Diversity and Evolution of Rosids

. . . cacao, mustard, and capers . . .
**Malvales**

- strongly supported order of 11 families
*Malvales*

- strongly supported order of 11 families
- (+/-) suite of wood, hair, leaf, and chemical features
Malvaceae is now “broadly” defined (includes Tiliaceae, Sterculiaceae, Bombacaceae)

- 243 genera / 4300 species
*Malvaceae - mallows*

1. leaves palmately veined  
   (simple or compound)

2. sepals valvate - not overlapping

3. stellate hairs

*Sphaeralcea*  
*Sphaeralcea*  
*Hibiscus trionum*  
*Trichospermum*  
*Hibiscus tiliaceus*
*Malvaceae - mallows*

4. Many stamens, often bundled, sometimes **monadelphous** into a staminal tube

**CA 5  CO 5  A (∞)  G (5-∞)**
*Malvaceae - mallows

“malvoids”

Malva - mallow, cheese

Althaea - hollyhock, marshmallow

Hibiscus
Malvaceae - mallows

“malvoids”

Gossypium - cotton

Napaea dioica - glade mallow

• only Midwestern endemic genus
*Malvaceae - mallows*

“tilioids”

*Tilia americana* - basswood, linden

*Trichospermum*
Central America

*Grewia*
Madagascar
*Malvaceae - mallows

“bombacoids”

Adansonia - baobabs

Pseudobombax
Malvaceae - mallows

“sterculoids”

Theobroma - “food of the gods,” cacao, chocolate

Cola
*Brassicales*

- 17 families
- morphologically diverse!

- glucosinolates
- myrosinase enzyme
- isothiocynates
- mustard oils
*Brassicales*

Capparaceae - capers

Caricaceae - papaya

Tropaeolaceae - garden nasturtium
*Brassicaceae - mustard*

Large (338 genera / 3710 species), complex family of mustard oil producing herbs (broccoli, brussel sprouts, cauliflower, kale, cabbage); *Arabidopsis* - genetic/genome model plant species

*Brassica spp.*
- mustard
- broccoli
- kale

*Arabidopsis thaliana*
*Brassicaceae - mustard*

- flowers “cross-like” with 4 petals, six stamens with 2 outer ones shorter - derivation of “Cruciferae” or “cross-bearing”

CA 4 CO 4 A 4+2 G (2)

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*Cardamine concatenata* - cut leaf toothwort  
*Cardamine pratensis* - cuckoo flower
**Brassicaceae - mustard**

- **CA 4 CO 4 A 4+2 G (2)**
- Gynoecium of 2 fused carpels separated by thin membrane with ovules in a parietal fashion.

- Fruit is a capsule that peels off the two outer carpel walls exposing the papery membrane or septum attached to the persistent replum.
*Brassicaceae - mustard*

- **CA 4  CO 4  A 4+2  G (2)**

- Fruits are called **siliques** or **silicles** based on how the fruit is flattened relative to the septum.
- **Siliques** flattened contrary to septum.
- **Silicle** flattened parallel to septum.

- X section -
*Brassicaceae - mustard*

- shape of fruits appear to have diversified rapidly in the family - unfortunately infra-familial classification has been largely based on the fruit.
*Brassicaceae - mustard

- *Aethionema* - Mediterranean region - is sister to rest of family
*Brassicaceae - mustard

Cardamine concatenata - cut leaf toothwort

- Common spring flowering woodland herbs

Cardamine douglasii - purple spring cress
*Brassicaceae - mustard

*Nasturtium officinale - water cress

- edible aquatic native with a mustard zing
*Brassicaceae - mustard

- Introduced or spreading

*Hesperis matronalis - Dame’s rocket

*Barbarea vulgaris - yellow rocket, winter cress
*Brassicaceae - mustard

Alliaria petiolata - garlic mustard
**Brassicaceae - mustard**

Garlic mustard distribution - 2006
Garlic mustard distribution - 2007
Garlic mustard distribution - 2008
Garlic mustard distribution - 2009-2016
*Myrtales*

- strongly supported order of 12 families
- defined by 2 anatomical features
**Myrtales**

- this combination placed the anomalous Vochysiaceae within Myrtales
- 3 very large tropical families

- Vochysiaceae
- Melastomataceae
- Combretaceae
- Myrtaceae
  - *Psidium - guava*
  - *Metrosideros - o‘hia*
• Diversification analyses identify three significant shifts in speciation

• Near or just within the crown radiations of these three families
*Onagraceae - evening primrose

A moderate sized family of 17 genera and about 650 species - most diverse in western N. America

CA 4  CO 4  A 4,8  G (4)

- 4 merous flowers, epigynous, and often well developed hypanthium

*Onagraceae - evening primrose

*Oenothera biennis* - evening primrose
*Onagraceae - evening primrose

- *Ludwigia* is sister to remainder of the family
- Tropical *Fuchsia* is diverse in South America
Onagraceae - evening primrose

Chamerion angustifolium - fireweed

Epilobium hirsutum - willowherb
*Onagraceae - evening primrose*

- Circumboreal *Circaea* is sister to woody southern hemisphere *Fuchsia*

- 2 merous flowers; fruit is one-seeded and bristly
Lythrum alatum - winged loosestrife

Close relative of the evening primrose family; mainly tropical in distribution

**CA 4-6  CO 4-6  A 8-12  G (4)**

- flowers 4, 5, or 6 merous with stamens double the number of sepals and in two distinct sets
- exhibits tristylos heterostyly
- hypanthium well developed but with superior pistil = perigynous

Lythraceae - loosestrife
Lythrum salicaria
purple loosestrife

Ecologically invasive in wetlands; from Europe

Cuphea - cigar plant

Trapa - water chestnut
Geraniales: Geraniaceae

Poorly understood order of 6 families – now placed next to Myrtales

Geranium family: 800 species of temperate herbs

*Geranium maculatum* - wild geranium
Geraniaceae - geranium

• 5 merous flowers with a superior pistil made up of 5 carpels each with a single ovule

Geranium maculatum - wild geranium

• fruit is a schizocarp = dehiscing fruit into one-seeded mericarps

CA 5  CO 5  A 10  G (5)

• 5 merous flowers with a superior pistil made up of 5 carpels each with a single ovule
Geraniaceae - geranium

Geranium robertianum - Herb robert

Erodium cicutarium - stork’s-bill
The stork’s-bills of genus *Erodium* drill their mericarps into the ground
Vitales: Vitaceae - grapes

Order with one family: sister to all other Rosids

Vitis - grape
Vitales: Vitaceae - grapes

Small family (800 species) of vines in the tropics and temperate areas - includes *Vitis vinifera* the wine grape

- flowers small and clustered in more showy inflorescences
- fruits: berries with several seeds

*Parthenocissus tricuspidata* - Boston ivy

*Vitis* - grape
**Vitaceae - grapes**

- *Vitis* - grape
  - leaves simple or compound; venation and lobing usually strongly palmate

- *Parthenocissus* - Boston ivy
  - plants climb by tendrils = modified inflorescences, or by holdfasts
Parthenocissus quinquefolia - Virginia creeper, woodbine

Vitaceae - grape
Vitaceae - grape

Vitis riparia (+ V. vulpina)
River, frost grape

Vitis aestivalis
Summer grape