Experimental Anatomy of Plant Development
Laboratory 10

Floral Development and Pollination

Introduction: We have known for many years that shoots develop vegetatively from the onset of meristematic growth until a transition in some or all apices begins reproductive growth. More recently, we have learned that this transition to reproductive growth can occur 1) when the plant reaches a threshold of size and maturity, 2) at a specific level on the stem, and/or 3) can triggered by light or some other environmental stimulus. In the simplest sense, reproductive growth involves a transition in organ development wherein meiosis occurs within sporangia. Other plants produce reproductive organs in association with the sporangia, involving various developmental modifications of the shoot (e.g., cones of conifers and flowers of angiosperms), and /or they may have entire fertile regions of the shoot (e.g., inflorescences).

Floral development begins with a transition of the shoot apex from vegetative to reproductive growth. Each flower is a fertile shoot consisting of a shoot apex (the receptacle) and several (usually four) types of leaves, that are produced in the sequence of 1) sepals, 2) petals, 3) stamens (the microsporophylls), and 4) carpel or carpels (the megasporophylls). When the anthers (i.e., microsporangia) of each stamen have produced microspores by meiosis and each microspore has begun to develop as a microgametophyte, the anthers dehisce to liberate the pollen for pollination. Recall the “A, B, C”, “A, B, C, D, E”, and the doublet and quartet models of flowering that were introduced in lecture.

In flowering plants pollination consists of transfer of the pollen to the stigma of the pistal (i.e., carpel or fused carpels), but in other seed plants this process usually consists of transfer of the pollen into the micropyle of the ovule. Pollination is effected by one of several mechanisms including insect and other pollinators, wind, water, etc. In flowering plants there are several chemical signaling mechanisms associated with either stimulating or retarding pollen tube growth to effect siphonogamous fertilization of the egg by the non-motile sperm.

MATERIALS AND OBSERVATIONS

A. Inflorescence Structure

1. Inflorescence bud of Coleus: Examine a longitudinal section of a fertile apex of Coleus. Compare the leaves you see at each node. Begin with the apical-most primordium you can identify. How do these compare to the vegetative leaves you have examined before? Compare the axillary meristems to the apical meristem. How do they compare? Compare the axillary meristems to each other. What are the similarities and differences. Diagram and label this apex. Include the sizes and shapes of the structures, and the major tissue zones, but do not take the time to draw individual cells.

2. Inflorescence of a sun flower: Now examine a longitudinal section of an immature inflorescence of fleabane, the sunflower genus Erigeron. What is a flower, and what type of inflorescence do you find here? Can you make out bracts that are axillary to the numerous flowers in this inflorescence? Why, or why not?
B. Floral Structures

Initiation of flower primordia on an inflorescence apex: Examine a longitudinal section of a floral stem tip of the black cherry, *Prunus serotina*. Note the apical meristem, bracts (= leaf) primordia and axillary floral buds. Identify the immature floral organs. What are the structures you see in the axils of the basal most leaves? By comparing such structures with those at successively more apical nodes, can you imagine the activity of the apical meristem and pattern of development for each flower? Diagram and label this specimen as it appears under the dissecting microscope.

C. More Mature Flower Structure

2. Immature Floral Structures - Cross Section: Examine a *Capsella* or *Lycopersicum* floral bud or young flower as it appears in cross section. Identify the organs and note the anatomy of the sepals and petals. Now examine the anatomy of the stamens and of the *gynecium*. Does this anatomy give us any indication of the homologies of these organs? Why or why not? What features of these organs do you think are helpful in assessing the homologies of these organs.

3. Immature Floral Structures - Longitudinal Section: Now examine a *Capsella* or *Lycopersicum* floral bud as it appears in longitudinal section. Note the anatomy of the various organs. Are any of them less mature than the others?

D. Flowering apices of *Arabidopsis*

Make cross sections and longitudinal sections of the roots of the *Arabidopsis* lines provided. Take photos of each. Identify the structures that express GFP or are malformed/missing (in the case of mutants) and label the appropriate organs.

LABORATORY – Checklist

By the end of the lab, your notebook should contain drawings of the following

[ ] Longitudinal section (diagram) of the fertile apex of *Coleus*.
[ ] Longitudinal section (diagram) of the floral head of *Erigeron*.
[ ] Longitudinal section of the inflorescence axis of *Prunis* showing floral buds and bracts.
[ ] Cross and longitudinal sections of the flower of *Capsella* or *Lycopersicum*.
[ ] Diagram of *Arabidopsis* plants showing various stages of flowering.

Were you able to: (these results should be recorded in your lab notebook)

[ ] Identify the basic morphology of the inflorescence and floral buds?
[ ] Understand the various stages of development involved in initial bolting, branching to form inflorescences, development of floral buds, and maturation of floral organs?