



Crop wild Relatives Digital Twins – Graphical User Interface

6 March 2025

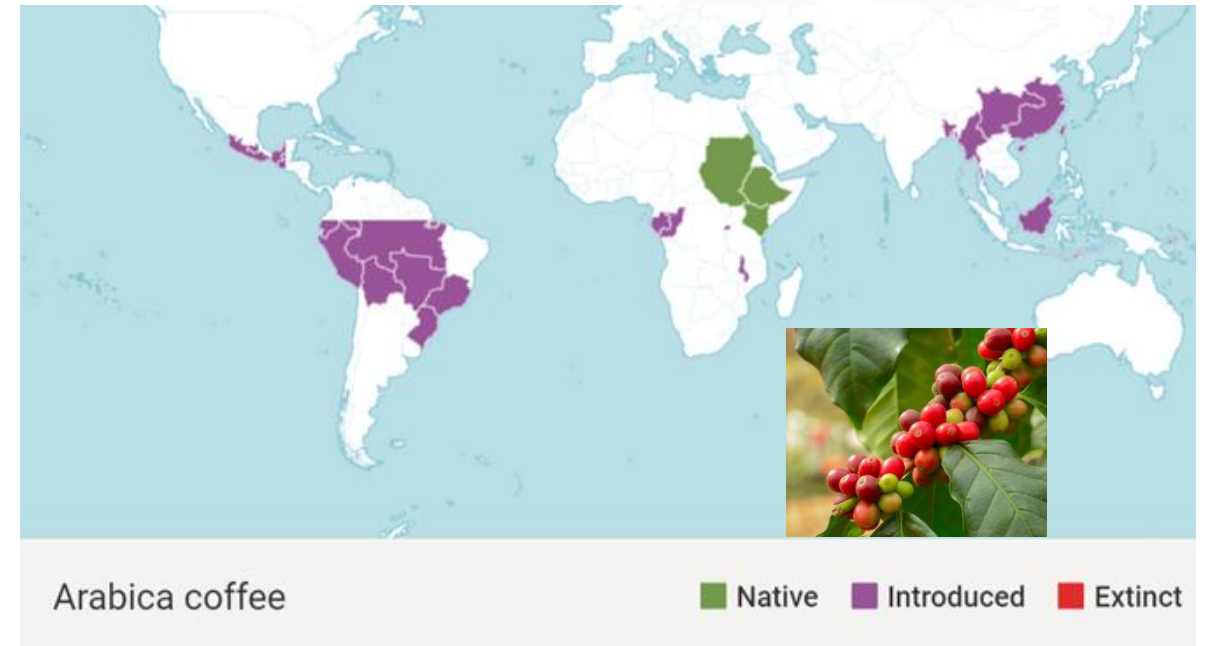
Desalegn Chala – Natural History Museum, University of Oslo

BioDT School and Hackathon

- What are crop wild relatives?
- Why crop wild relatives?
- The graphical user interface to assist decision making in using crop wild relatives for breeding purposes.

Definition of crop wild relatives

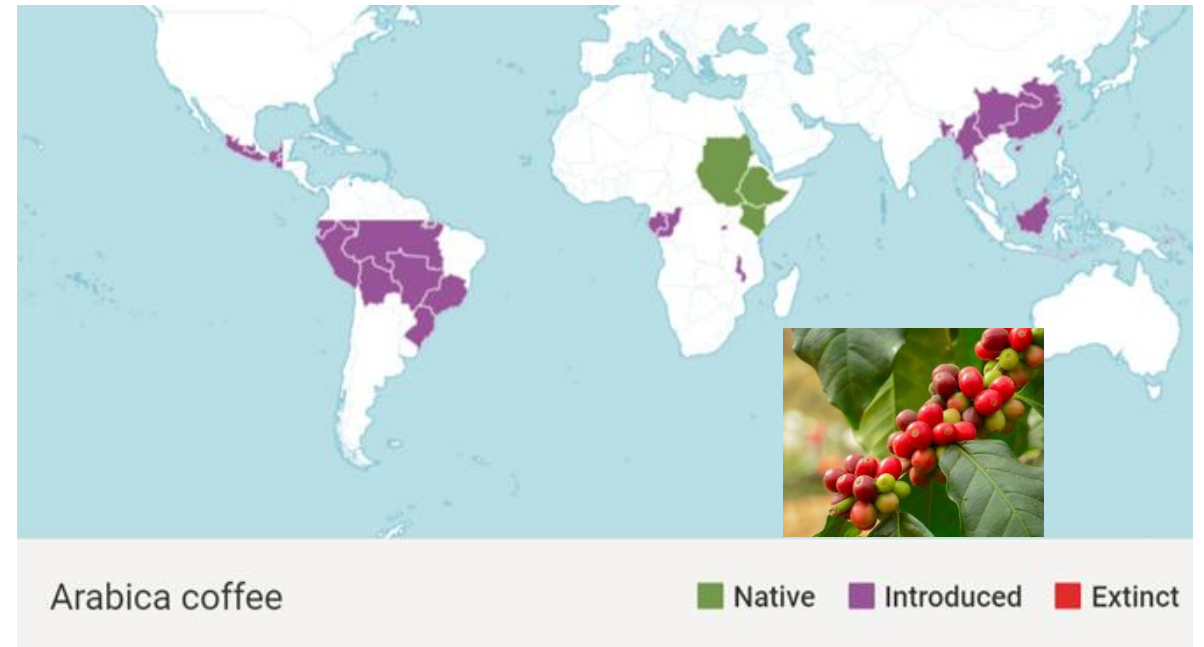
- By broad definition it refers to all taxa within the same genus as a crop (Maxted et al. 2006).
- For example, the scientific names of domesticated coffee are *Coffea arabica* and *Coffea robusta*
 - By this definition all wild plant species belonging to the genus *Coffea* are the wild relatives of coffee
 - Over 30 wild species in the genus



Density of georeferenced plant species occurrence records
<https://www.kew.org/plants/arabica-coffee-species/6>

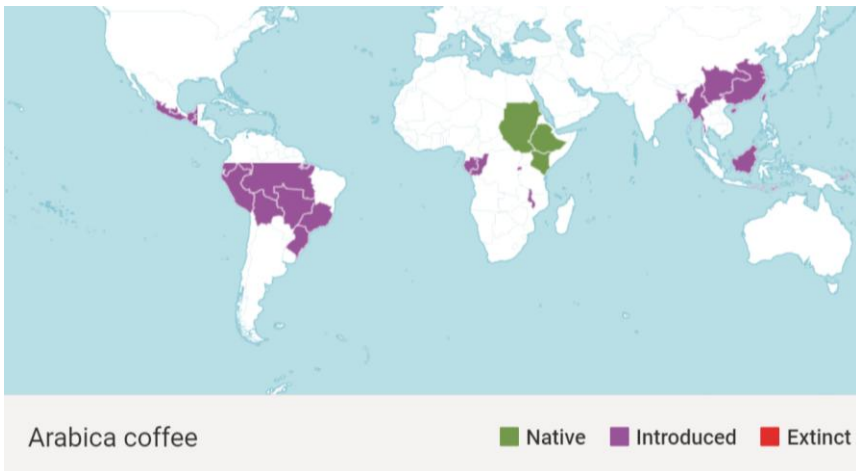
Definition of crop wild relatives

- ❖ Crop wild relatives are highly diverse
 - ❖ *Lathyrus sativus* or grasspea has about 180 wild species in the same genus.
 - ❖ This means it has about 180 wild relatives

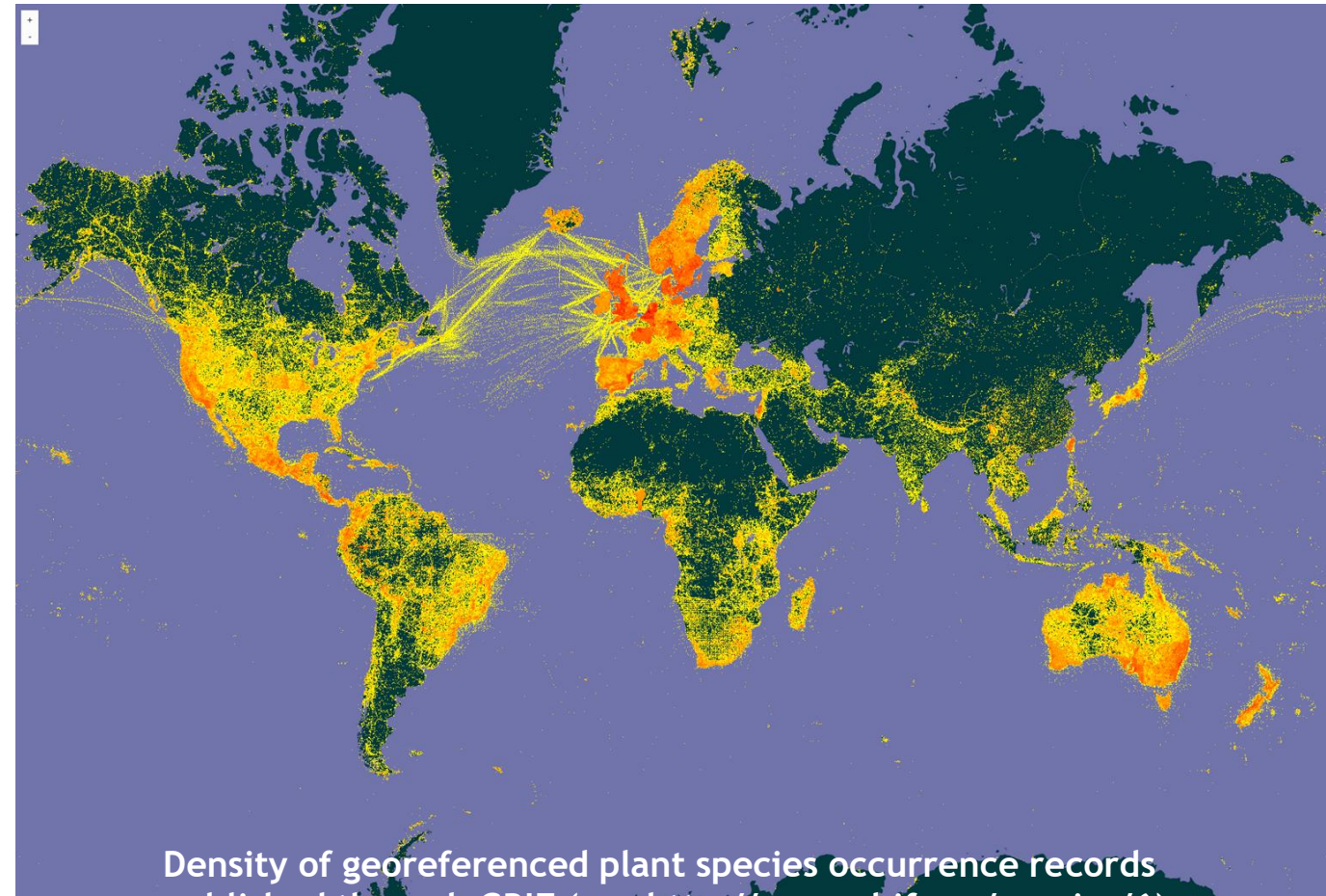


Density of georeferenced plant species occurrence records
<https://www.kew.org/plants/arabica-coffee-species/6>

- They account for around 21% of the world flora (Maxted and Kell 2009)
 - From 10 random wild plant species, the chances for two of them to be crop wild relatives is high likely



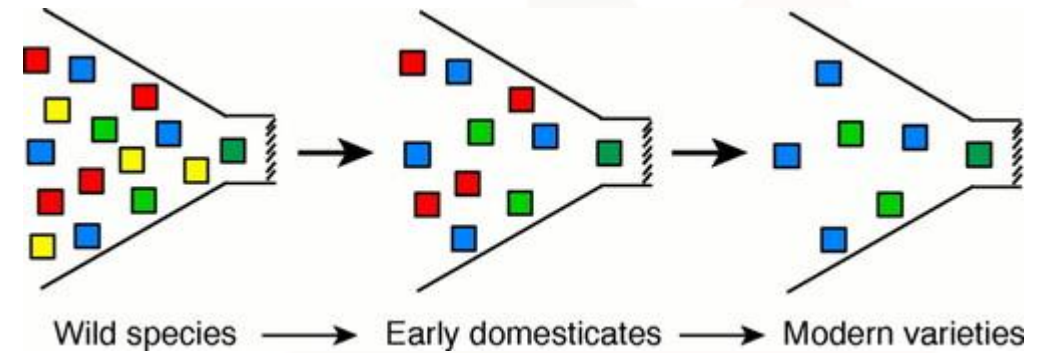
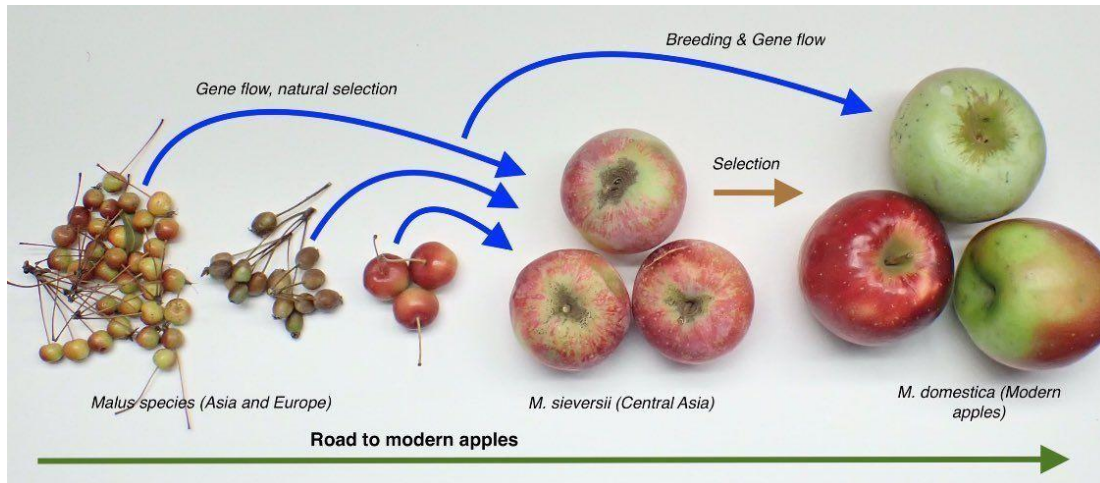
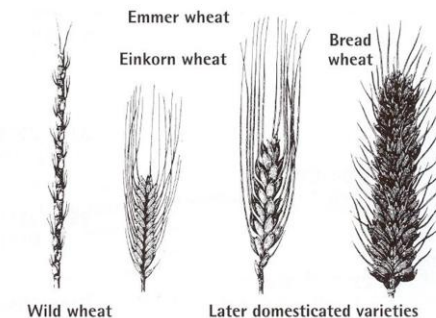
<https://www.kew.org/plants/arabica-coffee>



Density of georeferenced plant species occurrence records published through GBIF (see <https://www.gbif.org/species/1>)

Domesticated gene pool is limited by human induced selection pressure

- 🔥 Farmers are selecting the traits of their interest
 - 🔥 Genetic homogenization (loss of genetic diversity and some adaptive traits to diseases and extreme conditions)
- 🔥 The domesticated gene pool (genetic diversity in crops and breeding lines) is limited by the “domestication bottleneck”



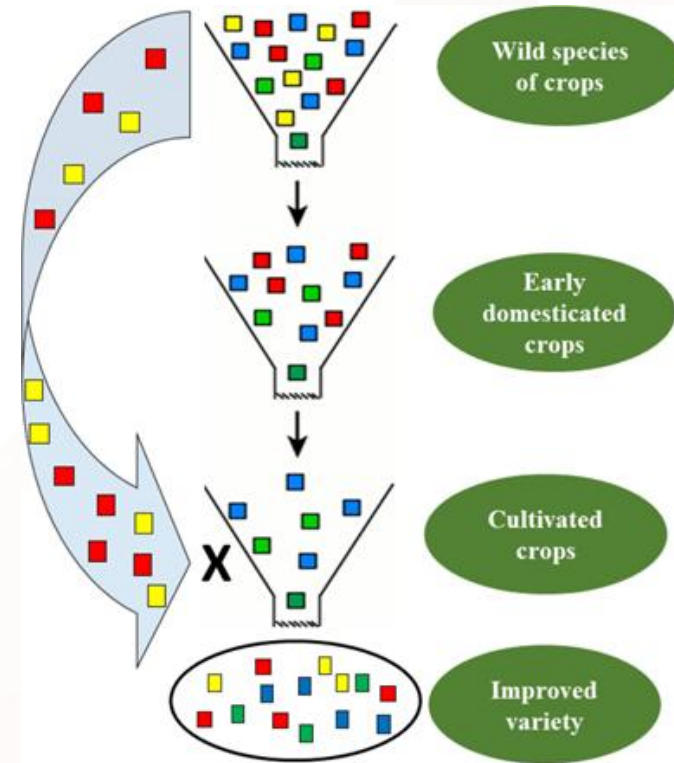
Crop wild relatives possess novel genetic resources

- ❖ The crop wild relatives have been in nature since the time of their evolution
 - ❖ Exposed to several selection pressures against both biotic and abiotic stresses
- ❖ Developed adaptive traits to:
 - ❖ Drought
 - ❖ Warmer temperature
 - ❖ Colder temperature
 - ❖ Saline soil
 - ❖ Insect and fungal pests as well as other diseases



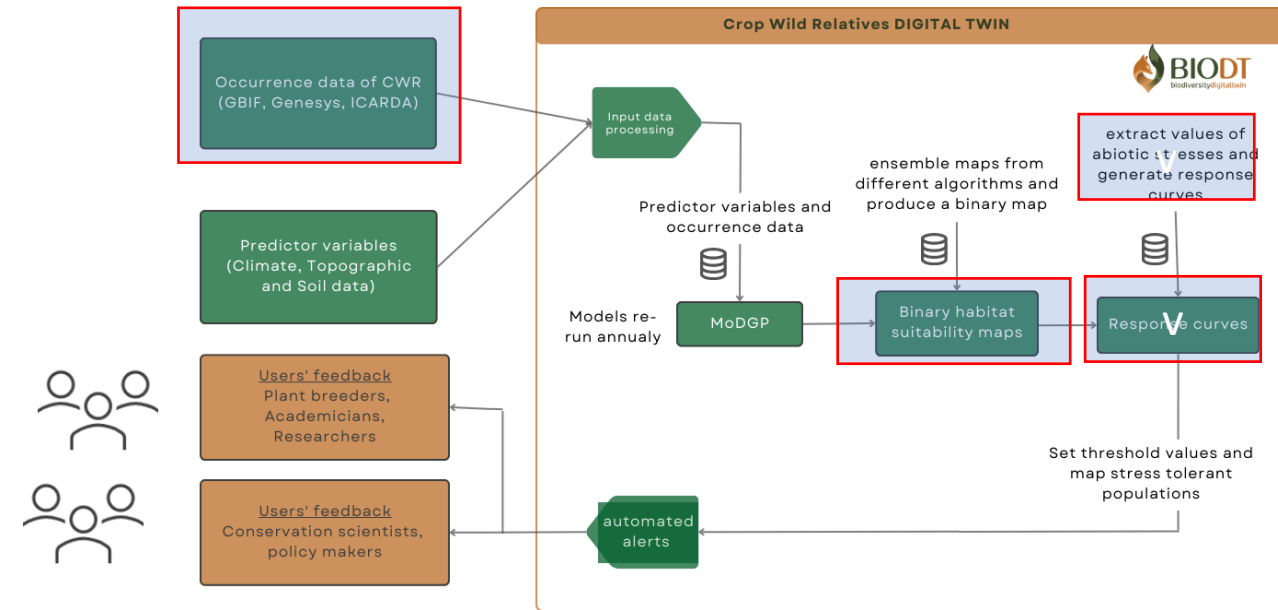
We need crops with better adaptation to changing environment

- Bringing back the genetic diversity lost through domestication bottleneck
- Introducing novel genetic resources developed against the selection pressure of biotic and abiotic stresses

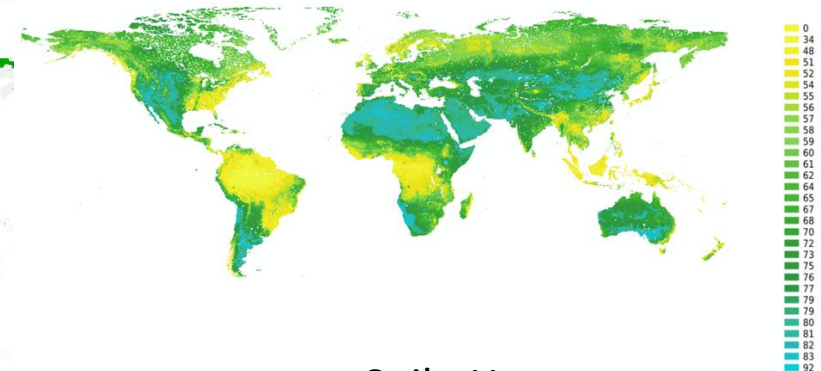


Salgotra et al. 2022

- Access and standardize data of crop wild relatives from online sources
- Produce habitat suitability maps
- Extract values of abiotic stress from suitable pixels and evaluate ranges of tolerances
- Generate maps of geographic areas where stress tolerant populations are growing

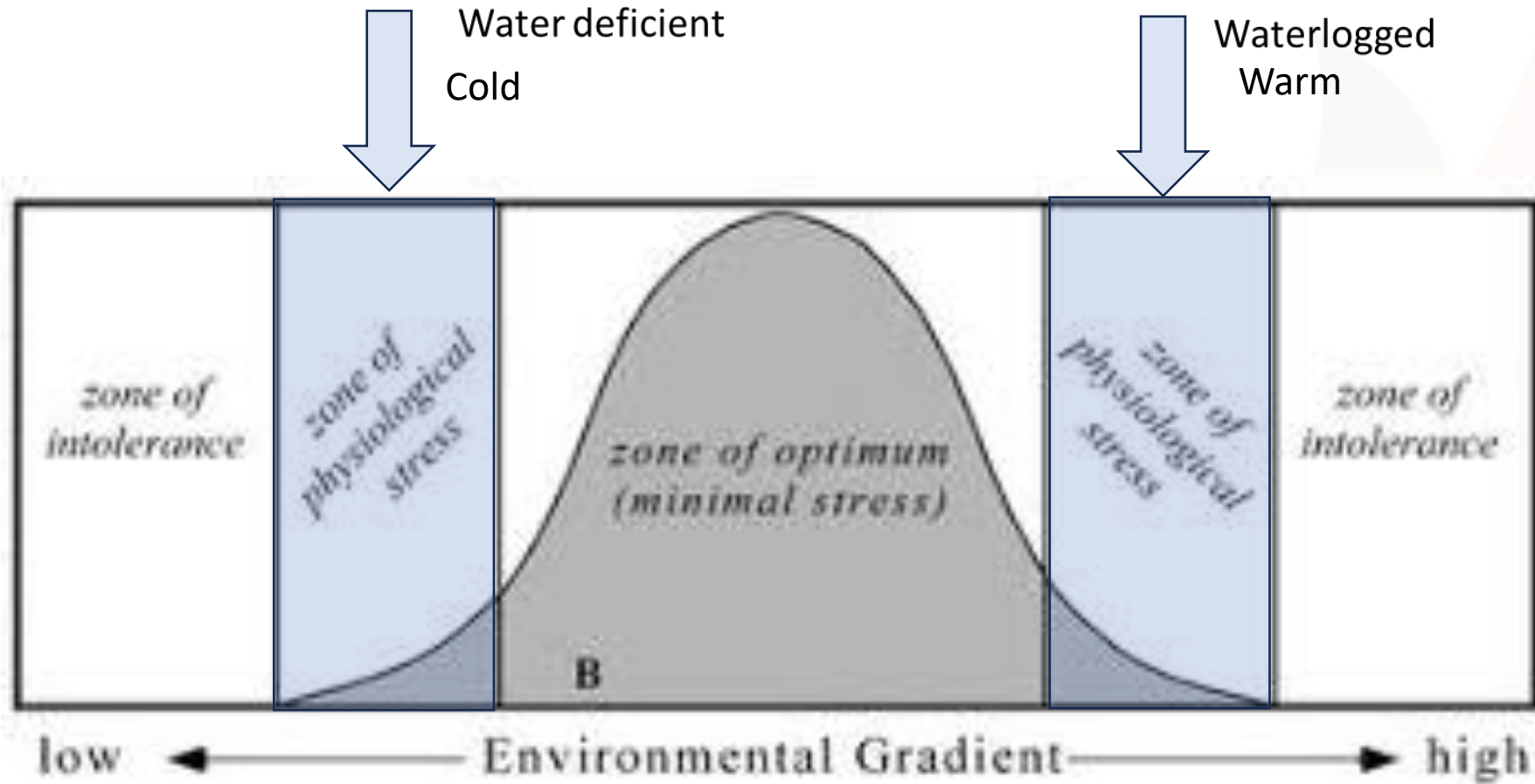


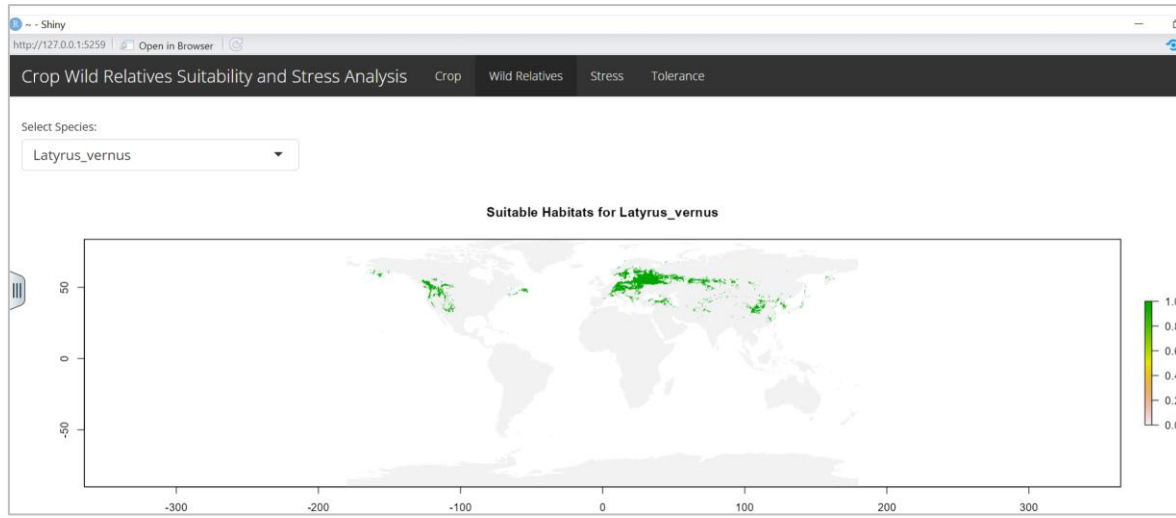
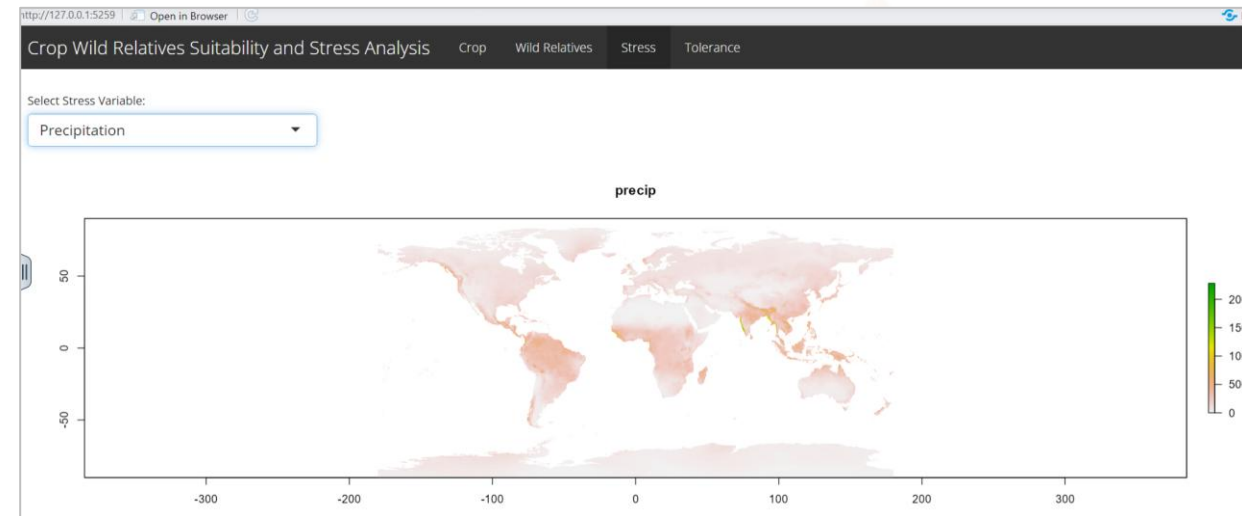
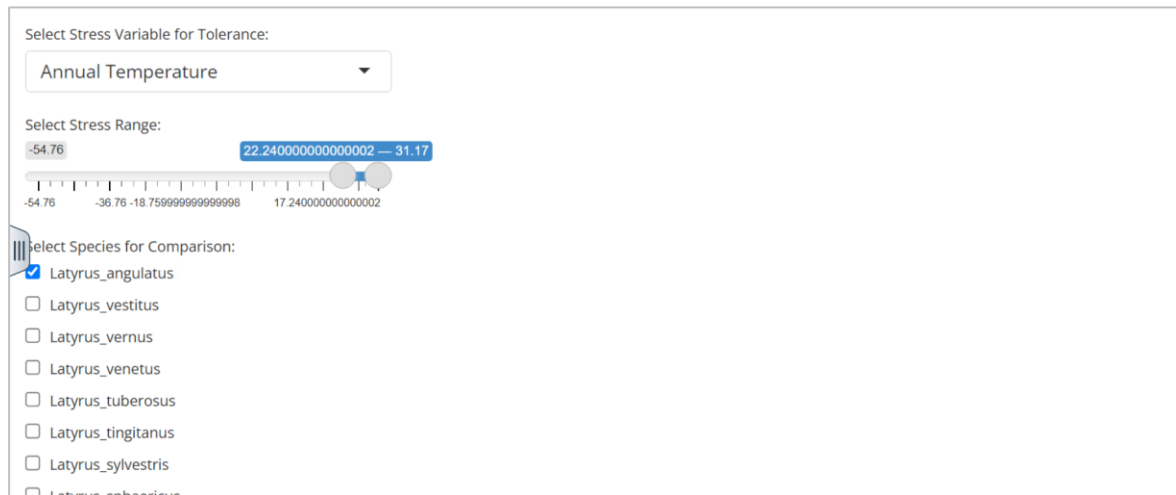
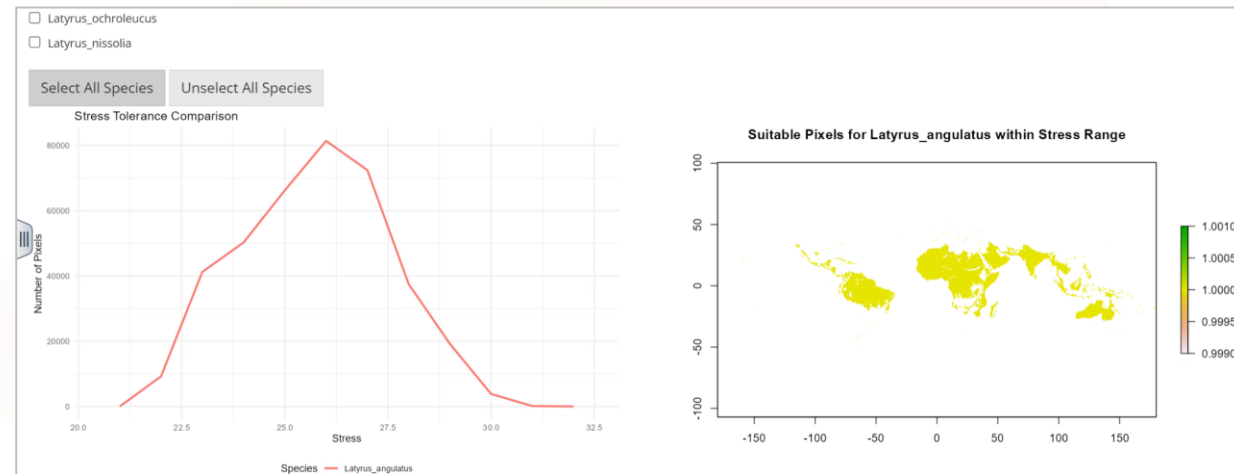
Habitat suitability map



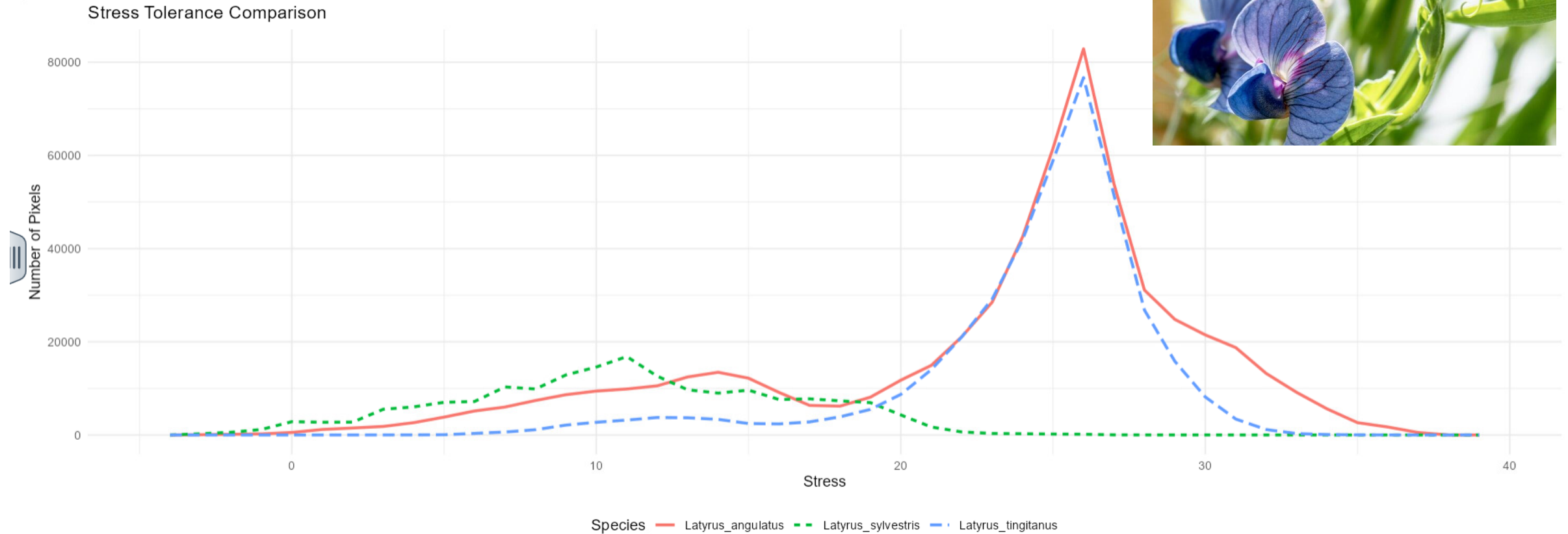
Soil pH

Temperature
Water Stress





Temperature tolerance ranges for three wild relatives of grasspea (Lathyrus sativus)



- Models are automated to run on annual base (by automatically accessing updated data, followed by new model iteration)
- This will enhance the number of model targets and the robustness of the models over time
- Creates an opportunity to provide automated alerts for new data with predicted traits (desired alleles)

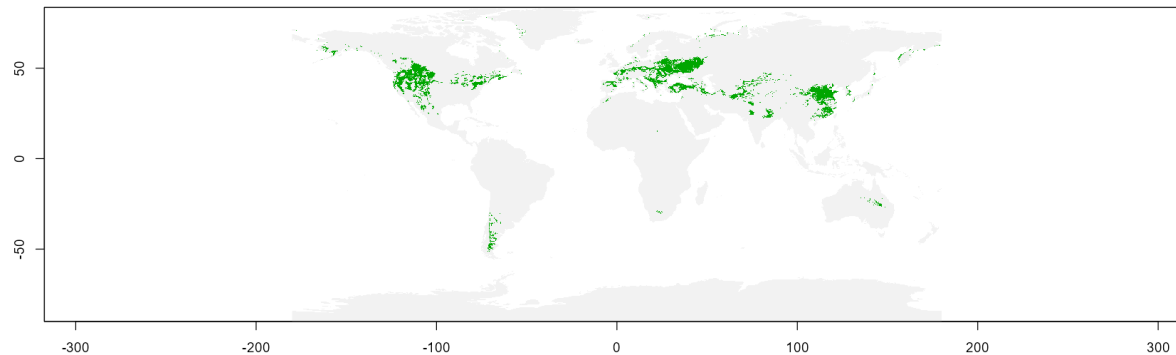


1. How do you interpret suitability maps for wild relative species?

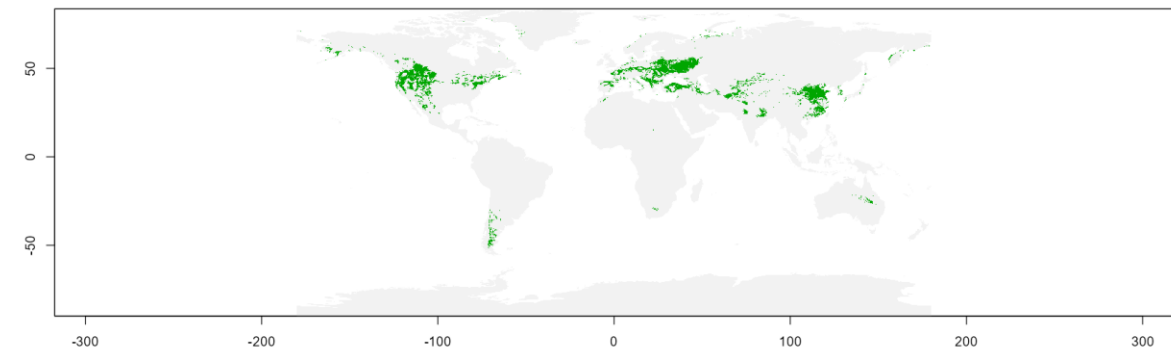
🔥 What insights can you derive from them?



Suitable Habitats for *Latyrus_pannonicus*



Suitable Habitats for *Latyrus_pannonicus*



- 1) For breeding grasspea in warmer climates, which three wild relative species would you select?
 - 🔥 In which geographic regions are these populations found?
 - 🔥 What if breeding for drought-prone and colder regions?
- 2) How do you use the app to compare abiotic stress tolerance across species?
 - 🔥 What insights can you gain from the "stress tolerance comparison" plot?
3. What are the limitations of relying on suitability maps to select populations of breeding interest?
 - 🔥 How can you address these limitations?

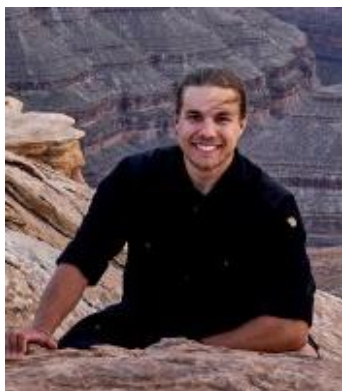
4. What additional environmental stresses (e.g., salinity, pests) can be targeted through breeding? For instance, how feasible is it to breed for resistance to biotic stresses?
5. What are the potential challenges of relying on crop wild relatives for breeding purposes (e.g., genetic incompatibility)?
6. How user-friendly is the Crop Wild Relatives Shiny App? Do you have any suggestions for improving its usability?

- 🔗 Link to the shiny GUI: <https://app.biodt.eu/app/biodtshiny-dev>
- 🔗 If you want to read more about crop wild relatives digital twin ([Crop Wild Relatives Digital Twin](#)) or





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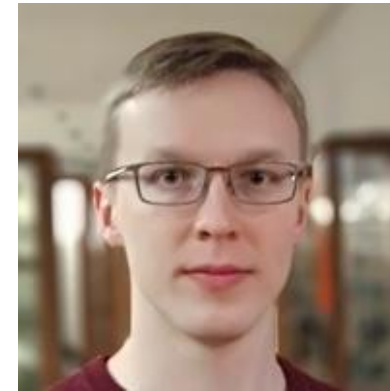
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