Genomics of plant genetic resources: origin, conservation, and discovery for future-proof agriculture

48h course, 6 CFU. Target: MSc students from an agronomy background

Lectures (45' each)

Module 1: Framing of the course

1. Course introduction, rules, mode of exam
2. Framing: food systems the Anthropocene
3. Agricultural sustainability
4. The status of the climate
5. Global climate models
6. Agrobiodiversity and PGRs: Basic concepts

Module 2: PGR genomes

1. Basics of Plant Genomes: DNA structure and features
2. Basics of Plant Genomes: Information flow and the Central Dogma of Biology
3. Basics of Plant Genomes: Genome organization
4. Basics of Plant Genomes: Plant genome evolution
5. Techniques in plant genomic analysis: Sanger sequencing
6. Techniques in plant genomic analysis: NextGen sequencing
7. Techniques in plant genomic analysis: Third generation sequencing
8. Reconstructing a de novo genome sequence
9. Molecular markers and Genomic Diversity in Major Crop Species (1)
10. Molecular markers and Genomic Diversity in Major Crop Species (2)
11. Population Genetics and Evolution of Gene Pools: HWE, Fst
12. Population Genetics and Evolution of Gene Pools: forces of evolution, mutation, selection
13. Population Genetics and Evolution of Gene Pools: forces of evolution, drift, migration
14. Population Genetics and Evolution of Gene Pools: phylogenetics

Module 2: PGR origin

1. Origin of Agrobiodiversity: Neolithic Revolution and domestication syndrome
2. Vavilov centers and Distribution of Wild Relatives
3. Cultural and environmental factors shaping PGR diversity
4. Conventional and Traditional farming systems
5. History of Breeding and breeding equation
6. Relation between breeding and PGR agrobiodiversity

Module 3: PGR conservation

1. Why conservation of PGRs is needed
2. Ex situ and In situ conservation
3. How PGRs are collected
4. PGR policy: ITPGR, Nagoya Protocol, Cartagena
5. Intellectual Property Rights in Plant Genetics
6. Genesys and PGR sharing databases

Module 4: PGR mining

1. Genebank genomics (datasets, methods)

2. Genebank phenomics (datasets, methods)
3. Genebank geographic analysis (datasets, methods)
4. Diversity Panels and core collections
5. Developing mapping populations and pre-breeding materials
6. Mapping alleles underlying traits
7. Mapping alleles underlying local adaptation
8. Discovering genes under selection
9. Breeding methods: MAS
10. Breeding methods: genomic selection
11. GMOs, historical perspective
12. New breeding technologies
13. Re-domestication of wild relatives
14. Climate analogues and ideotyping
15. Species distribution modelling
16. Participatory breeding methods
17. Synthesis: data-driven valorization of PGRs (1)
18. Synthesis: data-driven valorization of PGRs (2)