



# Risks and benefits of new genomic techniques (NGTs)

## An ecological perspective on the EU Commission's proposal

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## NGTs are...

an alleged **attempt to solve problems at a high organizational (ecological) level with methods on a molecular level**

due to the complexity of ecosystems, & disregard of ecological science in the proposal, **this attempt is likely to fail**



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**New genomic techniques from an ecological and environmental perspective: science-based contributions to the proposed regulations by the EU Commission**



# Scales of ecological science

## topics

**biosphere**

**landscape**

**ecosystem**

**community**

**population**

**individual**

**cells**

**molecules**

nutrient cycles  
climate change

ecosystem function

**novel organisms**

biodiversity

yield

fitness

adaptation





# Scale of NGT discussion and risk assessments

**biosphere**

nutrient cycles  
climate change



**landscape**

ecosystem function



**ecosystem**

novel organisms

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biodiversity

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**cells**

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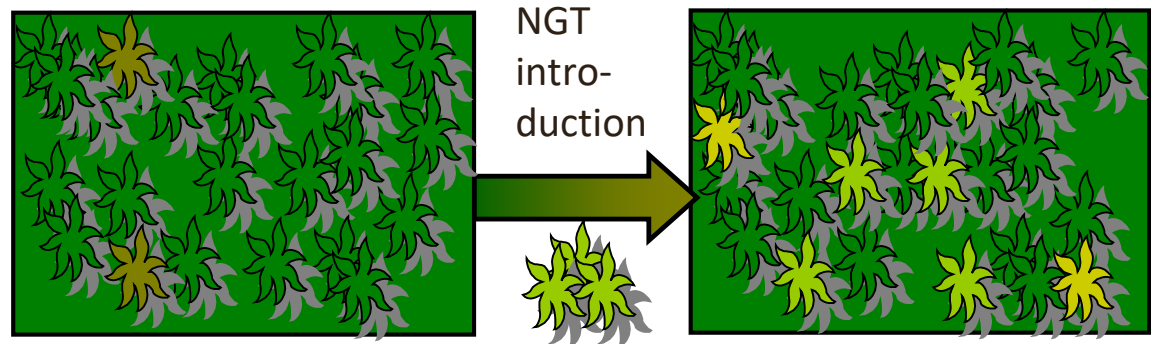
# Unresolved RISKS - an ecological perspective

**Outcrossing** of novel plants into the wild → **always (!)** unpredictable consequences

Three possibilities:

- a) **Aggressive spread** – insights from invasion ecology
- b) **No effect**
- c) **Outbreeding depression: overlooked** (e.g. Montalvo & Ellstrand 2001)

‘genetic contamination’  
with maladapted  
genotypes



→ International (Convention of Biodiversity, CBD) and national (e.g. §40 Abs. 2 Satz 3 BNatSchG) laws protect **genetic integrity of natural populations** by not permitting introductions of non-local genotypes into wild populations



## The precautionary principle

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Ecological & environmental consequences of introducing novel genotypes into the wild are **INHERENTLY UNPREDICTABLE**

Ecological risk is **SOLELY DETERMINED BY THE PHENOTYPE**

→ categorization of 'risk' or 'equivalence to' based on quantitative **molecular criteria is immaterial** for environmental risk assessment

**Scientific ecological knowledge must call for the precautionary principle and a case-by case risk assessment**



## Likelihood of outcrossing

*“The movement of transgenes beyond their intended destinations is a virtual certainty.”* Marvier and Van Acker 2005

Ellstrand 2018: metastudy on existing GMOs: 14 examples, > 1000 populations 2 cases with undesired environmental effects (canola, and one native grass)

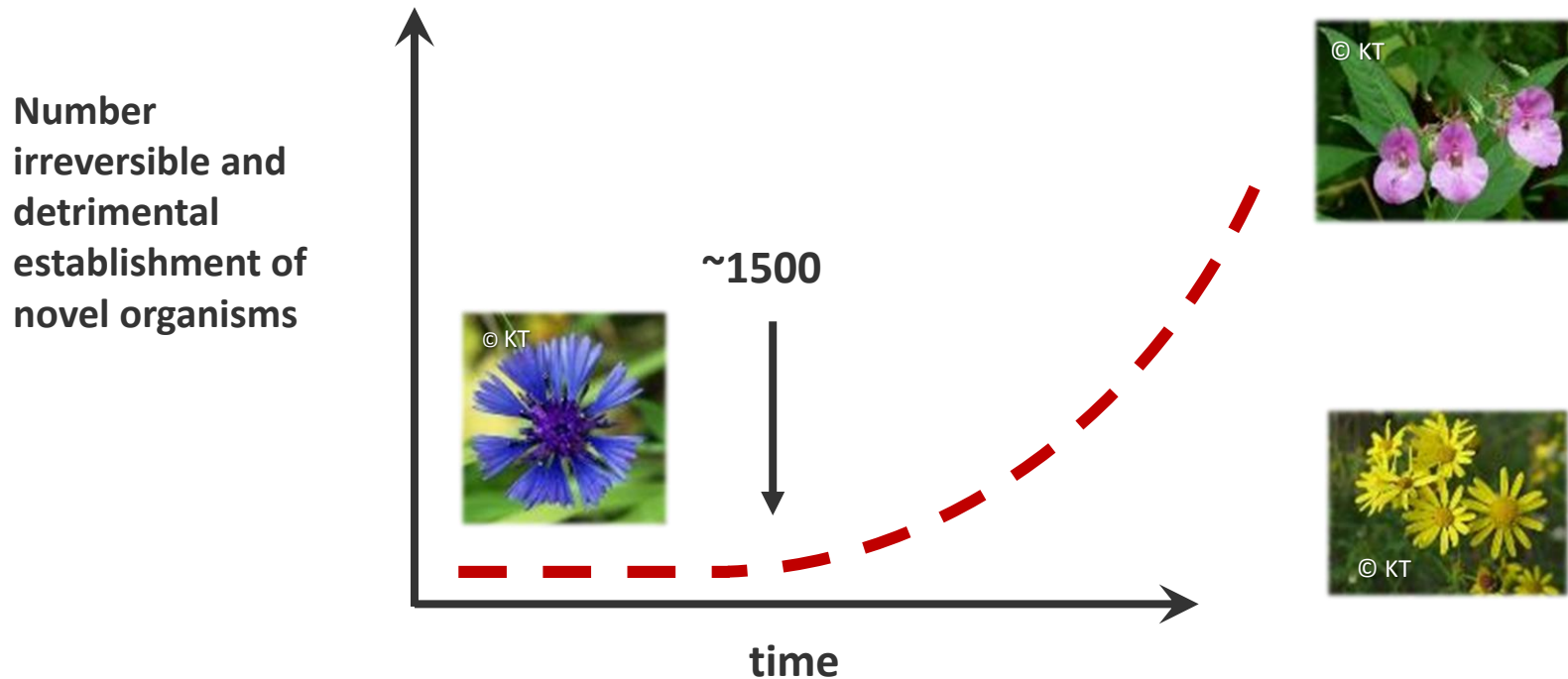


Outcrossing promoted by:

- Relatedness** (intraspecific: 100%, crop → wild relative: very high)
- Proximity** (wild to wild: 100%, crop-to-wild: distance-dependent)
- Number** of novel genotypes and individuals



Aggressive spread of novel organisms is a certainty if the number of newly introduced organisms is large (law of large numbers) Lockwood et al. 2009



Risk is larger if novel organism's phenotype DIFFERS from resident species or genotypes, rendering diverse communities more resistant against invasions





## What is NEW in NGT vs. classical breeding?

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**Large numbers in short time – a qualitative novelty, not only a quantitative one → larger likelihood of outcrossing & larger risk**

**Completely novel phenotypes (larger depth of manipulation)  
→ larger likelihood for unprecedented ecological effects**

**Large number of new genotypes with attested fitness effects in the wild (e.g. pathogen resistance), i.e. larger likelihood of spread**

**In the EU-Commission's proposal:**

**Application allowed for ALL PLANT SPECIES\***

**→ i.e. almost 100% likelihood of outcrossing, very high risk**

\*ca. 300,000 species (Mora et al. 2011)





## Application to all plants is irresponsible

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**Genetic integrity of wild plants must be maintained** to enable natural evolutionary processes and reduce extinction risk

release of wild plant NGTs is **at odds with international** (CBD) and **national legislation** (e.g. §40 Abs. 2 Satz 3 BNatSchG) to prevent 'genetic contamination': e.g., moving **naturally evolved** genotypes to new populations

**unregulated NGT applications in the wild pose an unprecedented danger to wild populations, communities and ecosystems**

**In the light of the biodiversity crisis, this is not acceptable**





## Application to all plants is not needed

Proposal & post-proposal debate: exclusively about application of NGT for food and feed (e.g. EFSA as main player)

→ **extension to wild plants is not only dangerous, but not even relevant**, raising the question why it has been introduced (no mentioning of potential uses)

**No ‘history of safe use’** for genetic modification or breeding of ~300,000 wild plant species and introduction into the wild

‘Equivalence to breeding-idea’ is **irrelevant for wild populations**

\*ca. 300,000 species (Mora et al. 2011)





**We call for a clear protection of wild plant species from any type of deregulation, i.e. a case-by-case risk assessment prior to release into the wild, consistent with the precautionary principle\***

\*not precluding domestication

GFÖ 2023: New genomic techniques from an ecological and environmental perspective: science-based contributions to the proposed regulations by the EU Commission

[https://gfoe.org/sites/default/files/ngt\\_gfoe\\_final.pdf](https://gfoe.org/sites/default/files/ngt_gfoe_final.pdf)





**Proposal: NGT contributions to sustainability /EU Green Deal**

**Benefits for sustainability and environmental protection:  
no scientific evidence**

Benefits for climate adaptation  
**no scientific evidence**  
(overall & specific examples)

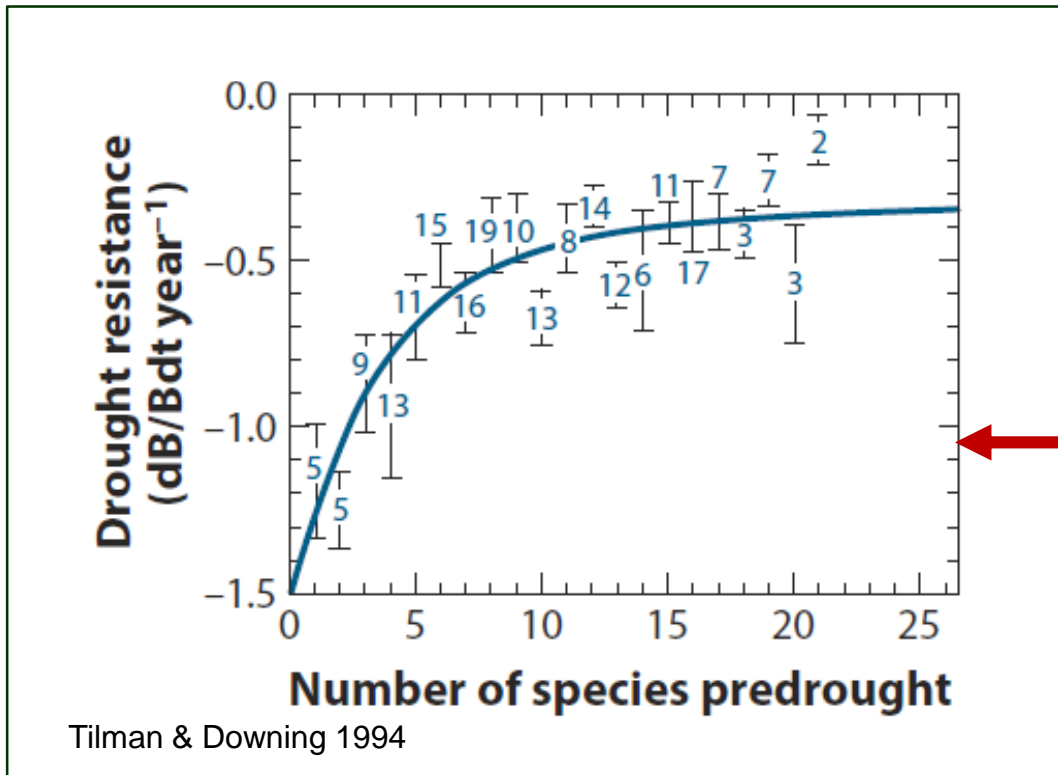


**Scientific evidence: monocultures = ultimate cause for  
unsustainability and lack of resistance to (climate) change**

**Benefits are an assumption with no evidence in favor but  
evidence against - if NGT are used within the current system**



## What we know (myriads of agro-ecological studies)



**Biodiversity promotes**

**Productivity (yield)**

**Yield stability**

**Resistance & resilience**

**nutrient cycle**

**pathogen resistance**

**resistance to weed invasion**

e.g., insurance effect or portfolio-effect

(Markowitz 1952, Yachi & Loreau 1999, Tilman et al. 2014)



**Examples:** no or much less fertilizers, high resistance & resilience, high yield stability, high social justice,

→ **very fast to implement, highly efficient**

**a) example: Genetic diversity effects: co-cultivation of a pathogen resistant with pathogen sensitive rice variety reduces the need for pesticides to nil**

Zhu Y et al.2000 (Nature)

**b) Intercropping of e.g. maize with legumes sets need of fertilization to nil, increases yield stability and makes pesticides (an herbicides) unnecessary (many studies)**



**Fast, safe, highly efficient, socially just solutions are at hand, that are supported by very extensive scientific evidence**

**NGTs may have a potential (in agriculture), but are still in a stage of promises**





## Summary

1) EU Commission proposal **ignores fundamental ecological principles** at the level at which NGT shall be applied → **many unresolved issues**

2) **Deregulating NGT1 for all plant species could become a serious threat for biodiversity conservation & sustainability**

3) **Quantitative molecular criteria** for deregulation and ‘equivalence’ with breeding are **irrelevant** for environmental risks  
→ **Precautionary principle** with case-by case risk assessment

4) **Diversification guarantees yield stability, low environmental impact, high resistance and resilience, and social justice**

**Science-based, fast, and efficient solutions** to the global polycrises should be prioritized





# Questions?

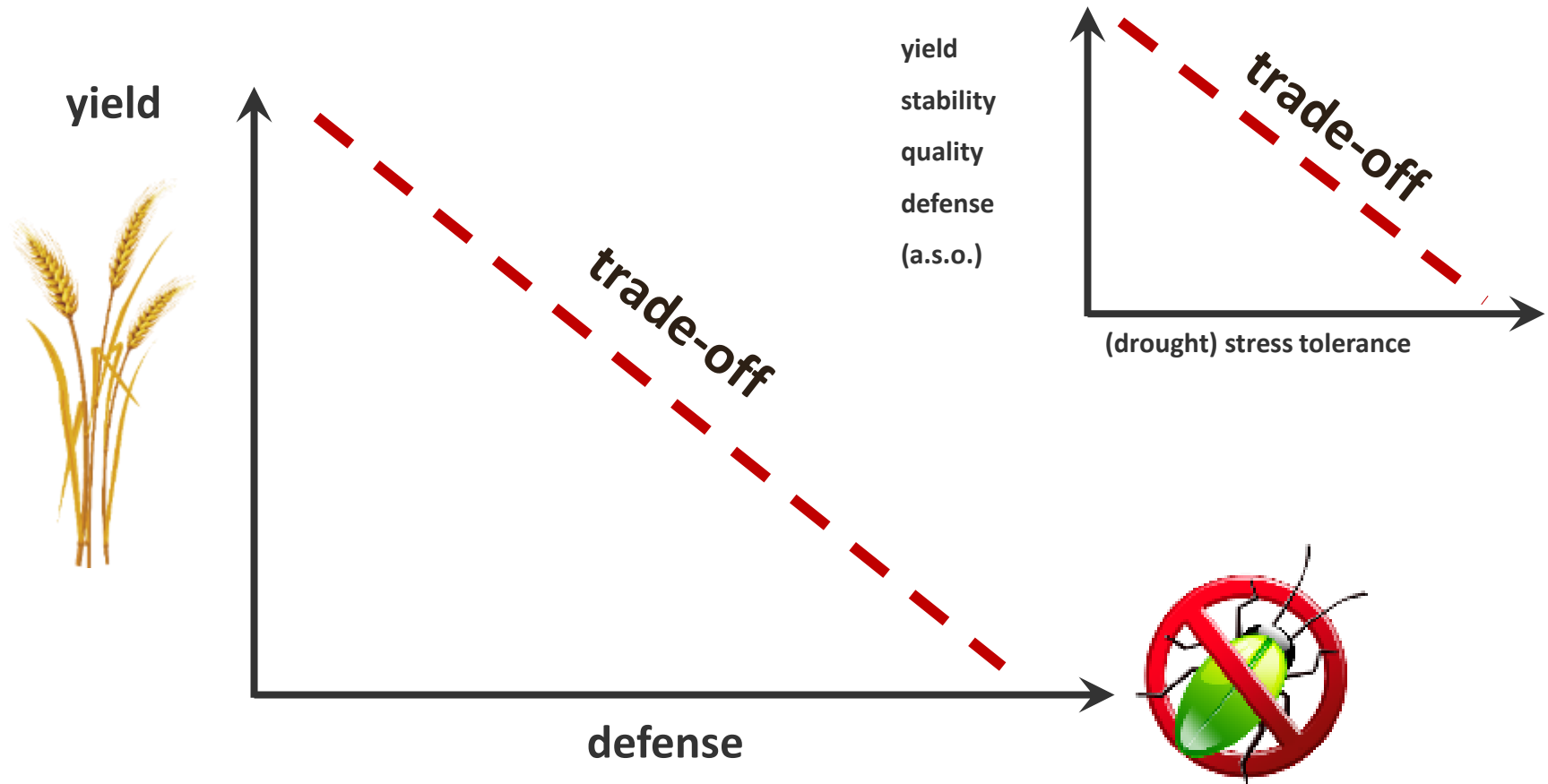
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# Learning from evolutionary ecology: no free lunch



**established cultivars trade-off the devil (low yield, enemies) with the deep blue sea (more enemies)**

**Drought resistant NGTs are no solution to increased frequency of droughts!**



- NGTs are very powerful → highly attractive for research
- If deregulated, NGTs will be used in countless scientific field studies\*, even with allegedly beneficial effects
- All species at stake?

\*Proposals made in many concept and research papers

e.g., Kessler et al. 2008, breed et al. 2019, Phelps et al. 2020, Popkin 2018, Chen et al. 2011),

