CONSERVATION OF PLANT GENETIC RESOURCES *

Principles of in situ, ex situ and on farm conservation; germplasm banks; procedures and standards related to collection; characterization and evaluation of plant genetic resources; elaboration and application of morphological descriptors in germplasm; processing, analysis, packaging, documentation and ex situ preservation of access samples in the short, medium and long term, with emphasis on genetic resources of cultivated species and other wild species of economic interest or potential use, either directly or for improvement of cultures; conservation units; cryopreservation and in vitro preservation; preservation policies, conservation and utilization of genetic resources; cultivars protection and legislation on genetic heritage.

Goals

At the end of the program, the Master's / PhD student in Plant Genetic Resources should:

(a) be familiar with the objectives, methods and strategies used to conserve plant genetic resources in situ, ex situ and on farm;

b) know the various alternatives to conserve plant genetic resources;

c) know the procedures for the rational management of conserved germplasm and the responsibilities inherent to that management.

d) know the public policies of preservation, conservation and use of genetic resources;

e) know the current laws to access genetic heritage, collection of germplasm, interchange, cultivars protection, among others;

f) learn how to elaborate and apply morphological descriptors in germplasm.

Methodology

- Expositive classes with audiovisual resources and observations in the laboratory and field.
- Reading and analysis of technical-scientific articles.
- Elaboration of projects of implantation and research.
- Seminars.
- Experimentation.

Assessment

- Theory test
- Seminar on Genetic Resources
- Practical classes report

Program content

Theory / Practical classes

Introduction and principles of plant genetic resources.

Procedures and standards related to collection.

Elaboration and application of morphological descriptors in germplasm.

Ex situ conservation of plant genetic resources.

Stages of ex situ conservation of plant genetic resources.

In situ conservation and on-farm plant genetic resources.

Collections and germplasm banks.

Management of conserved germplasm.

Processing, analysis, packaging, documentation and ex situ preservation of samples.

Conservation units.

New Federal Law which regulates access to genetic heritage.

Cryopreservation and in vitro preservation.

Preservation, conservation and utilization of genetic resources policies.

Registration and protection of cultivars.

SEMINARS IN PLANT GENETIC RESOURCES I *

Techniques for seminar presentations and use of audiovisual resources; (access to biodiversity and associated traditional knowledge, and background knowledge, bioprospecting and technological development, Access and Benefit Sharing Agreement (ABSA), FAO's International Treaty on Plant Genetic Resources for Food and Agriculture , FAO's Multilateral Access System and Benefit-sharing, Authorization Request: Chico Mendes Institute of Biodiversity Conservation-ICMBIO and Genetic Heritage Management Council-CGEN) by guest researchers and professors. In addition, the teacher responsible for the discipline should organize the presentations addressing relevant topics such as: the program's Internal Rules; *Qualis* CAPES rules; Academic Curriculum completion and study plan form.

Goals
To provide advanced knowledge on plant genetic resources, in addition to the primary objective of training students in oral presentation techniques, as well as contributing to improve the critical thinking of the participants regarding the technical-scientific literature.

Methodology
Timed lectures and seminars, with a maximum duration of fifty minutes, thirty for the exhibition and twenty for the discussion. The seminars have the possibility of using audio visual resources.

Assessment

Individual seminar presentations of the discipline by a committee with a score from 0 to 10. The students' attendance at the seminars presented during the semester will also be evaluated and will correspond to 20% of the final grade awarded to them.

Program content

Presentation of at least two subjects relevant to the student’s career (regardless of the concentration area chosen by them), with discussion about the presentation and the presented text.

SEMINARS IN PLANT GENETIC RESOURCES II *

Presentation of a seminar on the theme of the Dissertation Project, orally.

Goals

Provide advanced knowledge on plant genetic resource topics, and a dissertation-related dialogue so that the student can receive suggestions for project improvement.

Methodology

The presentation will be in the form of seminars with a timed presentation, with a maximum duration of fifty minutes, thirty for the exhibition and twenty for the discussion. The seminar offers the possibility of using audiovisual resources.

Assessment

Individual presentations of seminars related to the research project by a commission from 0 to 10. The students' attendance at the seminars presented during the semester will also be evaluated and will correspond to 20% of the final grade awarded.

Program content

Individual presentations of the seminars (scheduled in the first week of class)
Presentation of the final result of the discipline.

METHODS FOR DETECTING GENETIC VARIATION

Types, origin, nature of detected variation, enrichment of genetic variability, characteristics and protocols of genetic markers. Biometry and interpretation of molecular genetic markers data and morphological data. Estimators of genetic diversity, outcrossing rates, gene flow. Genetic distances. Applications in genetics, conservation and plant breeding, use of software programs for detecting variability in plants (PAST, GENES, and R).

Goals

- To know the mechanisms that generate and amplify the genetic variation;
- To Identify existing genetic variations for a given species;
- Identify the processes of evolution and domestication of the species and their effects on plant genetic variability;
- To learn strategies and forms of conservation and manipulation of genetic variability and their interactions in plant production.

Methodology

- Lectures with audio-visual resources and observations in the laboratory and field.
- Reading, analysis and discussion of technical-scientific articles.
- Application of specific software programs to the subjects addressed.
- Presentation of seminars with topics related to the discipline's subjects.
- Elaboration of implantation and / or research projects.
- Lectures specific to the subjects addressed

Program Content

1. Presentation and discussion of the syllabus;
2. Type, origin and nature of the variation detected;
3. Hybridization and recombination to enrich genetic variability;
4. Molecular and morphological markers as tools for variability identification;
5. Analysis and interpretation of molecular data to identify variability;
6. Analysis and interpretation of morphological data to identify variability;
7. Seminars (Mutation, recombination, gene flow, genetic drift, speciation);
8. Seminars (Types of Markers);
9. Genetic divergence as a method to evaluate genetic variability;
10. Structure of population as a method to evaluate genetic variability;
11. Observations and interpretations of genetic variability (directed study).

Form of Learning Assessment

Individual evaluations and discussion of texts.

DATA ANALYSIS APPLIED TO PLANT RESOURCES

Sample planning and data analysis for observational studies: fundamental concepts for sampling, simple random sampling, stratified sampling, systematic sampling and multistage sampling. Analysis of variance: assumptions of the mathematical model, transformation of data Planning and analysis of data for experimental studies: experimental designs, tests of means. Group of Experiments. Regression: technique of linear model adjustments, regression analysis of variance, introduction to nonlinear models with focus for growth curves. Non-parametric tests and their applications: Chi-Square, Mann Whitney, Kruskal-Walles. Use of the R program for all statistical analyzes approached in this component. Introduction to multivariate statistics.

-Goals

It will be an applied component for the student to developing the ability to choose appropriate analysis techniques for the dissertation project. It also aims to enable students to plan, analyze and interpret the results obtained from observational and experimental studies.

-Methodology

Lectures with practical examples of application in plant resources field. For each subject, after the theory exposition, lists of exercises will be provided, with examples related to the area of activity of the students.

-Assessment

Each class will propose work and exercise lists, and the achievement of these will be used for learning assessment. In case of learning difficulties and low performance in the proposed work, a retake test will be applied.

-Program content

Introduction to sampling theory: basic notions of sampling, simple random sampling, stratified sampling, systematic sampling and multistage sampling.

2. Analysis of variance: applications, hypotheses, assumptions and data transformation.

3. Experimental designs: design planning, completely randomized design, randomized block design, confounding, correlation tests between blocks and treatments, factorial experiments, multiple comparison methods for means, regression in analysis of variance.

4. Experimental groups.

5. Introduction to nonlinear models: adjustment of nonlinear models, growth curves (Gompertz, Logistic, Brody, among others).

6. Non-parametric tests and their applications: Chi-Square (adherence, homogeneity and independence), Mann Whitney, Kruskal-Walles.

7. Main components, variance and covariance matrix. Discriminant analysis, analysis of canonical variables, multivariate analysis of variance. Cluster analysis.

BIOMETRY: ANALYSIS AND INTERPRETATION OF MORPHOAGRONOMIC AND MOLECULAR DATA

Obtaining data on genetic resources. Types and storage of data. Evolution in analysis of morphoagronomic data and molecular genetics. Software use. Applications in genetics, plant breeding and conservation.

-Goals

Provide subsidies using software programs so that students can analyze, interpret and incorporate the information provided by morphological and molecular markers in researches on genetics of populations, quantitative genetics, genetic conservation and improvement of both natural populations and cultivated species.

-Methodology

Participatory expositive classes. Resolution of group and individual exercises. Class and scheduled activities. Use of computer programs. Practical classes.

-Assessment.

The evaluation will be continuous during the course, based on the student's participation in classroom activities, group work and through instruments such as tests, discussion of scientific articles, seminars, etc. that allow to evaluate the performance of the student in relation to the content, skills and attitudes aimed in the discipline.

-Program content

1. MOLECULAR, QUALITATIVE AND QUANTITATIVE DATA - OVERVIEW

2. SOFTWARE USE

2.1. Overview;

2.2. Software integration.

3. ANALYSIS BASED ON MORPHOAGRONOMIC MARKERS DATA.

4. ANALYSIS BASED ON MOLECULAR MARKERS DATA

4.1. Genetics of Populations;

4.2. Population genetic parameters;

4.3. Genetic equilibrium;

4.4. Reproductive systems;

4.5. Genetic structure of populations

4.5.1. Measures of diversity and similarity;

4.5.2. Analysis of variance with co-dominant and dominant markers.

5. CLUSTER ANALYSIS, CONSTRUCTION OF DENDROGRAMS, DEFINITION OF NUMBER OF GROUPS, COEFFICIENT OF COPHENETIC CORRELATION, PCA.

PLANT ANATOMY AND HISTOLOGY

Origin and organization of the plant: primary and secondary meristem. Cell diversity. Simple and complex tissues. Distribution of tissues in the vegetative and reproductive organs. Primary and secondary growth. Unusual activity of vascular exchange. Secretory structures in Angiosperms. Sporogenesis and embryogenesis. Plant-pathogen interaction. Histochemical methods for identification of compounds.

Goals

To recognize the tissue systems and the internal organization of the vegetative and reproductive organs of Angiosperms, to associate structure and function and to relate environmental factors to their development.

Methodology

Expository classes with multimedia projector. Practical classes of cell and tissue recognition using histological slides. Processing (fixation, dehydration, infiltration, embedding, sectioning and staining) of vegetal biological samples with interpretation. Development of practical work with report writing and abstract for a scientific event with a culture chosen by the student.

Assessment

Seminars on various topics of interest to students, if possible, related to their thesis topics;

Development of a practical work with report writing and a summary for scientific event. The practical work aims to deepen the knowledge in the practices and routines in plant anatomy.

Theory test with the content covered.

Program content

Morphology of vegetative and reproductive organs;

Diversity, structure and ultrastructure of the plant cell;

Primary and secondary meristem; secondary thickening meristem;

Simple tissues: parenchyma, collenchyma and sclerenchyma; typologies, distribution and functionality;

Complex tissues: xylem, phloem; evolution, distribution and functionality.

Coating system: epidermis and phellem: origin, cellular typologies and functionality;

Anatomy of vegetative organs: root, stem and leaf;

Anatomy of reproductive organs: flower, fruit and seed;

Ontogeny of stamens (parietal layers), sporoderm and pollen tube;

Androsporogenesis and Androgametogenesis;

Development of the megasporangium (nucleus, integument).

Megasporogenesis and gynogametogenesis;

Fertilization, endosporogenesis and embryogenesis;

Secretory tissues (nectaries, trichomes, hydathodes, laticiferous, among others);

Pathogen-plant interaction: structural mechanisms of plant defense;

Histochemical methods for identifying compounds;

Introduction to Scanning Electron Microscopy and Transmission Electron Microscopy.

ADVANCED TOPICS IN PLANT GENETIC RESOURCES (DISTANCE LEARNING)

To promote the insertion of international researchers in the fields of reproductive biology, plant genetics, plant breeding, statistical data analysis, developmental and production physiology, conservation of genetic resources and management of natural populations , as well as using various forms of distance communication through the interactive means of video conferencing, classes, symposia, seminars, among others.

Goals

Expand the use and internationalization of pedagogical practices enriching the use of Plant Genetic Resources.

Methodology

- Video conferencing class
- Online meetings
- Reading and analysis of technical-scientific articles
- Elaboration of implementation and / or research projects

Assessment
Individual evaluation, reports.

GENETICS OF POPULATIONS

Review of basic genetics (DNA, chromosome, alleles, allelic and non-allelic interactions); Basic principles of genetics of populations; Allele and genotype frequencies and Hardy-Weinberg equilibrium; Evolutionary forces that alter the gene frequencies (selection, genetic drift, migration and mutation); linkage equilibrium and disequilibrium; Use of population genetics in plant genetic improvement (cross-pollinated populations, selection and inbreeding); Population subdivision and Wright statistics; measures of population variability; Effective size; Analysis of molecular data for estimation of population parameters; Study of genetic diversity in plants and Case study (scientific articles).

Goals

To provide students the ability to analyze and relate the different topics of Genetics of Populations to the fields of genetic diversity, evolution, conservation and genetic improvement of plants.

Methodology

Expository class on the main topics of population genetics, case study with resolution of exercises and reading of scientific articles for seminars and or discussions. Demonstration of computer programs's use applied to population genetics.

Assessment

- Subjective and objective test;
- Exercises list

Program content

1. The reproductive mechanisms in plants and their implications: autogamous; allogamous and mixed system
2. Basic genetics: DNA, gene, alleles, chromosome and allelic and non-allelic interactions
3. Introduction to molecular markers used in the study of genetic diversity
4. Genetics of populations: Allele and genotype frequencies; Hardy-Weinberg equilibrium
5. Factors influencing population balance: Mutation; Migration; Selection; Inbreeding
6. Common themes in population genetics: Genetic Drift; The Founder Principle; Speciation; Gene flow
7. Linkage equilibrium and Linkage disequilibrium
8. Use of population genetics in breeding: crossbreeding, inbreeding and population mean.
9. Genetic Structure of Populations: Wright's F-statistics
10. Effective Population Size
11. Analysis of genetic diversity by molecular data: main parameters; analysis of molecular variance (AMOVA)
12. Exercise Lists
13. Seminars with presentation of scientific articles
14. Use of software programs for analysis of molecular data: main population parameters and analysis of diversity (clusters).

PLANT CYTOGENETICS

Genome organization in plants. Genome size variation of plants. General characteristics of chromosome structure and organization. Classical and molecular techniques of chromosome research. Mechanisms of genetic transmission. Gene linkage and recombination. Pollen biotechnology and genetic improvement. Modes of reproduction in plants. Chromosomal distribution and functional interpretation of epigenetic marks in histones in plants. Chromosomal mapping. Structural and numerical chromosome variations. Polyploidy and genetic improvement.

Goals

To present the organization of plants genome, the structure and function of the chromosomes in the genetic transmission, the causes and consequences of the numerical and structural chromosomal variations, providing subsidies for the elaboration of a cytogenetic characterization plan in germplasm banks and application of cytogenetics in plant breeding.

Methodology

The methodology used involves participatory expositions, individual extra-class exercises, guided studies, seminars and laboratory practice, aiming, above all, the student's conscious participation in order to develop a critical spirit in front of the information received. These activities will be mediated by the following strategies: expository classes; practical classes in the Laboratory of Culture and Tissues, in the National Cassava and Fruits Research Center (EMBRAPA); reading and discussion of technical-scientific articles; group work; seminars.

The evaluation will be continuous during the course, considering the participation of the student in classroom activities and group work, and using instruments such as tests, discussion of scientific articles, seminars, etc. that allow to evaluate the performance of the student in relation to the content, skills and attitudes objectified in the discipline.

Program content

1) Genome organization in plants, structure and morphology of chromosome
2) Mechanisms of Genetic Transmission
3) Genetics and cytology of meiotic chromosomes behavior
4) Variations in chromosome size and organization
5) Karyotype analysis
6) Classical and molecular techniques of chromosome research in plants
7) Chromosomal recombination
8) Pollen Biotechnology and Genetic Improvement
9) Modes of plant reproduction
10) Chromosomal distribution and functional interpretation of epigenetic marks in plant histones
11) Structural chromosomal changes: types, causes and consequences
12) Numerical chromosomal changes: types, causes and consequences
13) Morphological, physiological and cytogenetic significance of polyploidy
14) Manipulation of genome composition and genetic improvement.

PRINCIPLES AND TECHNIQUES OF PLANT PROPAGATION

Flowering and fruiting. Seed formation. Germination. Pre-germinative treatments. Seed conservation. Statistical tools applied to germination tests. Collection and composition of seed lots. Legislation and legal aspects of propagation. Anatomical, physiological and practical bases of vegetative propagation.

goal

To enable the master's degree in propagation techniques of plants, aiming at the multiplication and conservation of plant genetic resources.

Methodology

- Expositive classes with audio-visual resources and laboratory and field observations.
- Reading and analysis of technical-scientific articles
- Elaboration of implementation and / or research projects
- Lectures

Assessments

Individual assessments and participation in discussions

Program content

Introduction
Importance and general aspects of propagation

Sexual plant propagation

Factors influencing fruiting and flowering

Evolution and formation of seeds

Seed development

Seed Conservation

Germination

Mobilization of reserves

Pre-germinative treatments and dormancy mechanisms

Statistical conditions and tools applied to germination tests

Legislation applied to the production of seeds and seedlings of agricultural and forestry species

Asexual Propagation

- Aspects of vegetative propagation
- Anatomical bases of cutting, grafting and layering
- Propagation techniques by cutting
- Propagation techniques by grafting
- Propagation techniques by layering
- Propagation by specialized structures
- Principles and techniques of micropropagation
- General aspects of apomixis

SPECIAL TOPICS ON VEGETABLE GENETIC RESOURCES I

Topics related to recent advances in the field of reproductive biology, plant genetics, plant breeding, statistical data analysis, developmental and production physiology, conservation of genetic resources, and management of natural populations.

Goals

Studying topics of current interest in Plant Genetic Resources

Methodology

- Expositive classes with audiovisual resources and laboratory and field observations.
- Reading and analysis of technical-scientific articles
- Elaboration of implementation and / or research projects
- Lectures

Assessment

Individual evaluation, reports or texts discussion

PHYSIOLOGY OF BIOTIC AND ABYOTIC STRESS IN PLANTS

Abiotic stress: sensing mechanisms and signaling pathways activated in plants. Climate change and effects on plants. Biotic interactions: herbivory, infection by microbial pathogens or parasites and allelopathy. Production of secondary metabolites as defenses against environmental stresses.

Goals

To present the students the factors that lead to biotic and abiotic stress; to discuss how physiological and biochemical adjustments enable plants to develop responses to different environmental and biotic stresses and to relate them to the production of secondary metabolites. Present and discuss the challenges imposed by climate change and its effects on plants and strategies for survival in the face of ecosystem changes.

Methodology

- Expository classes with audiovisual resources
- Reading and analysis of technical-scientific articles
- Practical classes / technical visits to laboratories
- Lectures

Assessment

Individual assessments and participation in discussions

Program content

Definition of plant stress

Acclimatization and adaptation

Abiotic stress

- Environmental factors and biological changes in plants

- Saline stress,

- Water stress,

- Thermal stress

- Oxidative stress

- Signaling routes and production of metabolites

- Molecular and biochemical mechanisms working as stress sensors in plants

-Climate changes and effects on plants

Biotic interactions

- Physiological mechanisms in defense against pathogens

- Defense responses against herbivory
- Signaling mechanisms associated with interactions between plants and herbivorous insects
- The role of elicitors in plant defense
- Systemic plant defense against other organisms
- Production of secondary metabolites

Basic metabolism and origin of secondary metabolites

- Volatile oils
- Phenolic compounds and flavonoids
- Tannins and quinones
- Saponins
- Methodologies for isolation and identification of secondary metabolites in plants

MANAGEMENT OF NATURAL POPULATIONS

Phytosociology. Phytogeography of plant formations. Growth and production dynamics. Dendrometric methods. Sampling techniques in forest inventories. Criteria and indicators of environmental sustainability. Conservation of forest genetic resources. Non - timber forest products. Sustainable forest management.

Goals

To train students in the analysis and interpretation of the structural parameters of the forest and their interrelationships, as well as dynamics of growth and production, serving as the basis for the elaboration and execution of plans of ecological and economic continuous use of forest products, as well as maintenance of biodiversity and forest regulatory functions.

Methodology

- Expository classes with audiovisual resources and in laboratory and field observations.
- Reading and analysis of technical-scientific articles
- Technical visit in experimental fields
- Seminars presentation

Assessment
Individual assessment and text discussions

Program content

Phytosociology

Floristic composition: diversity index, aggregation and similarity

Analysis and processing of floristic information

Structural analysis of the forest: horizontal and vertical structure

Analysis and processing of horizontal structure information

Analysis and processing of vertical structure information

Internal structure and diametric structure

Analysis and processing of internal structure information

Analysis and processing of the information of the diametric structure

Brazilian Biomes

Atlantic Forest

Amazon Rainforest

Cerrado

Caatinga

Techniques, Tools and instruments for tree measurement

Volumetry and biomass estimation in different parts of the tree

Concepts and objectives of forest inventory

Planning and types of forest inventory

Planning and types of forest inventory

Sampling methods and systems; size and shape of sample units

Monocyclic and polycyclic management systems:

Management systems: clear cut in alternating bands

Regulation of forestry production

Simulation of regulation of forest production methods

Multiple use of native forest: direct and indirect forest use

CENTERS OF ORIGIN AND DOMESTICATION OF VEGETABLE SPECIES

Identification of centers of origin and centers of diversity of cultivated plants; Concept of domestication and the domestication syndrome; Domestication and the origins of agriculture; Implications of domestication studies for the genetic improvement of crops; Redomestication and neodomestication; Domestication of plants in the old world; Origin of cultivated plants and domestication in the new tropical world; Analysis of the interactions of different peoples with the environment; Conservation of wild progenitors; Practices and knowledge associated with genetic resources.

Goals

To present the centers of origin and diversity and discuss the principles and processes involved in the domestication and dispersal of the main cultivated plants.

Methodology

Expository classes, analysis and discussion of articles relevant to the topics covered in the program. Practical classes and visits to germplasm banks.

Assessment

The evaluation will be continuous during the course, considering the participation of the student in classroom activities and group work, and also using instruments such as tests, discussion of scientific articles, seminars, etc. that allow evaluating the performance of the student in relation to the content, skills and attitudes aimed at the discipline.

Program content

1) Identification of centers of origin and centers of diversity of cultivated plants;
2) Concept of domestication and the domestication syndrome;
3) Genetic and molecular basis of the domestication syndrome;
4) Domestication and the origins of agriculture;
5) Geography of domestication;
6) Implications of domestication studies for genetic improvement of crops;
7) Redomestication and neodomestication;
8) Domestication of plants in the old world;
9) Origin of cultivated plants and domestication in the new tropical world;
10) Origin and domestication of native Amazonian crops.
11) Practices and knowledge associated with genetic resources.

PLANT SYSTEMS AND REPRODUCTIVE BIOLOGY

Taxonomic concepts and methods; classification systems; botanical nomenclature; morphology and systematics of vascular plants; main families of agronomic interest. Aspects of floral biology and its importance in pollination and fertilization of angiosperms. The interaction between flower and pollinators. Pollinators and dispersers action in plant communities.

Goals

To study and understand the APG IV classification system, the main monocotyledonous and eudicotiledonea families and to understand their most relevant morphological characteristics. To study floral biology with an emphasis on reproductive aspects and its relationships with pollinating agents.

Methodology

- Expository classes with audiovisual resources and observations in the laboratory (Botany laboratory C4 and Herbarium) and field lessons.
- Reading and analysis of technical-scientific articles
- Elaboration of implementation and / or research projects
- Lectures

Assessment

The practical classes will be developed in the laboratory using stereomicroscopes , microscopes and chemical reagents. In addition, there will be a field class or fieldwork for application of the theory given in the classroom. The form of assessment will be through seminars and abstracts (total: 10.0 points), submission of a report based on the field class (5.0 points) and a written test (5,0 points).

Program content

Botany: importance, historical classification systems.

02. Characterization of the main groups of Angiosperms.

03. Taxonomic concepts; species concepts.

04. Classification system: characteristics and examples, with emphasis on phylogenetics.

05. Botanical nomenclature.

06. Importance of Herbaria and herborization.

07. Analytical identification keys: use and confection.

08. Characteristics of Angiosperm taxa and main representatives of agricultural interest.

09. Reproductive system and floral morphology.

10. Phenology and flowering control.

11. Microsporogenesis and megasporogenesis.

12. Types of pollination and fertilization mechanisms.

13. Forage behavior of pollinators and dispersers.

14. Structure and population dynamics of pollinators and dispersers in plants and plant communities.

15. Analysis of pollen and nectar.