Genome Editing in Agriculture and Food Systems in The Netherlands

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Brussels, May 23rd-24th, Gijs Kleter* (WFSR)

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Source image #1: USDA ARS Image Gallery

Schedule

- Netherlands as agri-food hub & portal
- Breeding ecosystem
- Companies' stance
- Governmental initiatives
- Public perception
- Conclusions

Netherlands: agri-food trade hub

Imports: €72.5B

Exports: €105B
(domestic €75.7B, imports €29B)

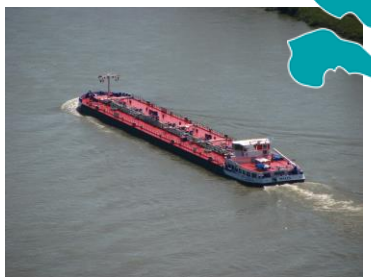

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Image source: Bing (CC-BY), WUR

Trade data (2020): Wageningen Economic Research

Horticulture: Dutch top sector

Cultivation, greenhouse construction, breeding, trade, etc.

- Knowledge-intensive
- Export-oriented
- Specifically regulated
- Helping solve societal issues

Food & ornamental

53% 35%

Export volume €24.5 billion
~6,000 exporters, ~¾ Dutch make
(2019)

R&D spending €765 Million
~$^2/_3$ breeders and wholesales
(2017)

Data source: CBS (2020)

Images: Bing (CC-BY)

Dutch plant breeding ecosystem

- "Plant source materials"
  - ~300 companies, ~€3 Bn exports
  - ~2,000 new plant variety registrations / year
  - NLD home to largest vegetable breeders
    - Multinationals: Monsanto, Bayer, Syngenta, BASF, etc.
    - Family businesses: Enza, Rijk Zwaan, Bejo, Bakker, etc.
    - Affiliations of JPN corps.: Takii, Sakata
  - "Seed Valley"
- Transdisciplinary academic & contract research
  - E.g., Wageningen UR, spin-offs
  - Funding: Applied, public-private, fundamental

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Data: SEO report, Plantum, HollandBio

Dutch government initiatives on new plant breeding techniques

- 2013: Summoned by Parliament to make the case in Brussels for **exemption of cisgenesis from the scope of GMO legislation**
- 2017: Dutch ministries propose the exemption of **techniques that do not ultimately introduce foreign DNA** into the plants
- 2017: The new government's accord explicitly states it will make the case for application and authorization of new techniques such as CRISPR Cas
- 2018: Dutch minister of Agriculture pleads for relaxation of rules for experimental use of genome editing (*e.g.*, for plant breeding research)

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Data: Dutch government, Europe Seed

Dutch government initiatives on new plant breeding techniques

Ministry of Infrastructure and Water Management:

- Advocacy of the Safe-by-Design approach to be applied to biotechnology
  - Part of broader initiative on chemical and nanomaterials safety
  - Pursued within OECD, amongst others
    - "Safe(r) innovation approach"
  - *E.g.*, agreement with tyre industry
- Anticipate potential safety issues at an early stage

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Data: Dutch government, Europe Seed

Dutch plant breeding sector position on”genome editing

- Position papers for roundtable discussions with govt.
  - For example, ENZA, Rijk Zwaan, KWS, Plantum
- Items commonly addressed
  - Current legislation too stringent
  - Need to respond quickly to changing trends
    - Shorter generation time with CRIPSR Cas
    - Stress & disease resistance, yield, taste, etc.
  - Different uses for research and breeding
  - Level playing field internationally, enforcibility
  - Intellectual property rights, accessibility

Public research on genome editing

- Scopus: 1,777 publications (2012-2023)
  - Agri-food:
    - Editing of microbes (Wageningen, Delft, Utrecht, Groningen, Ede)
    - Crop genome editing (Wageningen, Amsterdam)
    - Bacteriophages (Delft)
  - Medical:
    - Cancer: gene function
    - Editing of human cells, gene therapy
    - Organoids, etc., etc.
  - Ethics, responsible use, society, etc.
  - CRISPR Cas systems

Public research on genome editing

- Examples of research on genome editing
  - Wheat: altered gliadins (coeliac disease-related)
  - Heat-resistant and disease-resistant crops
  - Chicory: production of functional metabolite
  - Off-target effects of CRISPR Cas in crops
  - Microbes: production of industrial compounds
  - Starter cultures (e.g., lactic acid bacteria)
  - Societal issues, e.g. consumer acceptance
  - Future of crop breeding research (roadmap)

Dutch general public's stance on genome editing

- Various studies carried out
  - Particularly by the Rathenau institute, COGEM, etc.
  - General conclusions (genome editing of plants):
    - No broad awareness of techniques
    - Dutch citizen receptive yet critical, *i.e.:*
      - Allow it to solve societal problems
      - Avoid concentration of power
      - Require safety assessment/regulation
      - Take into account broader perspectives
      - Be transparent about uncertainties

Data: Rathenau 2019, 2023

Genome editing in other fields

- Microbes
  - Netherlands has a substantive fermentation industry
    - Companies interested in innovation
    - Investment by government in research into precision fermentation
  - Academic research, *e.g.*, Delft, Wageningen
- Animals
  - Broad societal debate (2002): negative stance towards GM animals with productivity traits
  - Recent call for relaxation (animal welfare reasons)

Conclusions

- The Netherlands has an important vegetable and ornamental plant breeding sector and academic community which are innovation-oriented
    - New genomic techniques to be used as research tool and/or breeding tool
- The Dutch government and authorities try to make the case for relaxation of rules for new genomic techniques
- The Dutch public is not fully aware of these techniques and is willing to accept it under a range of conditions (*e.g.,* clamp down on corporate dominance0

Thank you for your attention!

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