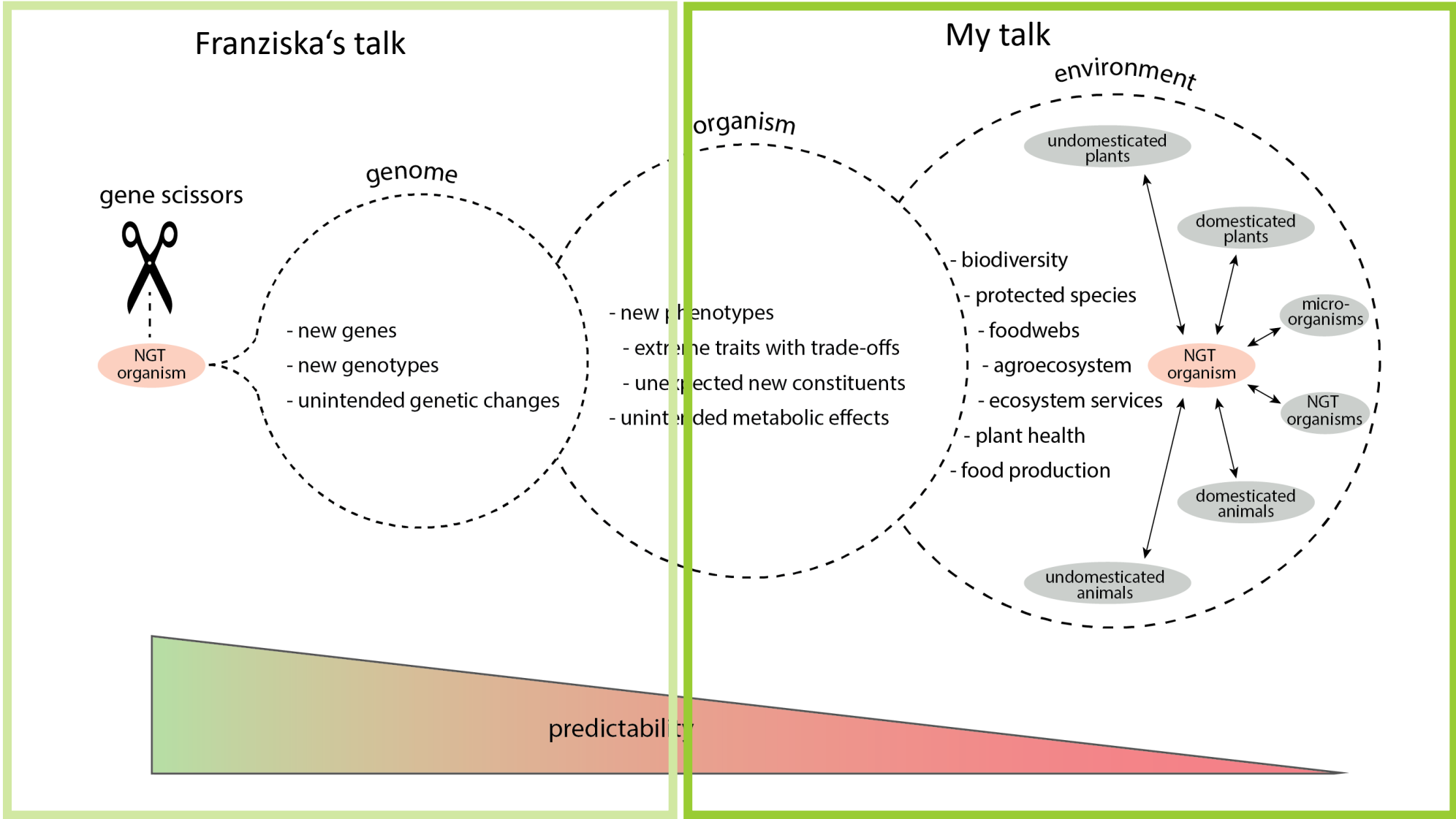


# Possible interactions of NGT plants with the environment

Meike Schulz



# *Camelina sativa*

- Oil seed crop of Brassicaceae family
- Closely related to *Arabidopsis thaliana*, *Brassica napus*
- Sexually compatible with *C. microcarpa*, *C. rumelica*, *C. alyssum*
- Hybridizes with *Capsella bursa-pastoris*
- High level of polyunsaturated fatty acids in its oil
- Uses: human food, biofuels, biobased chemicals



# *Camelina sativa* as example for an NGT crop

- Re-emerging crop due to agronomic traits
- Allohexaploid plant with three very similar subgenomes
- Changing all homeologous genes with conventional or mutagenesis breeding difficult
- SDN-1 applications are promising
- More complex changes possible
- Most interesting trait: altered fatty acid composition



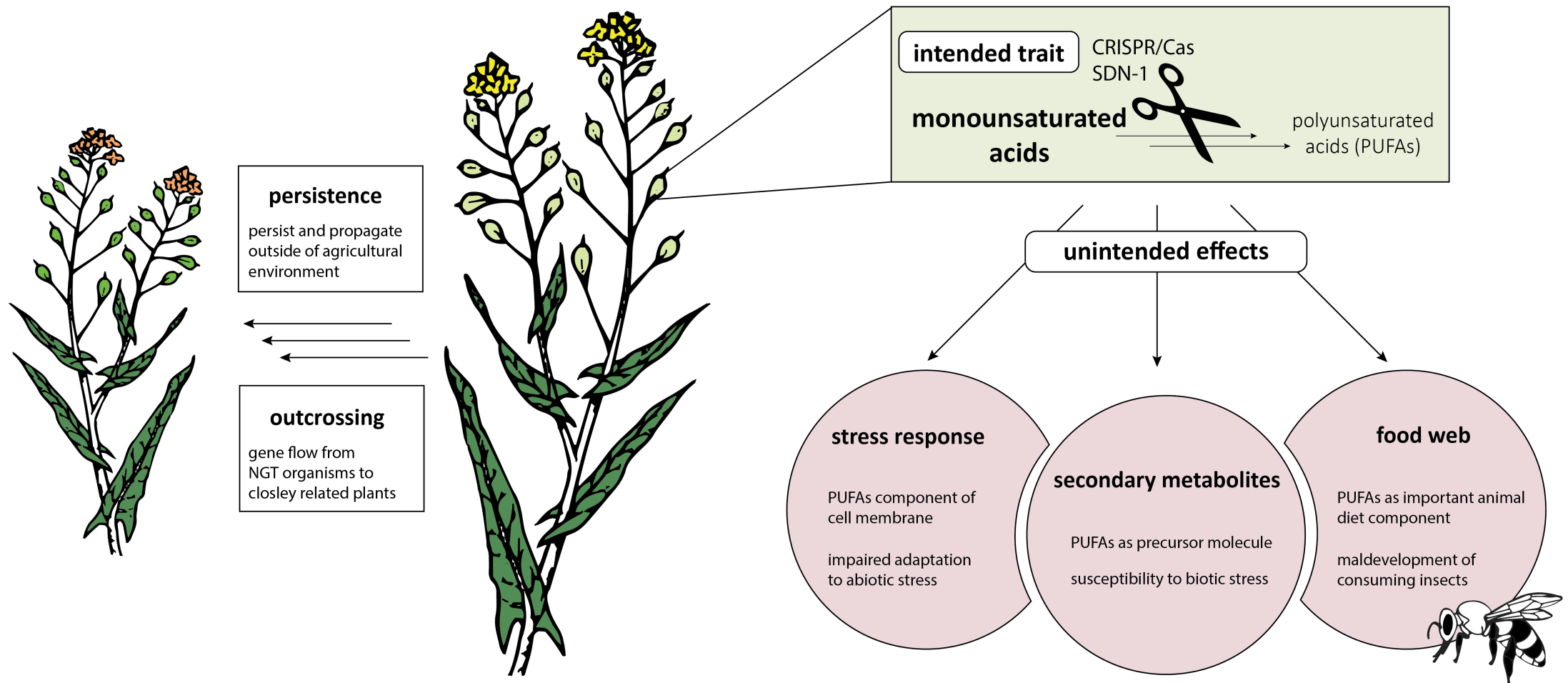
# Alteration of fatty acids in *Camelina sativa*

- *Camelina* seeds have high oil content (~ 32-49%)
- Contains different kind of fatty acids, e.g.:
  - Monounsaturated fatty acids (MUFAs)
  - Polyunsaturated fatty acids (PUFAs)
- PUFAs known for low oxidative stability  
→ less utilizable e.g. for biofuels
- Possible solution: reduction of PUFAs using NGTs

• **Intended trait:**

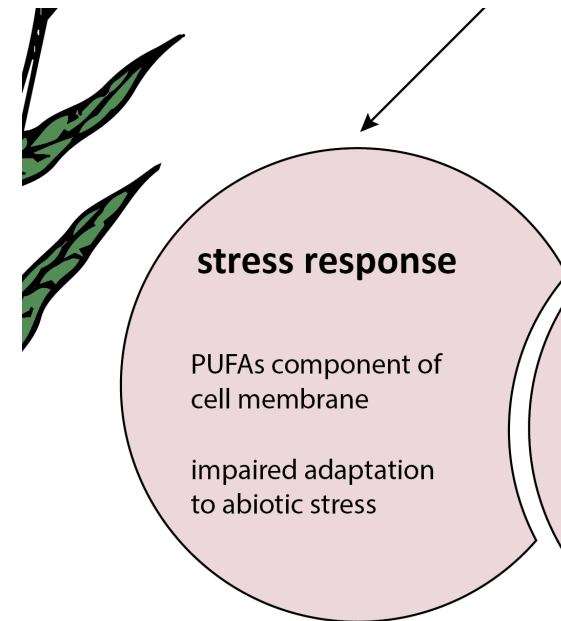


# Overview of unintended effects in *Camelina sativa*



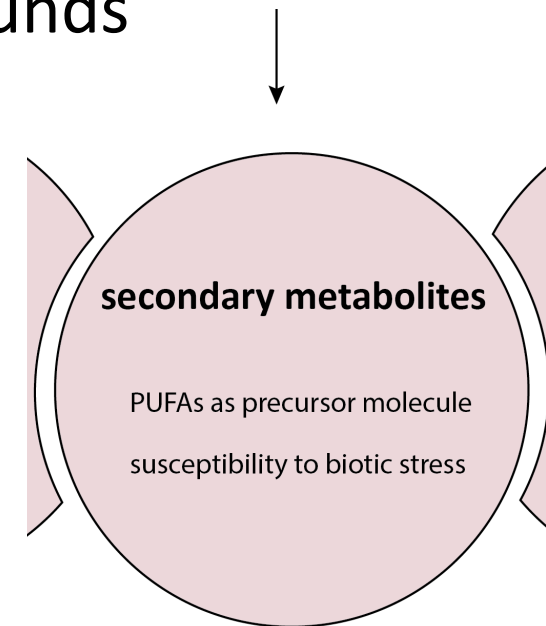
# Unintended effect 1: influences on the stress response

- PUFAs are important for membrane functions + climate adaptation
- Abnormal FA profile alters membrane lipid composition  
→ affects fluidity
- Severe impairment of abiotic stress response
  - No surviving under low T conditions
  - Impaired development and survival under high salt condition



# Unintended effect 2: influences on secondary metabolism

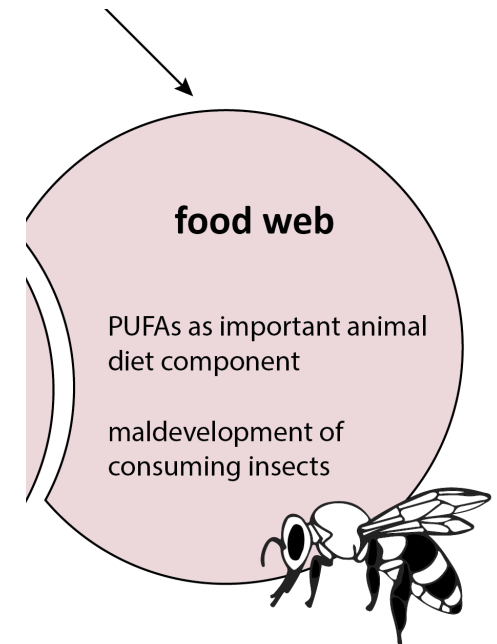
- PUFAs = precursor molecules for secondary plant compounds
- Jasmonic acid (JA) + derivatives part of complex signalling pathway network
  - Network is regulating climate adaptation and stress response
- Lower PUFAs amount → less JA synthesis  
→ susceptibility to biotic + abiotic stress is rising





# Unintended effect 3: impact on the associated food web (e.g. insects)

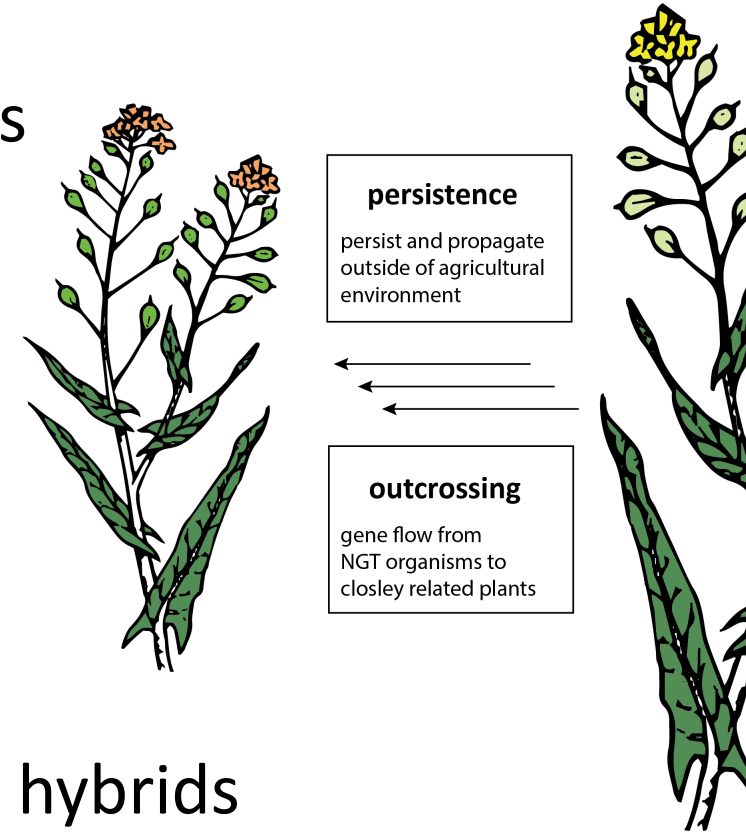
- Altered FA composition in plants showed
- Ex 1: **impairments** of the brain, the hypopharyngeal gland of honeybees + **impaired** learning ability
- Ex 2: transgenic *Camelina* fed to larvae of crop pest *Pieris rapae* led to **body impairments**: heavier body, smaller wings in adults



→ altered FA composition may have adverse effects on associated insects, e.g. pollinators

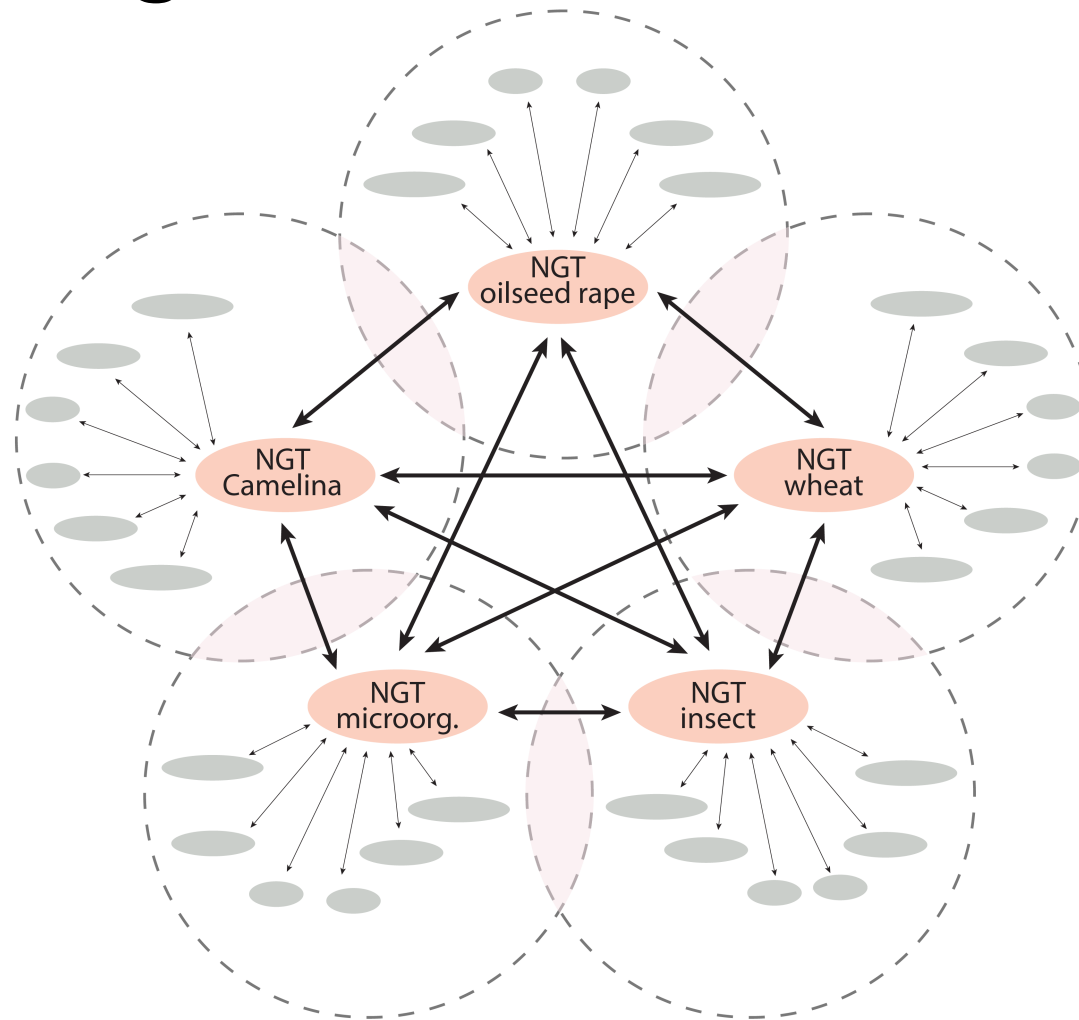
# Additional possible unintended effects on ecosystem level

- **Gene flow** from NGT plants to closely related plants
- **Hybridization** of NGT plants
- **Propagation** outside of agroecosystems
- **Persistence** of NGT plants (GMO contamination reservoir)  
→ Next generation effects can occur



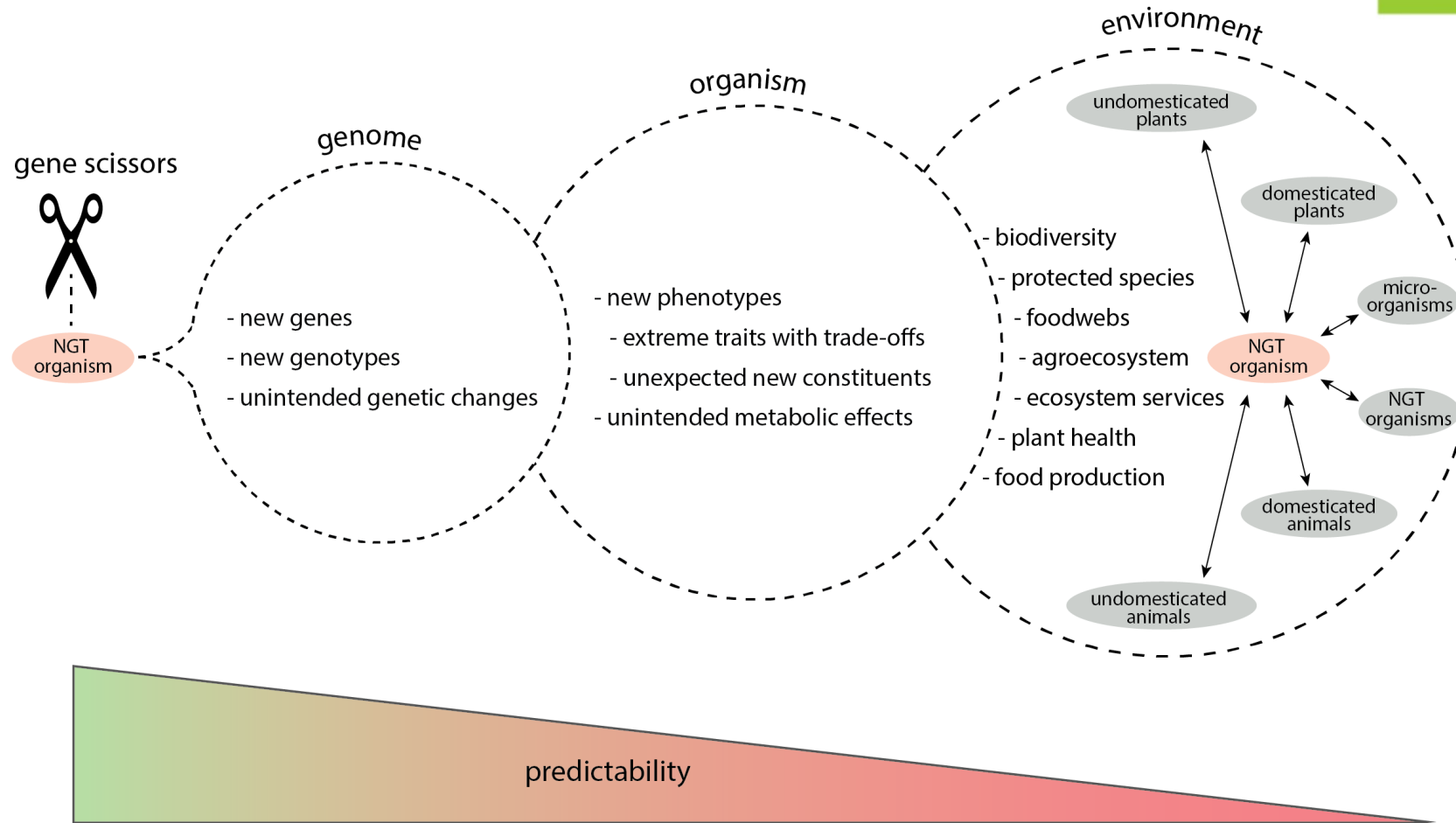
→ Even without fitness advantage of NGT *Camelina*, hybrids in future generations might show increased survival rates

# Interactions of NGT organisms within a shared receiving environment



# Summary

- NGTs enable to produce organisms with more complex **intended and unintended** genomic alterations that can go along with risks.
- The genetic changes can cause **direct, indirect, immediate, delayed and cumulative effects** on the level of the organisms and their interactions that can cause environmental hazards.
- The predictability of risks **is decreasing** from genomic to ecosystem level, **uncertainties are increasing**.
- Especially if NGT organisms can **persist and propagate** in the environment and/or are interacting with other NGT organisms within a shared receiving environment, risk assessment is likely to become **inconclusive** due to major uncertainties.



Thank you for your attention! Now is the time for questions and discussion 😊