

Genetic resources and the importance of crop diversity

ir. Peter Keijzer

Program coordinator Breeding & Innovative cropping



October 20, 2021 Swedish R&D Days for Organic Production, Uppsala



Overview of this talk:

- ➤ The Louis Bolk Institute
- The Breeding & Innovative cropping program
- Genetic resources in breeding
  - ➢ Bioimpuls potato breeding
  - > OHM in cereals and OV in carrot and kohlrabi
- Importance of crop diversity
  - > Functional agrobiodiversity
  - > Mixed cropping of legumes and cereals
  - Stimulation of biodivers flora in arable fields



#### The Louis Bolk Institute

An independent non-profit foundation dedicated to further sustainable agriculture, food and health by doing contract research.

55 people employed annual turnover of about 4.5 M euro offices in Bunnik.





#### The Breeding & Innovative cropping program

Is one of four programs which make up our research branch.

Other programs: Soils & Arable production systems Sustainable dairy farming & Agrobiodiversity Food & health



## Genetic resources in breeding



(Pictures: Centre for Genetic Resources Netherlands)





Participative breeding for organic potato production: **Bioimpuls** 

2009 - 2029





### Why does it take so long?

Genetic resources:

In pre-breeding, resistance genes are crossed in from breeding lines or wild species.

Each crossing generation takes up at least 4 years.

By 2029, all resistance genes processed will be incorporated in commercial selection pipelines and will eventually yield new resistant varieties.

Louis Bolk WAGENINGEN Instituut UNIVERSITY & RESEARCH Why does it	take so long?
major genes 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029	2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040
DUS     DUS       Dib2     1     2     3     4     5     6     7     8     9     10     11     1     2     Launch	
Commercialcross DUS DUS R8 1 2 3 4 5 6 7 8 9 10 11 1 2 Launch	
Commercial cross DUS DUS Athlete etc. DUS 1 2 3 4 5 6 7 8 9 10 11 1 2 Launch	
Commercial cross DUS DUS Launch	
Commercial cross DUS DUS Alouette etc. DUS 1 2 3 4 5 6 7 8 9 10 11 1 2 Launch	
BC1         BC2 : backcross 2         Commercial cross         DUS         DUS         DUS           R9 or edn2         5         1         2         3         4         5         6         7         8         9         11         1         2         Launch	
BC1: backcross 1         BC2: backcross 2         BC3: backcross 3         Commercial cross           bcp         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         7         8         9	ous ous 9 <u>10 11 1 2 Launch</u>
BC1: backcross 1         BC2: backcross 2         BC3: backcross 3         Commercial cross           4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         7         8         9	ous ous 9 <u>10 11 1 2 Launch</u>
BC1         BC2: backcross 2         BC3: backcross 3         BC 4: backcross 4         Commercial cross           buk         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1	ous ous s 6 7 8 9 10 11 1 2 Launch
BC1: backcross 1         BC2: backcross 2         BC3: backcross 3         BC4: backcross 4         Commercial cross           iop         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4	DUS DUS 4 5 6 7 8 9 10 11 1 2 Launch
BC1: backcross 1         BC2: backcross 2         BC3: backcross 3         BC4: backcross 4         Commercial cross           SCr         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3         4         5         1         2         3	DUS DUS 3 4 5 6 7 8 9 10 11 1 2 Launch





Genetic resources:

At the start in 2009, sources of resistance were already identified and seeds from F1-generation crosses with those sources could be picked from the shelve.

Without that, a survey to identify sources and make the first inter-species crosses would have taken up precious time (3-4 years)!





## Importance of crop diversity





### 'new' or 'alternative' variety concepts

Classic variety concept means that the **genetic uniformity** within the variety is **as high as possible** (inbreds from self-pollinators, F1-hybrids)

When the variety is adapted to the foreseen conditions under which the variety has to perform, the **performance is predictable** 

However, when **conditions cannot be foreseen** or strictly controlled, flexibility within the variety might offer more **adaptive ability** 

✓ Organic heterogeneous material (OHM)
✓ Organic varieties (OV)



### Organic heterogeneous material (OHM)

Aim is to start with maximum genetic variation within your outcrossing 'variety' and by using the harvested seed in part as sowing seed it will optimally adapt to the conditions on the farm.





# Harvested grain has typically to be marketed in **short chains**, to ensure **good products and appreciation** from consumers

In 2014 we had a series of landraces and populations baked into bread: <u>no relation</u> between protein content and quality.



Biobackstube Ahaus – Bakproef voor LBI



Organic varieties are bred and produced fully under organic conditions and contain a high degree of genetic variation.

Organic varieties can be registered, so they have to pass DUS testing

In crops where regular varieties have a high degree of genetic uniformity, the **DUS protocols** might not allow for genetic variation within a candidate variety



In 2020, in cooperation with Bingenheimer Saatgut (D) we tested two candidate organic varieties in two crops at NakTuinbouw (NL) to assess usability for OV's of the existing DUS protocols

Kohlrabi needs adjustment, for carrot the existing protocol seems ok







## Importance of crop diversity





#### Exemples:

> Introduce predators to control crop pest insects

- > Supply feed for birdlife
- Raise pollinators to improve pollination and crop yield





#### Why? > Introduce predators to control trips in onion in stripcropping







2021: washed away

Merlijn van den Berg



# Why? > Supply feed for birdlife in field margins and embankments





2021/22 first winter

Dennis Heupink Merlijn van den Berg



#### Why? > Raise pollinators to improve quality + yield in pear (non-organic)



Results promising but still have to be published....., sorry



Willemijn Cuijpers



### Functional agrobiodiversity

#### Prerequisites?

- ✓ Observe and monitor relentlessly.
- ✓ Fiel margins and embankments should be treated like another crop, which needs full attention and effort.

Nettles after clipping without disposing of clippings > too nutrient rich





# Mixed cropping



Why?

- > Suppress weeds
- Improve nutriënt efficiency, product quality, yield distribution stability



### Mixed cropping wheat - faba bean

#### Average yield for 3 spring wheat and 7 faba bean cultivars





Floor van Malland



#### Average yield for 5 spring wheat and 2 lupin cultivars



Average lupin yield (t/ha)Average wheat yield (t/ha)





Floor van Malland



#### Prerequisites?

#### ✓ Information on varieties to devise optimal combinations











Floor van Malland



11

#### Prerequisites? ✓ Possibility to seperate seeds or an outlet in which to sell



Project for market opportunities to start in 2022



Abco de Buck

27



# Stimulation of biodivers flora in arable fields



### Stimulation of biodivers flora in arable fields

#### Why?

> As bridge for **farming close to N2000 areas** 

- > As **tool** in nature-inclusive farming
- > eco-schemes, improve atractiveness landscape, ....







Udo Prins



# Thank you for your attention!

### Questions later in the panel session....

Website: <a href="http://www.louisbolk.org">http://www.louisbolk.org</a>

E-mail: p.keijzer@louisbolk.nl

