

### DISCIPLINE SPECIFIC CORE COURSE – 14: Reproductive Biology of Angiosperms

#### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
<b>Reproductive Biology of Angiosperms – DSC 14</b>	4	2	0	2	Class XII pass with Biology/ Biotechnology	Nil

#### Learning Objectives:

- To understand the scope of reproductive biology, development and structure of male and female reproductive units of the flower, organization of male and female gametophytes, pre-fertilization, fertilization and post-fertilization events.
- To understand the processes and significance of pollen--pistil interactions, apomixis and polyembryony.
- Significance of seed as a diaspore.

#### Learning Outcomes:

Upon completion of the course, the students will become familiar with:

- The significance and scope of reproductive biological studies in crop production and conservation. Structure and function of anther and ovule, male and female gametophyte.
- The significance of associations of MGU, FGU and double fertilization; embryo and endosperm development, genomic imprinting.
- Pollination and seed dispersal mechanisms, apomixis and polyembryony as alternate pathways of angiosperm reproduction.
- Experiential learning through field trips, scientific photography, videography and documentary preparation. The students will also learn to write scientific reports and present scientific data.

#### Unit 1: Introduction

**01 Hour**

Introduction about Reproductive biology and its scope; significant contributors to the field; structure of flower.

#### Unit 2: Anther and Pollen

**05 Hours**

Anther wall: Structure and functions, microsporogenesis, microgametogenesis; Pollen wall: Structure and functions, Number Position Character (NPC), pollen viability and storage, Male Germ Unit (MGU) – structure and significance.

#### Unit 3: Pistil

**04 Hours**

General structure and types of pistil and ovules; megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of *Polygonum* type); Organization and ultrastructure of mature embryo sac; cell specification; Female Germ Unit – structure and significance.

**Unit 4: Pollination**

**04 Hours**

Types (Self, cross, geitonogamy, xenogamy), significance; Structure of the stigma and style; Pollen-pistil interactions- capture, adhesion, hydration, pollen tube penetration; Path of pollen tube in the pistil; Role of synergids in pollen tube attraction; Double fertilization; Polyubey block

**Unit 5: Self-Incompatibility**

**04 Hours**

Basic concepts (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self-incompatibility (in brief): mixed-pollination, intraovarian and in vitro pollination and fertilization, modification of stigma surface, parasexual hybridization.

**Unit 6: Endosperm**

**02 Hours**

Types (2 examples each), development, structure and functions; Genomic imprinting

**Unit 7: Embryo**

**04 Hours**

General pattern and comparison of development of dicot and monocot embryo (initial apical cell and basal cell polarity, globular embryo with radial polarity, mature embryo); Suspensor: structure and functions; Embryo-endosperm relationship; Nutrition of embryo, haustorial systems: Embryo patterning.

**Unit 8: Seed**

**02 Hours**

Structure and importance of seed as diaspore, as storage organ; germination and seedling formation.

**Units 9: Polyembryony and apomixis**

**02 Hours**

Introduction, types, causes and applications.

**Unit 10. Applications of Reproductive biology**

**02 Hours**

Haploid embryos - concept and significance; crop productivity, conservation

**Practicals**

**60 hours**

- Anther: Wall and its ontogeny, tapetum (amoeboid and glandular), Microspore mother cell, spore tetrads, uninucleate, bicelled and dehiscent anther; Temporary stained mounts of T.S. anther to study the organization.
- Pollen: General morphology, pseudomonads, polyads, pollinia (slides/digital resources, fresh material); Ultrastructure of pollen wall (micrograph); Pollen viability: tetrazolium test/FDA; Germination: calculation of percentage germination in different media using hanging drop/sitting method.
- Temporary mounts of pollen grains cleared with 1N HCl/KOH to study germ pores; Ultrastructure of male germ unit (MGU) through micrographs.

- Ovule: Types-anatropous, orthotropous, amphitropous/campylotropous, circinotropous, unitegmic, bitegmic; tenuinucellate and crassinucellate; Special structures: endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/digital resources).  
Female gametophyte: developmental sequence of monosporic embryo sac only; Ultrastructure of Female Germ Unit.
- Pollination: Adaptations; bagging experiment; \*\*project on pollination.
- Intra-ovarian pollination; Test tube pollination (through digital resources).
- Endosperm: Dissections of developing seeds for endosperm with free-nuclear haustoria.
- Embryogenesis: Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages; Study of suspensor through electron micrographs.
- Seed dispersal mechanisms (adaptations through live specimens), \*\*project on seed dispersal

\*\* The projects can be on pollination/ seed dispersal or on any other topic based on the syllabus. It can be a write-up with visuals. The students can also make a digital project submission in the form of a documentary of 5-10 min.

#### **Suggested Readings:**

- Bhojwani S.S., Bhatnagar S.P. & Dantu P.K. (2015). The Embryology of Angiosperms, 6th Edition. By VIKAS PUBLISHING HOUSE. ISBN: 978-93259-8129-4.
- P. Maheshwari, (2004). An introduction to the embryology of Angiosperms. Tata McGraw-Hill Edition, ISBN: 0-07-099434-X.
- Johri, B.M. (1984). Embryology of Angiosperms. Netherlands: Springer-Verlag. ISBN: 13:978-3-642-69304-5
- Raghavan, V. (2000). Developmental Biology of Flowering plants. Netherlands: Springer. ISBN: 978-1-4612-7054-6.
- Shivanna, K.R. (2003). Pollen Biology and Biotechnology. New Delhi, Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
- Mangla, Y., Khanduri, P., Gupta, C.K. 2022. Reproductive Biology of Angiosperms: Concepts and Methods. Cambridge University Press ISBN 978-1-009-16040-7.
- Tandon R, Shivanna KR, Koul M Reproductive Ecology of Flowering Plants: Patterns and Processes 1st ed. 2020 Edition ISBN 978-9811542091. Springer Verlag
- Kapoor, R., Kaur, I. Koul M. 2016. Plant Reproductive Biology and Conservation IK International Publishing House Ltd. India ISBN: 9789382332909

**Additional Resources:**

- Shivanna, K.R., Tandon, R. (2020). Reproductive Ecology of Flowering Plants: A Manual. Springer (India) Pvt. Ltd. New Delhi, Heidelberg, New York, Dordrecht, London
- Shivanna, K. R., & Rangaswamy, N. S. (2012). *Pollen biology: a laboratory manual*. Springer Science & Business Media.

**Note:** Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.