

**INTERNATIONAL SEED PRODUCTION**  
**Horticulture and Crop Science 630**  
 3 cr. hrs.

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**SYLLABUS**  
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- I. TEXT:** Seed Production: Principles and Practices. M.B. McDonald and L.O. Copeland, 1997; Chapman & Hall, New York, NY, 749 pp.

**OTHER READINGS:**

Research papers from refereed journals (e.g. Seed Science and Technology, Seed Science Research, Agronomy Journal, J. Amer. Soc. Hort. Sci., Crop Science) as assigned by instructors and student discussion leaders.

- II. CLASS SCHEDULE:** Lecture: T Th 9:00 - 10:20 AM 333D KH

**III. GRADE DISTRIBUTION AND SCALE:**

Exam I (wk 4)	40%	90-100	A
Exam II (wk 7)	40%	80-89	B
Class presentation/discussion	20%	70-79	C
		60-69	D
		< 60	E

- IV. PREREQUISITE:** HCS 420 (Seed Science) or permission of instructor

**V. COURSE OBJECTIVES AND STUDENT LEARNING OUTCOMES:**

- A) The study of international seed production principles (from flowering/fruit set through seed quality assessment and seedling establishment) from a physiological and ecological perspective. This class will be taught using internet video conferencing with instructors from OSU, Brazil, Alabama A&M, and Chile.
- B) The student will be able to:
1. Apply concepts of plant growth and development to the production of high quality seed.
  2. Identify environmentally sensitive cultural and pest management strategies for application in seed production.

3. Develop awareness of unique challenges associated with seed production of specialty crops and genetically-modified cultivars.
4. Review and assess current research literature related to seed production

## **VII. COURSE ORGANIZATION AND CONTENT**

### **International Seed Production 18 modules of ~80 minutes.**

#### **I. INTRODUCTION AND PRINCIPLES**

##### **1- Global Seed Industry (OSU; Samuel)**

##### **2- Seed Industry in USA, Brazil and Chile (~ 30 minutes each one)**

##### **2.1 USA (OSU; Miller)**

- 2.1.1 Introduction
- 2.1.2 Improved seed leads to gains in crop yield
- 2.1.3 Purchased seed use in the United States
- 2.1.4 Seed industry development in the United States
- 2.1.5 U.S. organizations facilitating seed production
- 2.1.6 Impact of American seed industry development on public research and development
- 2.1.7 Where is seed produced in United States

##### **2.2 Brazil (ESALQ; Julio)**

- 2.2.1. Highlights about the country
  - a) Location
  - b) Geography, climate, population, distribution of gross domestic product
- 2.2.2. Agriculture in Brazil
  - a) Contribution to GDP
  - b) Crop production and productivity
- 2.2.3. Seed Production
  - a) Seed industry development in Brazil
  - b) Seed production location
  - c) Seed demand

##### **2.3 Chile (PUC; Samuel)**

- 2.3.1 Highlights about the country
  - a) Location
  - b) Geography and climate
  - c) Agricultural land use
- 2.3.2 National and International markets
  - a) Characteristics of the national market (value, main species, national certification)

- b) International market and evolution of exportations (value, main species, reason for growth)
- 2.3.3 Reasons for growth of Chilean seed exportations
  - a) Natural advantages
  - b) Technological reasons
  - b) Political and economic reasons
- 2.3.4 Main species and areas of seed production in Chile
- 2.3.5 Challenges of the Chilean Seed Industry

### **3- General principles of flowering, pollination, seed development and morphology (ESALQ; Julio)**

- 3.1. Flowering induction
- 3.2. Types of flowers and inflorescences
- 3.3. Types and agents of pollination
- 3.4. Pollen and ovule formation
- 3.5. Pollination and double fertilization
- 3.6. Importance of pollination: influence in seed genetic purity and yield
- 3.7. Embryogenesis and seed development
- 3.8. Seed maturation
- 3.9. General morphology of monocotyledonous and dicotyledonous seeds

### **4- Seed quality (ESALQ; Ana)**

- 4.1. Introduction: importance of seed quality.
- 4.2. Parameters of seed quality:
  - a) varietal identity and purity
  - b) physical (integrity of the seed, seed formation and water content)
  - c) physiological (viability and vigor)
  - d) sanitary attributes (insect and seed born diseases).
- 4.3. Relationship of seed quality and production factors:
  - a) field production
  - b) processing
  - c) storage
- 4.4. Seed quality evaluation primary tests:
  - a) sampling
  - b) purity
  - c) viability (germination and tetrazolium tests)
  - d) moisture content
  - e) seed health
  - f) vigor.
- 4.5. "In house" seed quality control main procedures.

### **5- Fundamentals of seed production (How to produce the perfect seed) (3 sessions)**

#### **5.1 Fundamentals of seed production I: Genetic, breeding and seed production (PUC; Samuel)**

- 5.1.1 Introduction

- a) The breeding process, achievements and importance to agriculture
- b) Seed production: overview of the main objectives of seed production and the activities involved in the process.
- 5.1.2 Genetic of plant populations and breeding systems
  - a) Self-Pollination
  - b) Cross-Pollination
  - c) Apomixis
- 5.1.3 Categories of seed-propagated cultivars and species
  - a) Annual and biennial species
  - b) Perennial Species
- 5.1.4 Seed production systems
  - a) Annual and biennial cultivars
  - b) Perennial sources

## **5.2 Fundamentals of seed production II: Seed production and management (OSU; Mark)**

- 5.2.1 Introduction
- 5.2.2 Field Selection and Preparation
- 5.2.3 Seeding and Stand Establishment
  - a) direct seeding
  - b) seedlings
  - c) vegetative propagation
- 5.2.4 Plant populations and spacing
- 5.2.5 Seed Crop Management
  - a) weed control
  - b) irrigation
  - c) disease management
  - d) insect management
  - e) soil fertility (soil and foliar testing, etc.)
  - f) organic seed production methods
- 5.2.6 Pollination, Isolation, Roguing
  - a) op's vs. hybrids
  - b) mechanisms of hybridization
    - i. hand pollinated
    - ii. gene control pollination (self-incompatibility, male-sterile, etc.)
- 5.2.7 Seed Production Environment and Physiological Disorders
  - a) water stress
  - b) freezing injury
  - c) other
- 5.2.8 Precision Farming in Seed Production

## **5.3 Fundamentals of seed production III: Seed harvest, drying, processing and storage ESALQ (Silvio)**

- 5.3.1 Seed Harvest.
  - a) Introduction: importance.
  - b) Harvest methods: manual, mechanic

- c) General problems and possible solutions: planning; harvesting time; procedures and main machine adjustments; mechanical injuries; harvesting losses and its control; seed mixtures.
- 5.3.2 Seed Drying.
  - a) Importance.
  - b) Principles of seed drying.
  - c) Drying methods
- 5.3.3 Seed processing
  - a) Importance.
  - b) Basis of separation: size, weight; specific weight, shape, color; texture of seed coats; affinity to liquids; electrical conductivity.
  - c) Lines of processing (seed flux).
- 5.3.4 Seed storage
  - a) Introduction
  - b) Storage conditions: environment (relative humidity; temperature; micro organisms and insects.
  - c) Other factors to consider: seed initial quality; chemical treatment; seed species; packaging
  - d) Storage facilities: types, advantages and disadvantages

**6- Seed certification and legislation (each institution presents about its own country, ~30 minutes)**

**6.1 USA (OSU; Miller)**

- 6.1.1 History
- 6.1.2 Certification today
- 6.1.3 Seed certification organizations
  - a) OECD
  - b) AOSCA
- 6.1.4 The generation scheme of certification
- 6.1.5 Foundation seed production
- 6.1.6 How varieties become eligible for certification
  - a) Varietal release
  - b) Definition of a variety
  - c) Varietal review boards
- 6.1.7 Certification procedure
  - a) Planting stock
  - b) Application
  - c) Field inspections
  - d) Harvesting
  - e) Conditioning
  - f) Sampling
  - g) Seed inspection
  - h) Seed tagging
  - i) Marketing
- 6.1.8 Benefits of certification
- 6.1.9 Changing concepts and services

- 6.1.10 The future of seed certification
  - a) The changing seed industry
  - b) Competition and survival
  - c) New dimensions: new horizons

## **6.2 Brazil (ESALQ; Silvio)**

### 6.2.1 Introduction.

### 6.2.2 The Brazilian Seed System

- a) National producers register
- b) National cultivar register
- c) Seed production.
- d) Seed certification.
- e) Seed testing
- f) Seed marketing.
- g) Seed inspection: field and processing phases: seed sampling, analysis, certification, storage, transportation and marketing
- h) Seed demand
- i) Penalties.

### 6.2.3 Final comments.

## **6.3 Chile (PUC; Rebeca)**

### 6.3.1 Introduction

### 6.3.2 The Chilean Agriculture and Livestock Service (SAG)

### 6.3.3 Seed trade regulations, legal basis

### 6.3.4 General concepts of the law

- a) Purpose of the norms
- b) Legal definition of seed
- c) Seed classification and characterization
- d) Containers and labels
- e) List of officially described varieties
- f) Control function of SAG
- g) International trade

### 6.3.5 The breeder's Right in Chile

- a) Areas of protection
- b) Range of protection
- c) Transgressions and Sanctions

### 6.3.6 Seed Certification

- a) National
- b) International

## **II. APPLICATION OF PRINCIPLES ON SEED PRODUCTION OF DIFFERENT SPECIES**

### **7- Hybrid seed production in corn (OSU; Mark)**

#### 7.1 Introduction

#### 7.2 Importance of breeding, hybrid vigor, use of transgenic traits

- 7.3 Vegetative development
- 7.4 Reproductive development
- 7.5 Seed Crop Management
  - a) field selection, isolation, preparation, fertilization
  - b) seeding and stand establishment
  - c) irrigation
  - d) disease, insect, weed management
- 7.6 Pollination, detasseling, managing pollen drift
  - a) inbred lines
  - b) double-cross hybrids
  - c) single-cross
  - d) 3-way hybrids
- 7.7 Harvesting; husking; sorting
- 7.8 Drying; shelling
- 7.9 Cleaning
- 7.10 Conditioning
- 7.11 Storage; sizing; bagging; shipping
- 7.12 Quality control and assessment
- 7.13 Special requirements of sweet corn seed production
- 7.14 Seed enhancements; seed treatments

## **8- Hybrid seed production in vegetables (2 sessions) (PUC; Samuel and Rebeca)**

### **8.1. Tomato and pepper**

- 8.1.1 Introduction
  - a) Solanaceae family
  - b) Reproductive structures of tomato and pepper
  - c) Natural pollination mechanisms
  - d) The tomato and pepper seeds
  - e) Advantages of hybrid cultivars in tomato and pepper
- 8.1.2 Seed production in protected structures (greenhouse, high tunnels)
  - a) Advantages and disadvantages
- 8.1.3 Hand pollination as hybridization process
  - a) Emasculation
  - b) Pollen extraction
  - c) Pollen storage
  - d) Hand pollination
- 8.1.4 Genetic male sterility as alternative for hybridization
  - a) Problems associated with emasculation
  - b) Use of genetic male sterility in pepper seed production
  - c) Advantages and disadvantages
- 8.1.5 Harvest, seed extraction and drying of tomato and pepper seeds

### **8.2. Cucumbers**

- 8.2.1 Introduction
  - a) Cucurbitaceae family
  - b) Reproductive structures of cucumber and natural pollination mechanism

- c) The cucumber seed
- e) Advantages of hybrid cultivars in cucumbers
- 8.2.2 Production of cucumber hybrid seed
  - a) Use of gynoeious lines in hybrid seed production
  - b) Use of growth regulators to modify sex expression of flowers
  - c) Flowering model in cucumber
  - d) Management considerations
- 8.2.3 Harvest, seed extraction and drying of cucumber seeds

### **8.3. Onion and carrots**

#### 8.3.1 Introduction

- a) Cytoplasmatic male sterility

#### 8.3.2 Production of onion hybrid seed

- a) Alliaceae family
- b) Reproductive structures of onion
- c) Biannual species: Photoperiod and vernalization requirements; seed to seed vs. seed – bulb-seed as method for establishment.

#### 8.3.3 Production of onion hybrid seed

- a) Isolation
- b) Depuration, bulb (onions)
- c) Planting pattern
- d) Split date
- e) Use of pollinators (bees)
- f) Weeds and downy mildew, weeds: genetic and physis purity
- g) Harvest

#### 8.3.4 Carrot

- a) Reproductive structures
- b) Biannual specie: vernalization requirements;

#### 8.3.5 Production of carrot hybrid seed

- a) Isolation
- b) Depuration, roots ( carrots)
- c) Planting pattern
- d) Split date
- e) Use of pollinators (bees)
- f) Weeds and genetic and physis purity
- g) Harvest

### **8.4 Broccoli and cauliflower**

#### 8.4.1 Introduction

- a) *Brassicacae*
- b) Reproductive structures of brassicae
- c) The broccoli and cauliflower seeds

d) Temperature and development

#### 8.4.2 Production of broccoli and cauliflower hybrid seed

- a) Use of self-incompatibility for hybridization
- b) Isolation
- c) Planting pattern
- d) Split date
- e) Nicking
- f) Use of pollinators (bees)
- g) Weeds and genetic and phytic purity
- h) Mildew and sclerotinia
- i) Harvest

### 9- Seed production in tropical species (2 sessions)(ESALQ)

#### 9.1. Coffee (Julio)

9.1.1. Importance of Coffee Production

9.1.2. Coffee Fruit and Seed General Morphology

9.1.3. Coffee Seed Production

- a) Producing coffee seedlings
- b) Selection of trees
- c) Harvesting
- c) Processing
- d) Drying and storage

#### 9.2. Tropical forages: *Brachiaria* spp. and *Panicum* spp. seeds (Ana)

9.2.1. Introduction:

- a) importance of tropical forage seeds
- b) characteristics of the market (national and international).

9.2.2. General aspects of seed production:

- a) cultivars
- b) field selection
- c) maturation
- d) seed harvest procedures (manual, mechanic, manual and mechanic)
- e) seed cleaning and storage.

9.2.3. Problems in seed quality evaluation:

- a) sampling
- b) purity
- c) viability (germination and tetrazolium tests)

#### 9.3. Recalcitrant species (Silvio)

9.3.1 Introduction.

9.3.2 Harvest procedures.

9.3.3 Transportation.

9.3.4 Desiccation tolerance.

### 9.3.5 Seed storage

## **10. Seed production of cotton (ALABAMA; Udai)**

- 10.1. Introduction
- 10.2. Origin, Botany and Species of Cotton
- 10.3. Breeding and Cultivar Development
  - a) Use of Transgenic traits and cultivars
  - b) Hybrid seed production/ importance
  - c) Roguing
- 10.4. Management of Seed Crop
  - a) Land Preparation and Isolation Requirement
  - b) Planting and stand establishment
  - c) Fertilization, irrigation and weed control
  - d) Control of pests and diseases
- 10.5. Harvesting/ Picking
- 10.6. Post harvest Operations and Quality Control
  - a) Ginning
  - b) Delinting
  - c) Seed Yield
- 10.7. Grading and Seed Treatment
- 10.8. Shipping and Marketing

## **11. Seed production of peanut (ALABAMA; Udai)**

- 11.1. Introduction
- 11.2. Origin, Botany and Species
- 11.3. Breeding and Cultivars Development
- 11.4. Cultivar and Isolation Requirements
- 11.5. Land Preparation and Seeding
- 11.6. Fertilization and Irrigation
- 11.7. Control of Weeds, Pests and Diseases
- 11.8. Judging Maturity and Harvesting (lifting) Pods
- 11.9. Cleaning, Drying and Shelling Pods
- 11.10. Seed Treatments, Storage, Shipping and Marketing

## **12. Seed production of native-wild species (OSU; David)**

## **13. Sunflower seed production (PUC; Rebeca)**

- 13.1 Introduction
  - a) Types of sunflower (based on their use)
  - b) Genes of agronomic interest:
  - c) Cytoplasmic male sterility
  - d) Clearfield
  - e) Others genes
2. Production of sunflower hybrid seed
  - a) Certification process

- b) Plant populations and spacing
- c) Crop rotation, Sclerotinia
- d) Pollination, Nicking, Isolation, Roguing

#### **14. Seed production of flowers (OSU; Miller)**

14.1 Introduction

14.2 Flower seed producers

14.3 Production areas

14.4 Seed production procedures

14.4.1 Greenhouse production of hybrid seeds

- a) Parental plant culture
- b) Genetic quality control
- c) Pollination management
- d) Seed harvest
- e) Seed cleaning

14.4.2 Field production of open pollinated varieties

- a) Site selection
- b) Isolation distance
- c) Crop culture
- d) Pollination
- e) Harvest and drying
- f) Seed cleaning

14.5 Review

### **VIII. CLASS PRESENTATION/DISCUSSION REQUIREMENTS**

Students (and invited presenters, as needed) will report on recent seed production literature using a journal club (“current topics”) format.

### **IX. ACADEMIC MISCONDUCT**

Students are trusted to act in good faith in exams, laboratory projects and essays. If we personally determine that students have breached that trust, we will report this through appropriate channels to the University Committee on Academic Misconduct. The OSU Student Handbook thoroughly covers the subject of academic misconduct and its treatment, if student require further information. Academic misconduct will not be tolerated.

### **X. TEACHING STUDENTS WITH DISABILITIES**

Anyone who feels they may need an accommodation based on the impact of a disability should contact us to arrange an appointment as soon as possible. At the appointment we can discuss the course format, anticipate your needs and explore potential accommodations. We rely on the Office for Disability Services for assistance in

verifying the need for accommodations and developing accommodation strategies. If you have not previously contacted the Office for Disability Services, we encourage you to do so at (614) 292-307 (V) or (614) 292-0901 (TDD).