Adapting life histories to changing environments
- Focus Group Y-5

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Life History Strategies

- Timing and nature of life history events
  (germination, flowering, senescence)

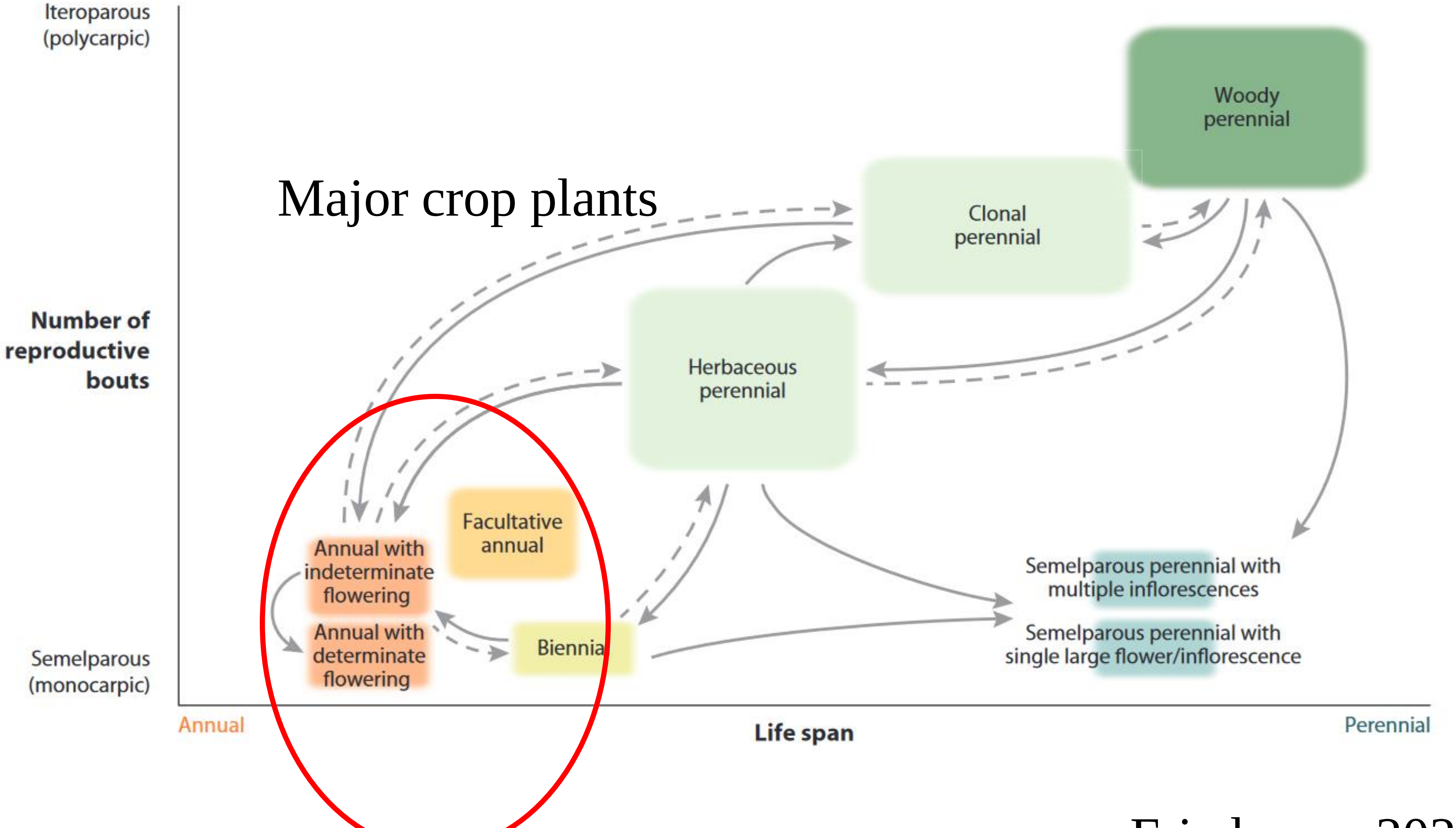
- Strong determinant of plant architecture (Y-3, Y-4, Y-1)

- Resource allocation in growth, reproduction and survival (Y-2, S)

- Optimise fitness - constraints (trade-offs)

⇨ Breeding has reduced genetic variation, and environmental plasticity

Life history variation



Friedmann 2020

Sustainable agriculture and climate change

Diversified and sustainable food production

- Diversify & modify the phenology of elite crops

⇒ Developmental variation and plasticity

- Develop “novel” crops (orphan crops, de novo domestication)

⇒ Adapt to new (managed) environments

Modification of life history traits is key

Changing the phenology in woody perennials

Global warming: early bud break

changes in phenology + adverse events => crop losses

Frost damage on Apricot flowers

Burgundy vines have been set alight to fight against frost.

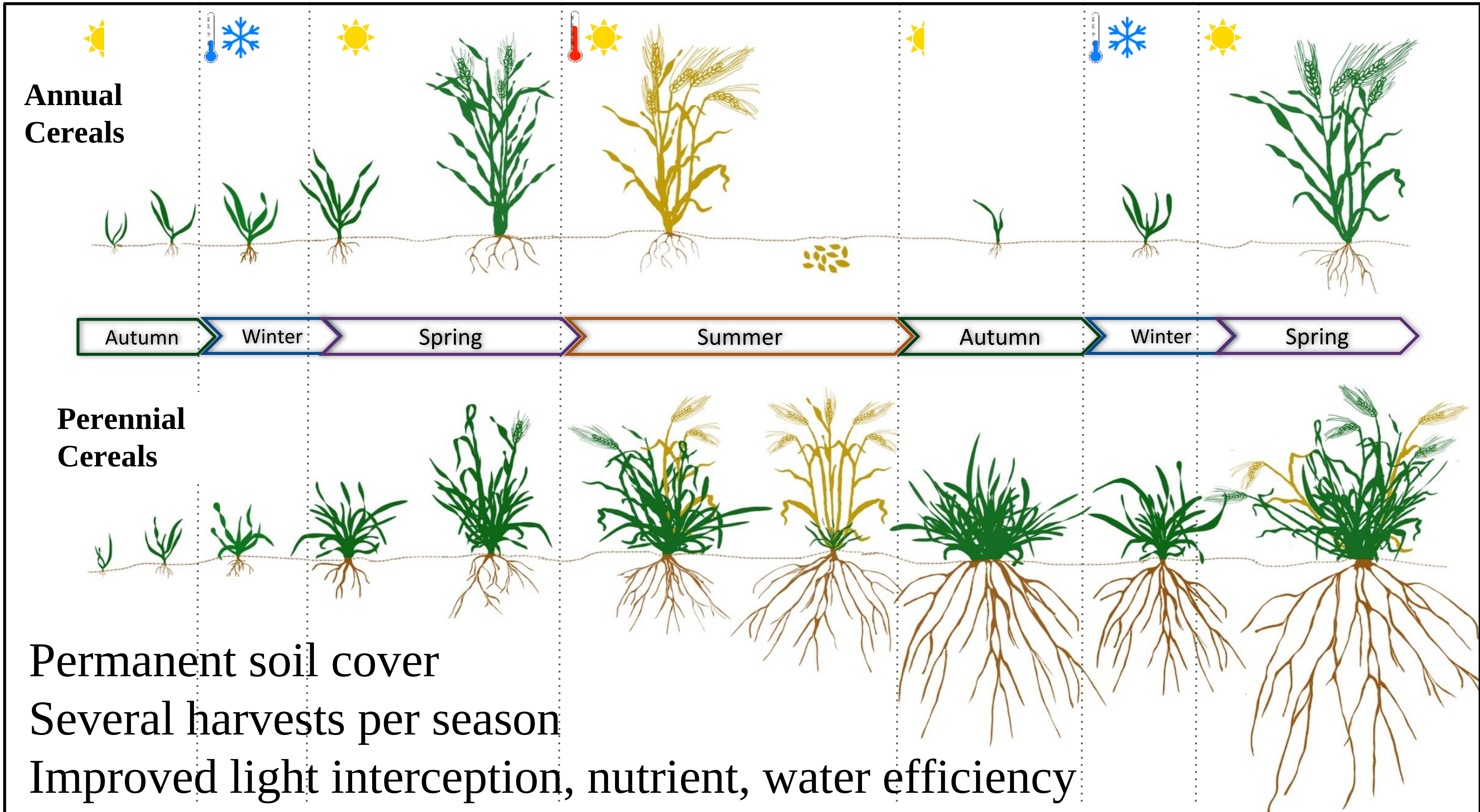
Photograph: Etienne Ramousse/Zeppelin/Sipa/Rex/Shutterstock

Laura Rossini (University of Milan)

Orphan crops: Adapting Quinoa for cultivation in Germany
Adapting flowering time to long day conditions

Prof. C. Jung (University of Kiel)

Perennial Cereal Crops



Permanent soil cover

Several harvests per season

Improved light interception, nutrient, water efficiency

Chances and Challenges

Sequencing technologies and gene editing - tap into exotic germplasm and interspecies genetics

Knowledge on molecular players determining life history traits in models

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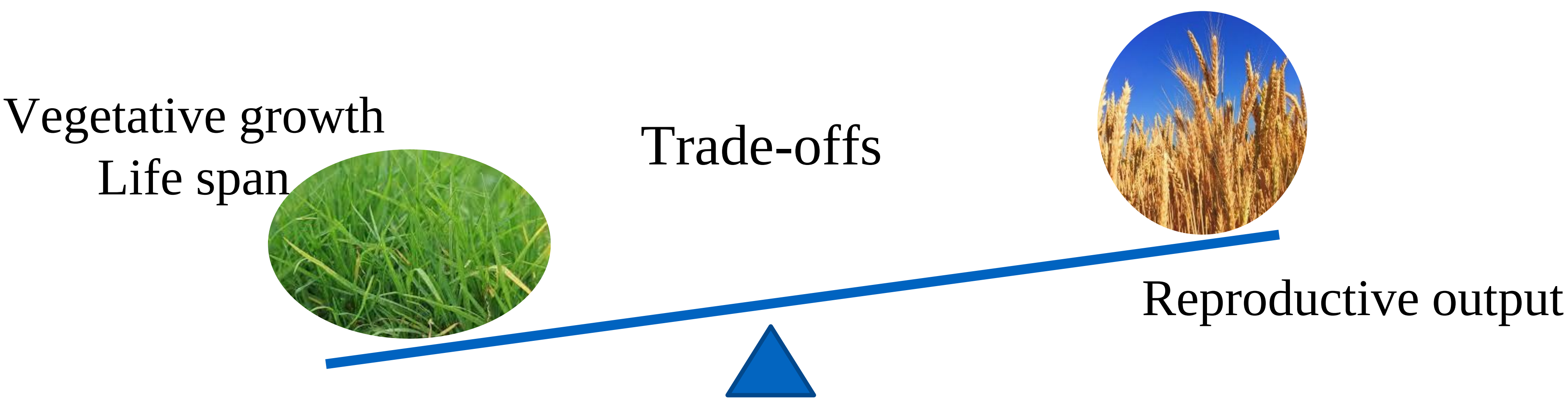
Model species to crops and wild relatives

G*E*M

Trade-offs between different life-history traits

Competition for resources, Genetic Pleiotropy



Research strategies

Genetic diversity guided gene/variant identification

- Fully sequenced diversity collections (elite – wild) - comparative genomics
- Construction of experimental populations/introgression lines (wide crosses) – gene mapping
- Generation of mutant populations
- Multi-site field trials + controlled conditions (G*E*M)
- Methods and tools for interspecies genetics

Knowledge guided gene/variant identification/characterisation

- Screen natural variation at candidate genes
- Engineer allelic series at candidate genes (protein/expression)
- Macroscopic and microscopic phenotyping (how is the establishment/growth of different plant meristems regulated?)
- Reconstruction of novel traits (gene editing)

Functional characterization

- Mechanistic understanding of trade-offs
- Dissecting gene pleiotropy
- Modelling life-history-plant architecture-resource allocation in different environments

Optimising Life-History

- Modify life history traits in elite crops (flowering time, senescence)

- Adapt orphan crops (novel crops) to new environments

- Overcome trade-offs between different life-history traits (many and big seeds)

- Modify a whole suite of life history traits (perennial cereal crops- new management practises-)

Increase agro-biodiversity, climate stability, sustainability