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Genetic engineering for sustainable food systems?

From the perspective of agro-ecological plant breeding

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(A) About Getreidezüchtung Peter Kunz

- non-profit organization developing field crops for low input and organic agriculture in Feldbach (CH) and North Hesse (D)

Main goals:

- Development of diverse, locally adapted field crops
- Involvement of agri-food system stakeholders in the breeding process
- Increasing the diversity of cultivated field crops, breeding of major and minor crops

gzpk-Kulturen

gzpk varieties grown in CH, F, D, CZ, P, IT, GB, LV

(B) New Techniques for Genetic Modification

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What do we want, what do we need?

vs.

What is technically possible?

→

Precise definition of problems of agricultural production in Europe and their causes

(e. g. Green Deal and Farm to Fork objectives)

→

Would a breeding intervention be an adequate solution to the problem?

(B) New Techniques for Genetic Modification

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New GM-techniques and plant breeding - current trends

- Power relations and profit
  - Research phase: minor and cash crops →→ Commercialization phase: only cash crops

  →Products in the marketing pipeline:

  - Mainly for high income markets of the Global North

(B) New Techniques for Genetic Modification

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New GM-techniques and plant breeding - current trends

- Reduction of fertilizers and pesti-/herbicides → No, herbicide resistance (still) main breeding target - labor cost reduction
- Increasing agrobiodiversity → No, developing economically less important field crops to expensive → few crop varieties grown on ever bigger fields for return of investment
- Accessibility → No, beside patents, technical efforts still large, small breeding institutions not able to use new GM techniques

(C) Agroecological Plant Breeding

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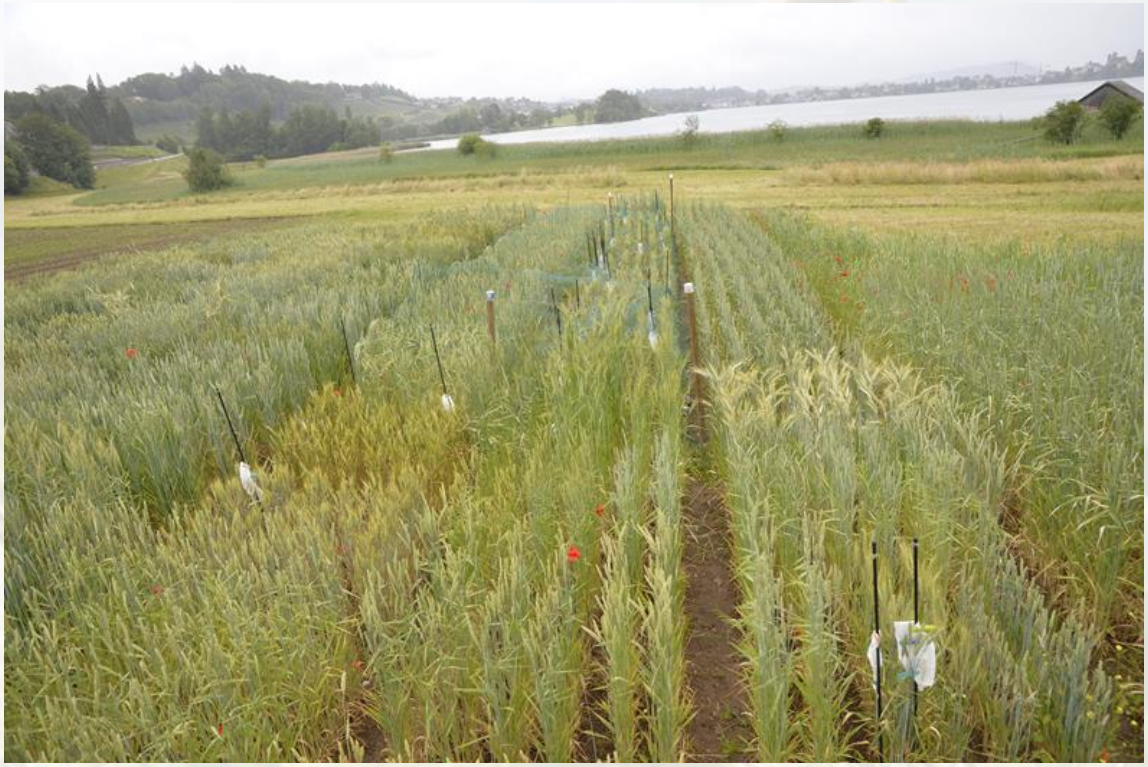
What kind of plant breeding has the potential to positively contribute to the sustainable development of European agriculture?



(C) Agroecological Plant Breeding

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Two directions in plant breeding

(1) Biotechnology	(2) (Agro)Ecology
One genotype → all desired traits and qualities in one plant for production in monoculture	Diverse field crops → interaction of all elements in agricultural systems considered

→ current focus is on biotechnological solutions - the much greater potential of agroecological breeding is not used and not being promoted politically

(C) Agroecological Plant Breeding

Current Example from biotechnology wheat breeding

German Plant Breeders' Association project PILTON:

- Breeding wheat with resistance to fungal diseases
- Method: silencing a single gene with CRISPR
- Objective: Plant is permanently in defence mode against fungi

Potential problems:

- **Focus on only** one tolerance-mechanism

→ if fungi overcome the tolerance → threat of widespread problems with "super fungi diseases"

→ Beneficial symbioses of plants with soil fungi → also inhibited by the genetic modification

(C) Agroecological Plant Breeding

Alternative approach in **agro-ecological breeding**

→ a **broader approach based on different resistance mechanisms** might be the more sustainable way → selection of diverse plants that remain healthy under field conditions

→ **complementary and preventive measures in cultivation**: multi-structured crop rotation and avoidance of fungi-promoting growth regulators

→ High diversity of locally adapted varieties as **barriers to the spread of the disease**

(C) Agroecological Plant Breeding

Alternative approach in agro-ecological breeding

→ breeding and local cultivation of different genotypes to create resistance barriers

→ Breeding of alternative, heterogeneous (non DUS-conform) “varities”

→ Mixtures and Populations → **increasing resilience**

(C) Agroecological Plant Breeding

Mixtures and Populations

Increasing resilience using complex farming systems with diverse crops in one field.

Conclusion

- Majority of **current commercial breeding goals → not geared towards sustainable developments** (Green Deal and Farm to Fork objectives)
- Imbalance towards the promotion of biotechnology → **Agro-ecological breeding should be promoted**
- **Deregulation of GM-plants would massively restrict the exchange of genetic material** between breeding organizations (Breeders' Exemption)
- **Access to technology is restricted due to patents**