Plant Propagation PLS 3223/5222

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The Development of Seeds

Chapter 4

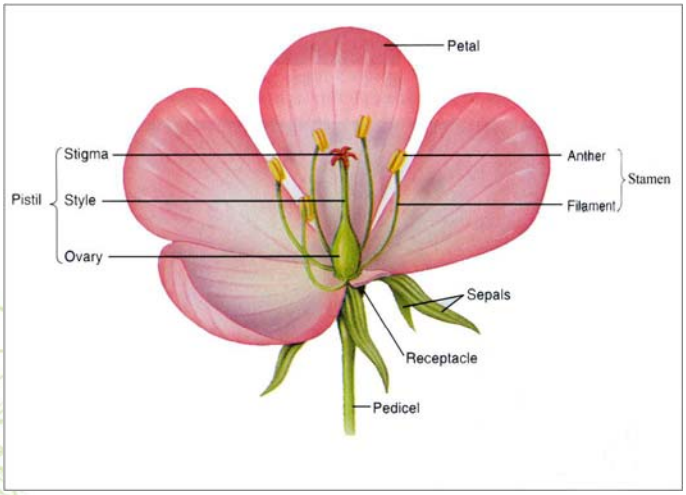
Chapter 4 Objectives are to Understand:

- What a seed is
- The basic parts of an angiosperm flower (Dr. Dehgan optional lecture resource)
- The stages of seed development
- Unusual types of seed development (Dr. Tignor optional lecture resource)
- Plant hormones and seed development
- Ripening and dissemination

Four hundred million years ago……

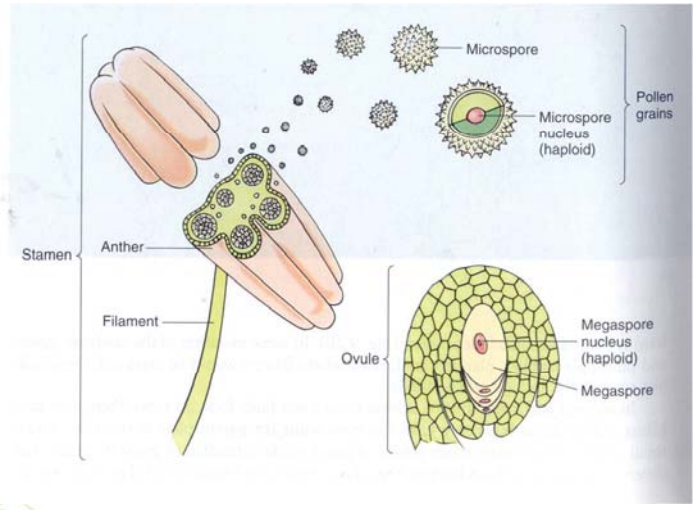
- -roots
- -vascular system

Flower Structure of a Typical Angiosperm Plant (Complete)



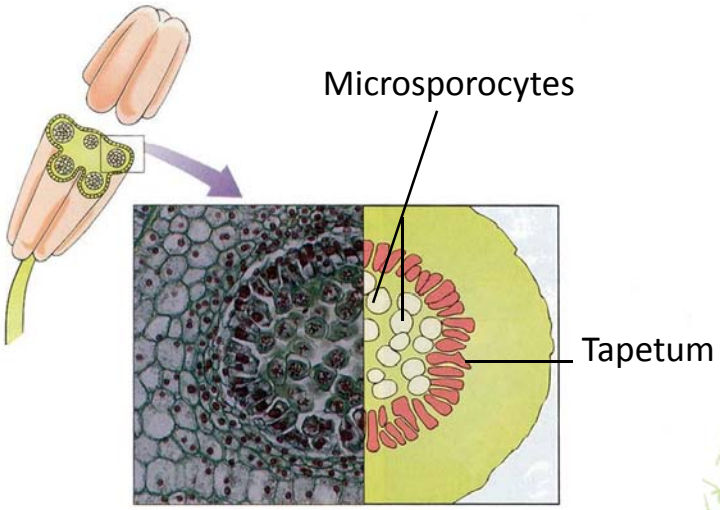
Mauseth, 1998

Stamen and Ovule



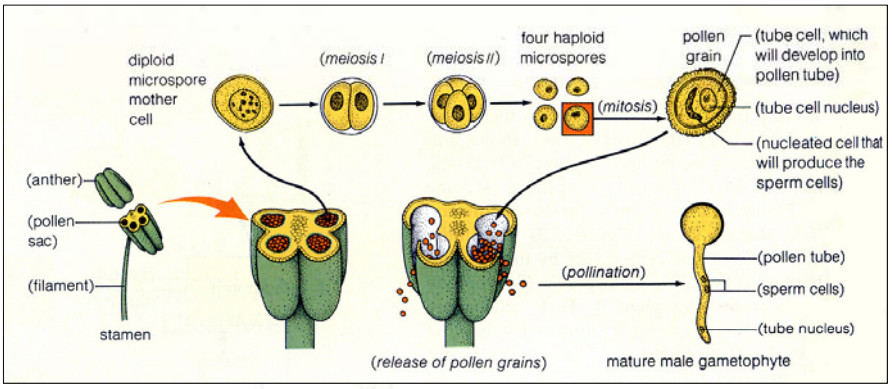
Mauseth, 1998

Anther Development



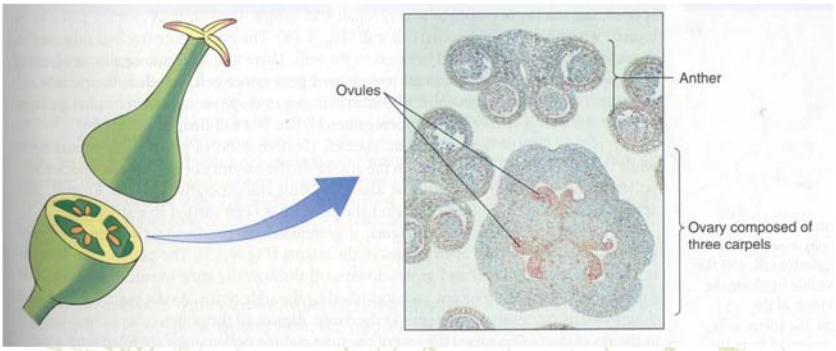
Mauseth, 1998

Mature Pollen Grain



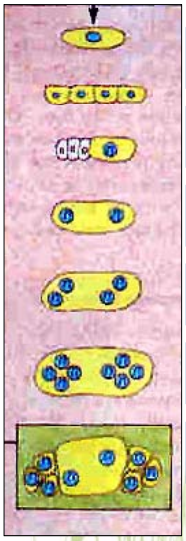
Starr and Taggart, 1987

Pistil Development



Mauseth, 1998

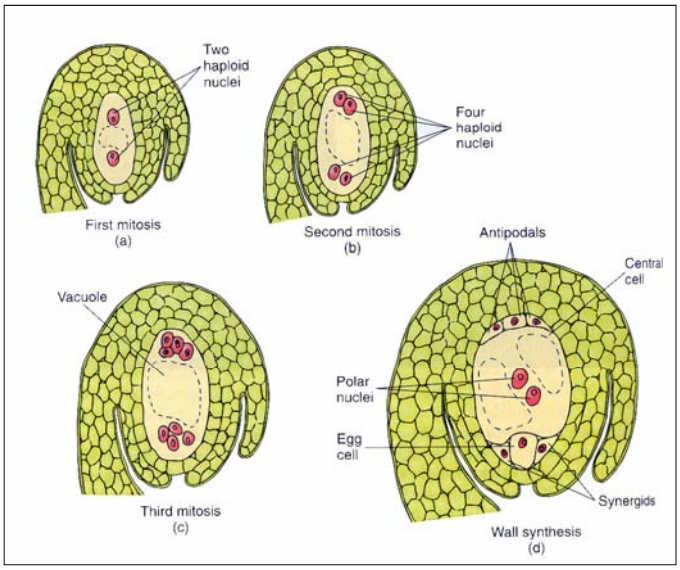
Megasporangium Development



1. Meiosis I, II in megaspore mother cell; four haploid megaspores
2. Three megaspores disintegrate
3. Mitosis in remaining megaspore
4. Mitosis produces four haploid nuclei
5. Mitosis produces eight haploid nuclei
6. Cytoplasmic division; embryo sac (seven celled, eight nuclei)

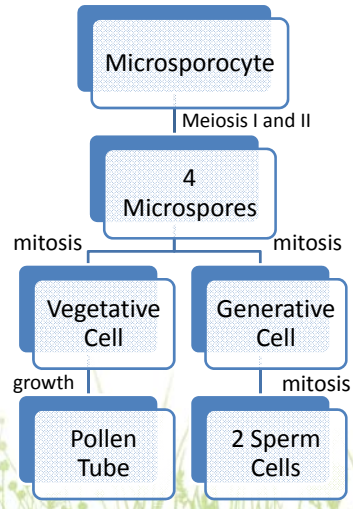
Starr and Taggart, 1987

Megasporangium Development



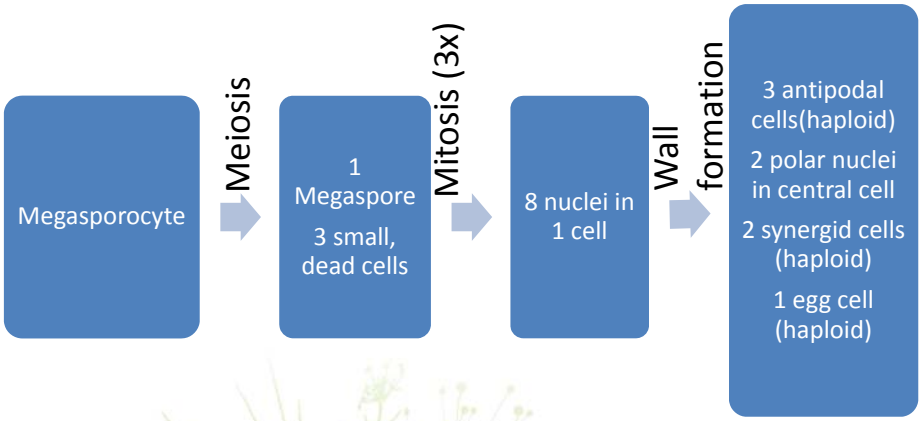
Mauseth, 1998

Microgametophyte Development (all flowering plants)



Adapted from Mauseth, 1998

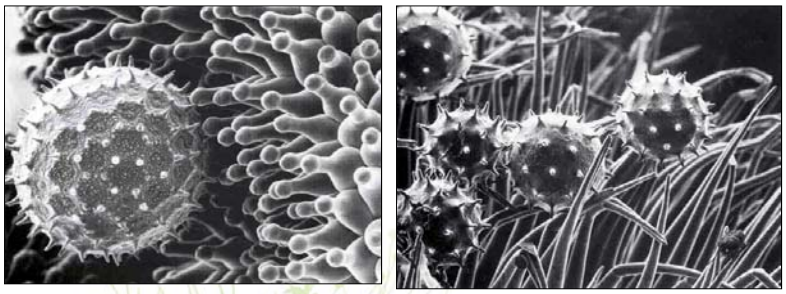
Megagametophyte Development (Polygonum type)



Adapted from Mauseth, 1998

Pollination

-The transfer of male pollen to the female stigma



Cresti et al., 1991

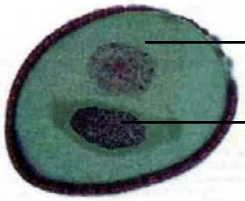
Pollen Germination

Cresti et al., 1991

Pollen Grain

Sperm Cells (2)

Tube Nucleus



Tube Cell

Generative Cell

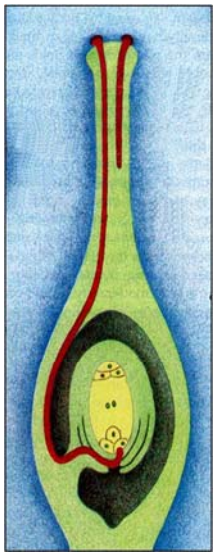
Stern, 2003

Pollination/Fertilization

Pollen grains land on a stigma and germinate

Pollen tubes containing sperm grow through the style

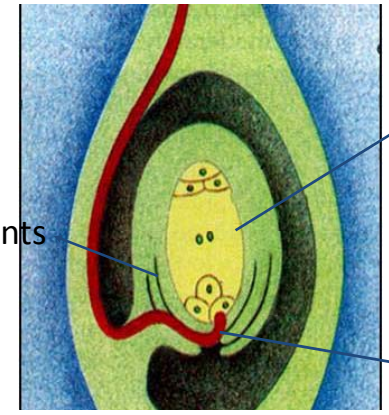
Pollen tube enters each ovule to deliver the sperm to an awaiting egg



Starr and Taggart, 1987

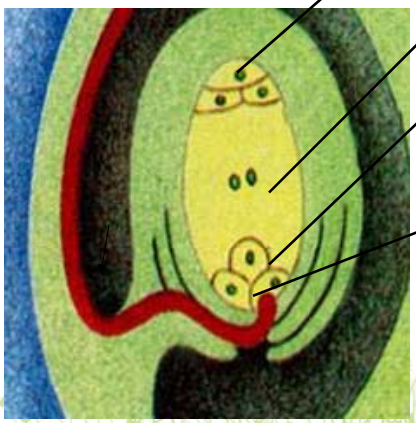
Fertilization

-The sexual union of a male and female gamete



Starr and Taggart, 1987

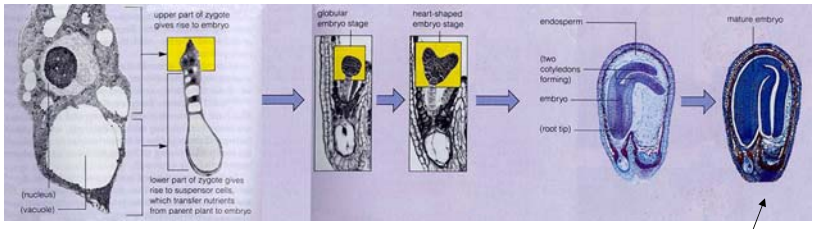
Double Fertilization



Starr and Taggart, 1987

Embryo Differentiation-Dicots

zygote

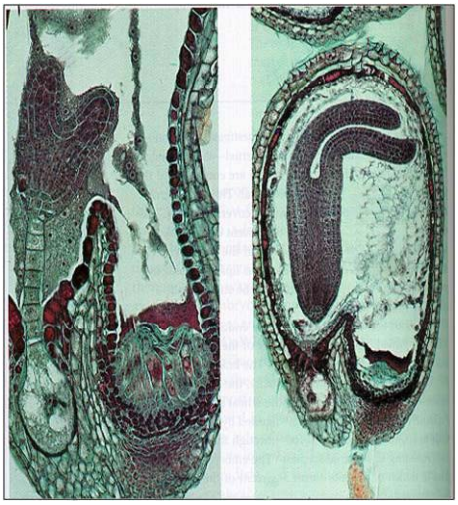


proembryo globular heart torpedo

cotyledon

Starr and Taggart, 1987

Dicot Torpedo/Cotyledon Embryo Stage

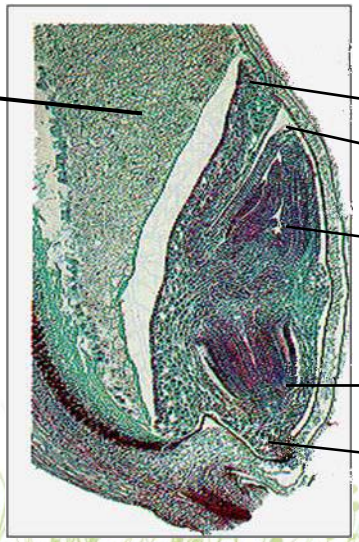


Raven et al., 1999

Dicot Monocot

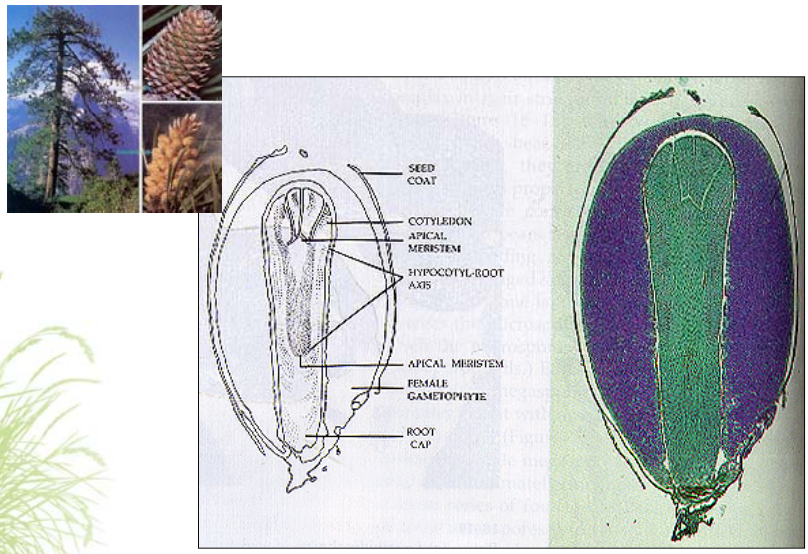
Starr, 2001

Monocot -Coleoptilar Embryo Stage



Raven et al., 1999

Gymnosperm-Cotyledon Stage



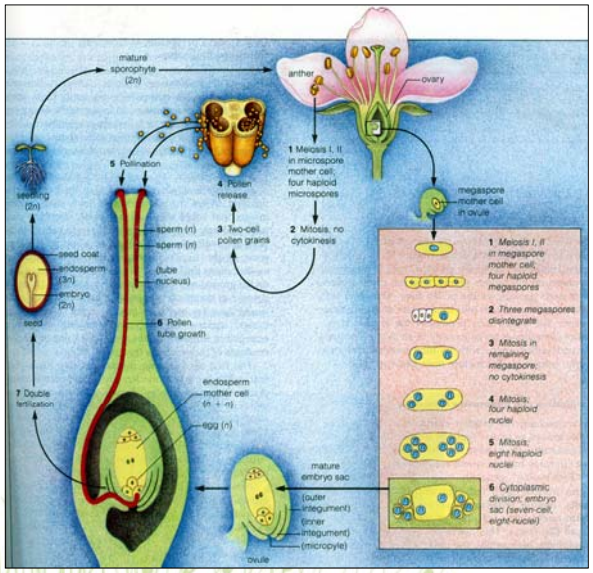
Raven et al., 1999

Components to a Seed

Seed

- The sexual reproductive unit in a plant
- A matured ovule containing an embryo

Embryo | **Protective covering** | **Storage tissue**



Starr and Taggart, 1987

Morphological Types of Seeds

I. *Endospermic*- Seeds with dominant endosperm

Rudimentary	• small embryo
Linear	• more developed embryo
Miniature	• embryo fills more than half of seed
Peripheral	• embryo encloses endosperm

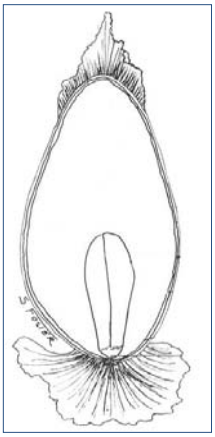


Figure 4-1

Morphological Types of Seeds

II. *Non-Endospermic-* Seeds with dominant embryo

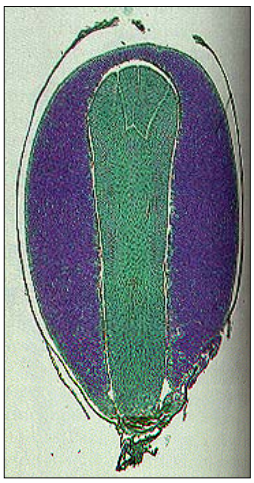
- Hard seed coats
- Thin seed coats
- Woody outer seed coats
- Fibrous outer seed coats

Starr and Taggart, 1987

Morphological Types of Seeds

III. Unclassified

- Rudimentary embryo with no food storage (orchids)
- Modified miniature embryo located on periphery of seed (grasses)
- Embryo surrounded by gametophyte tissue (conifers)



Raven et al., 1999

Stages of Seed Development

Stage I- Histodifferentiation	• embryo and endosperm differentiate due to cell division • increase in weight • embryo begins cotyledon stage
Stage II- Cell expansion	• rapid cell enlargement due to accumulation of food reserves • increase in DNA, RNA, and protein synthesis
Stage III- Maturation drying	• seeds have reached physiological maturity • rapid water loss • lea proteins

Stages of Seed Development

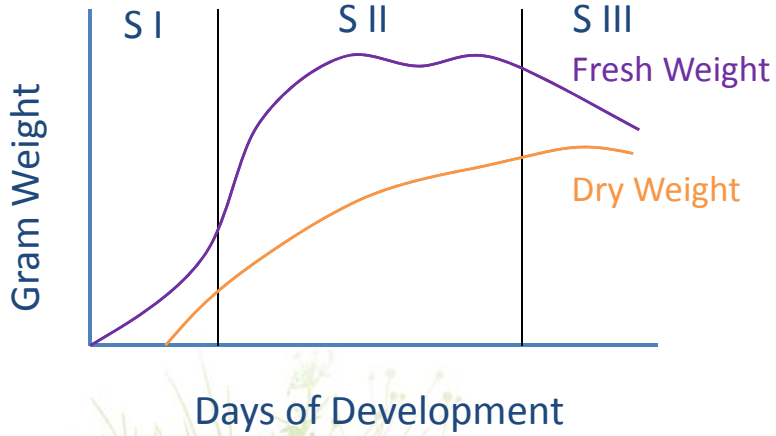


Figure 4-16: Redrawn from Hartmann et al., 2011

At this point, 3 things can happen:

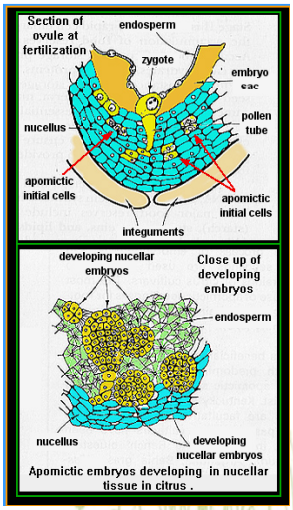
- Seeds will germinate prematurely on the plant without drying; vivipary
- Following maturation drying, seeds will be in a quiescent condition
- Following maturation drying, seeds will be in a dormant condition

Hartmann et. al, 1997

Ripening and Dissemination

Orthodox	Recalcitrant
• Seeds that tolerate maturation drying and survive at less than 10% moisture	• Seeds that are unable to withstand maturation drying

Unusual Types of Seed Development



Hartmann et. al, 1997

Apomixis

- The production of an embryo that bypasses the usual process of meiosis and fertilization; asexual seed production

Polyembryony

- The development of multiple embryos within the same seed

Plant Hormones and Seed Development

- Growth and differentiation of the embryo
- Accumulation of food reserves
- Storage for use during germination and early seedling growth
- Growth and development of fruit tissue

Hormone	Seed Development Response
Auxin	Free IAA (Stage I and II) Conjugated IAA (Stage III, germination); signal fruit development
Gibberellins	Stage I and II; signal fruit devel.; parthenocarpy, pollen tube growth
Cytokinins	Stage I and Early Stage II; embryo differentiation
Abscisic Acid	Stage II storage reserves; germination inhibitor
Ethylene	Minor role; embryo degreening

Optional Resources- Web Lectures

Dr. Bijan Dehgan

- pollination biology

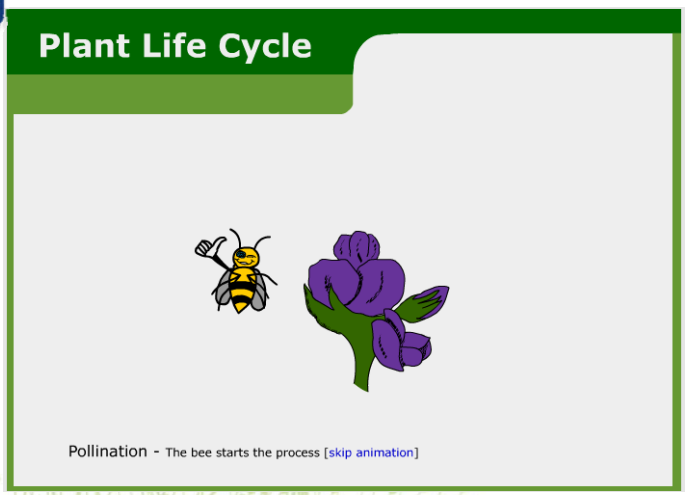
UF UNIVERSITY of FLORIDA

Dr. Buddy Tignor

- apomixis

The UNIVERSITY of VERMONT

Dr. Sandy Wilson- animated angiosperm lifecycle



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http://irrecenvhort.ifas.ufl.edu/Propagation/index.html