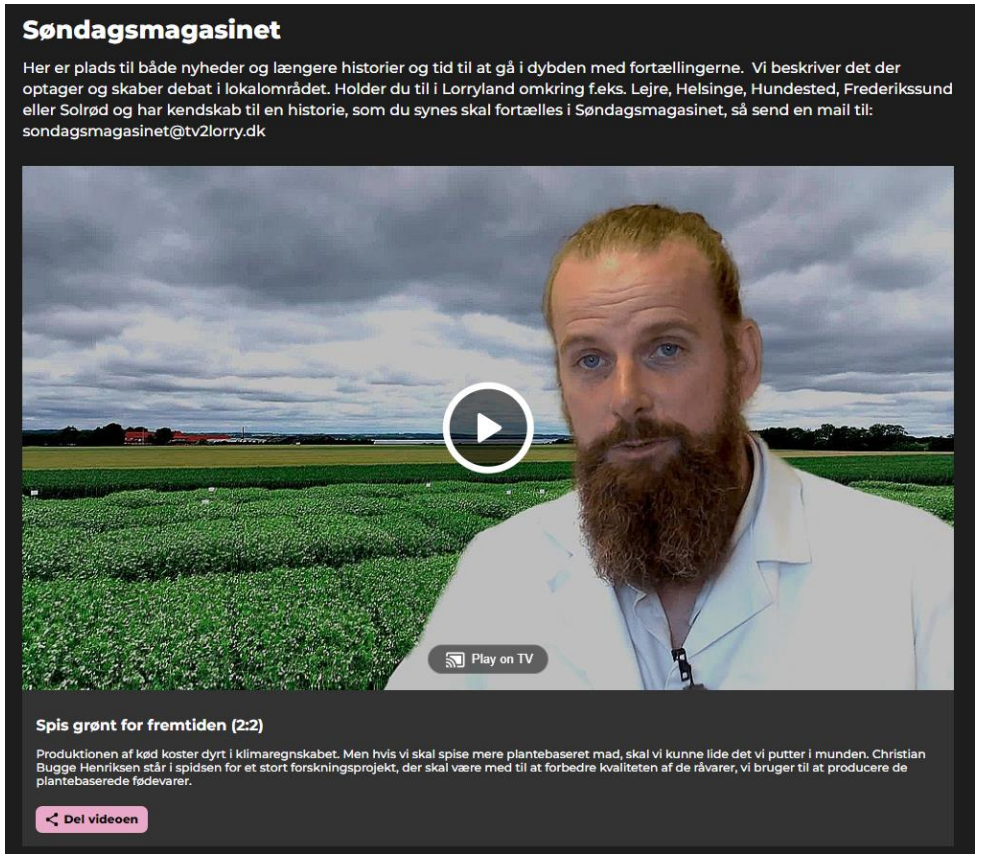
First AQRIFood leaf samples are ready for nutrient analysis

PLANT-BASED FOOD: Once analyzed, the samples collected from our Sejet breeding plots will hopefully reveal the best quality crops for plant-based foods.

https://plen.ku.dk/forskning/afgroedevidenskab/climate-and-food-security/aqrifood/news/tracking-samples-from-farm-to-lab-table/

TV2 LORRY





https://www.tv2lorry.dk/sondagsmagasinet/sondagsmagasinet-2116

Peas & Love (2022-2026)

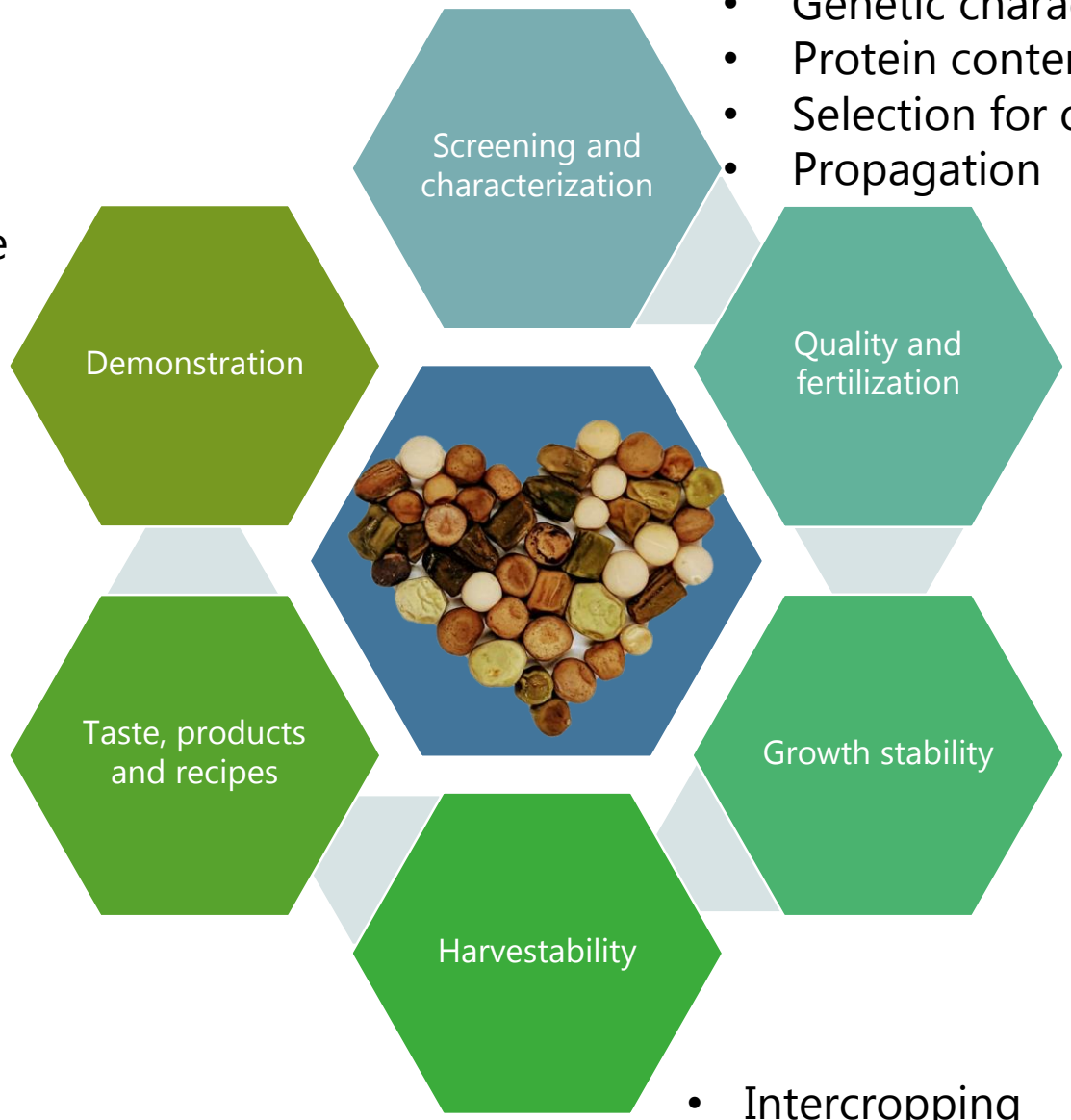
- Pea yield stability, taste and quality – potential of old cultivars for increased organic pea production
- **Project coordinator:** Dorte Bodin Dresbøll
- **Participants:** University of Copenhagen; Innovation Centre for Organic Farming; Pure Dansk; Loop Food Lab
- **Funding:** ICROFS Internationalt Center for Forskning i Økologisk Jordbrug og Fødevaresystemer; Ministeriet for Fødevarer, Landbrug og Fiskeri; gudp




PEAS & LOVE

- ~300 old accessions
- Genetic characterization
- Protein content
- Selection for other activities
- Propagation

- Growth at field scale
- Events



- Different organic fertilizers
- Quality: nutrients, protein content and amino acids

- Drought tolerance
- Root growth

- Taste tests
- Development of recipes
- Development of products

- Intercropping

Pea propagation

Field propagation: 133 accessions

Large: 15m x 1.5m
30 accessions

Small: 1m x 1m
43 accessions

Small: 1m (fenced)
82 accessions

Large variation! But it is also what's inside that matters ☺

https://icrofs.dk/forskning/dansk-forskning/organic-rdd-7/peas-love

Healthy and high-quality crops = nutritious and safe food?

- Healthy crops are not always nutritious foods
- Yield versus food quality parameters?
- Quality scoring depends on application – direct consumption, isolate, concentrate, extrudate etc.
- Post-harvest processing is often required (food safety, bioavailability, functionality, taste, smell…)
- Optimization begins in the field – improve quality during plant growth
- Growth method and fertilization strategy is important
- Interdisciplinary collaboration!

Collaboration possibilities

- Novel crops and raw materials for plant-based foods
- Agricultural production methods and systems for novel crops
- Analytical methods for evaluating the quality of crops and raw materials
- New technologies – data driven crop and food production

Two available positions in the PNFQ research group

PhD fellowship in protein crops for plant based food

https://jobportal.ku.dk/phd/?show=157560

Postdoc of Plant nutrition and analytical chemistry

https://employment.ku.dk/all-vacancies/?show=157559

Thank you for your attention

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https://plen.ku.dk/english/research/plant_soil/plant-nutrients-and-food-quality/