Genomics of Plant Genetic Resources for Future-Proof Agriculture

6CFU (48h) course given to MSc students.

Plan of Lectures

Module 1: Setting the Stage

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

Module 2: Genomics of PGRs

7. Basics of plant genomes: DNA structure and features
8. Basics of plant genomes: information flow and the central dogma of biology
9. Basics of plant genomes: genome organization
10. Basics of plant genomes: plant genome evolution
11. Techniques in plant genomic analysis: Sanger sequencing and Illumina
12. Techniques in plant genomic analysis: Third generation sequencing
13. Molecular markers and genomic diversity in PGRs (1)
14. Molecular markers and genomic diversity in PGRs (2)
15. Population genetics and evolution of PGR gene pools: HWE, Fst
16. Population genetics and evolution of PGR gene pools: forces of evolution - mutation, selection
17. Population genetics and evolution of PGR gene pools: forces of evolution - drift, migration
18. Population genetics and evolution of PGR gene pools: phylogenetics

Module 3: Origin and conservation of PGRs

19. Origin of Agrobiodiversity: Neolithic Revolution and domestication syndrome
20. Vavilov centers and distribution of wild relatives
21. Cultural and environmental factors shaping PGR diversity
22. Conventional and Traditional farming systems
23. History of Breeding, breeding equation
24. Relation between breeding and agrobiodiversity
25. Ex situ and In situ conservation
26. How PGRs are collected and shared
27. PGR policy: ITPGR, Nagoya Protocol, Cartagena
28. Intellectual Property Rights (IPR) in PGRs

Module 4: Mining of PGRs for future-proof agriculture

29. Genebank genomics (datasets, methods)
30. Genebank phenomics (datasets, methods)
31. Genebank geographic analysis (datasets, methods)
32. Diversity Panels and core collections
33. Map genotype-trait associations in plant genetic resources
34. Mapping alleles underlying local adaptation
35. Limitations of GWAS mapping approaches
36. Developing mapping populations and pre-breeding materials
37. QTL mapping methods
38. Breeding examples: MAS
39. GMOs, historical perspective
40. New breeding technologies: genome editing
41. Genomic selection
42. Species distribution modelling
43. Climate analogues and ideotyping
44. Frontiers: Climate-genome models to predict allelic offset
45. Frontiers: Re-domestication of wild relatives
46. Frontiers: Participatory breeding methods
47. Synthesis: data-driven valorization of PGRs (1)
48. Synthesis: data-driven valorization of PGRs (2)