

# Distyly and pollination of *Nymphoides montana* (Menyanthaceae)

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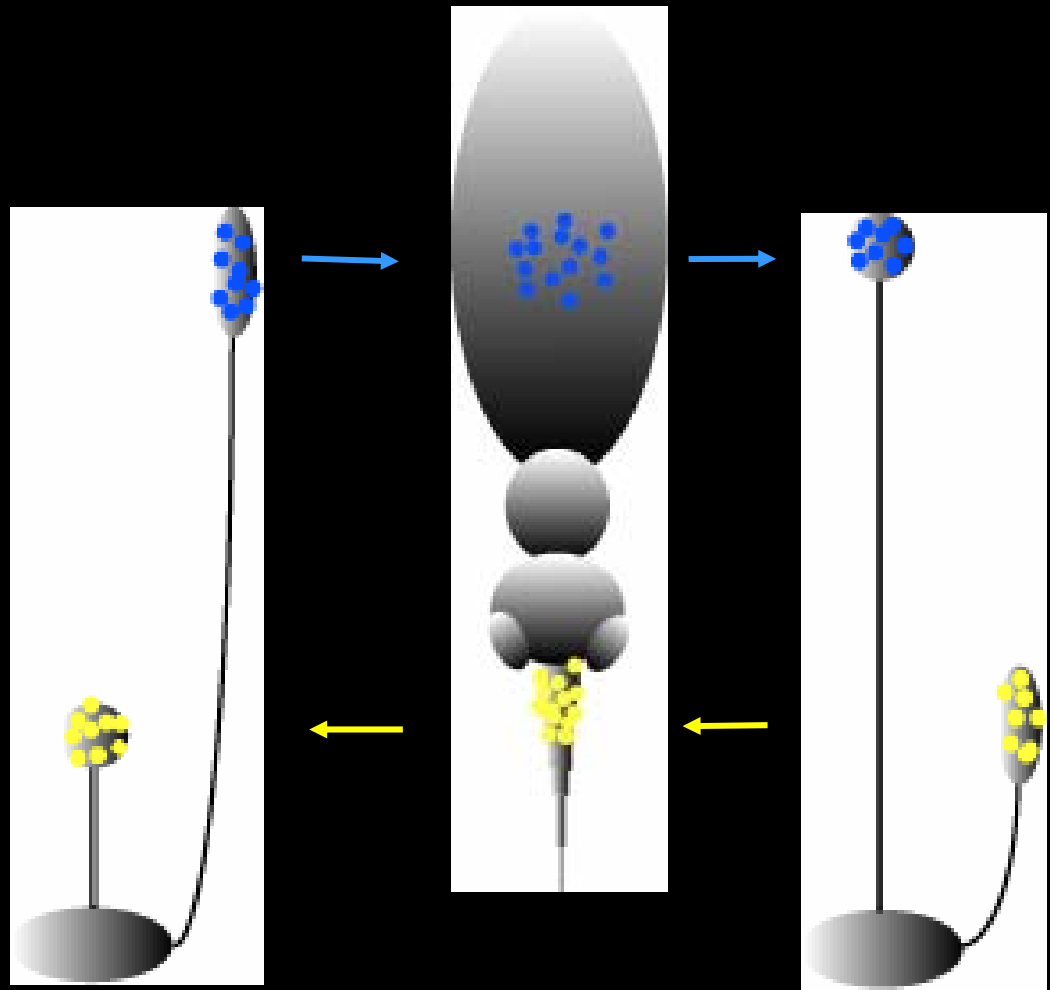
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# Heterostyly

- Reproductive system
- Distyly
  - Short style (Thrum)
  - Long style (Pin)
  - Reciprocal herkogamy
  - Incompatibility system
  - Ancillary traits
- Efficient crossing (Lloyd-Webb model)



Short-style

Long-style

————— Long-level pollination

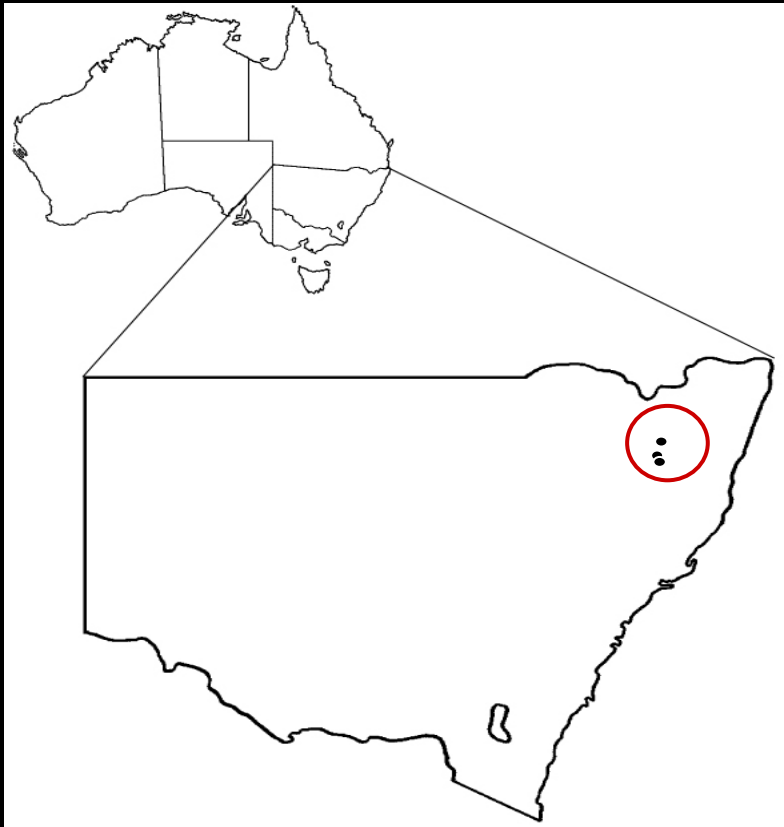
————— Short-level pollination

# Aims

- Reproductive biology of *Nymphoides montana*
  - Morph-specific differences in:
    - Floral morphology
      - Primary traits
      - Ancillary traits
    - Incompatibility system
    - Morph ratio
    - Reproductive success

# Study sites

- 3 populations on Northern Tablelands, NSW, Eastern Australia



- Dumaresq Dam
- Thomas Lagoon
- Glencoe

## Distyly in *Nymphoides montana*

- Short style (SS)
  - Stigma below anthers



- Long style (LS)
  - Stigma above anthers

## *Nymphoides montana*



- Perennial aquatic plants
- Floating leaves & inflorescences



- Reproduce vegetatively by stolons



- Sexually by seeds

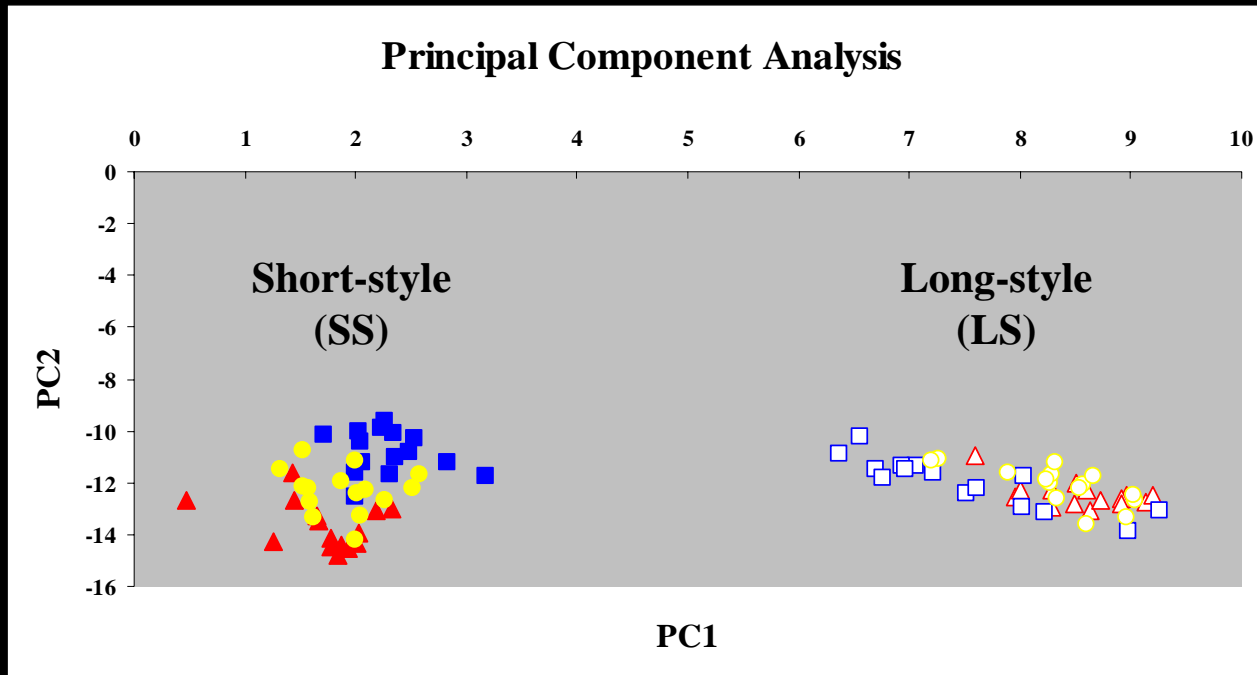
- Flowers
  - Open one day only



- Insect pollinated
  - Introduced & native bees
  - Flies
  - Butterflies

# Primary traits

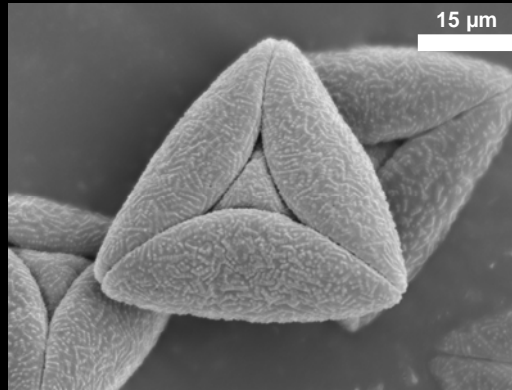
- 2 distinguishable morphs
  - PC1: 80.6%
  - PC2: 12.4%



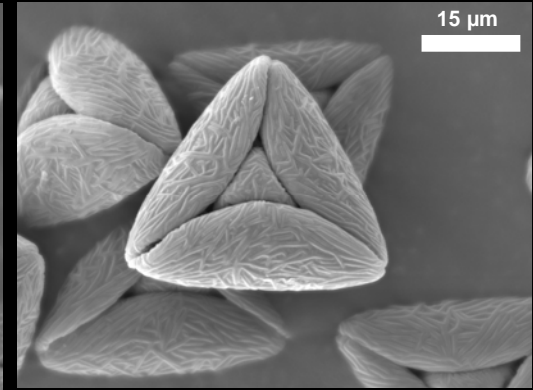
- Univariate stats
  - Stigma height SS < LS ( $P < 0.0001$ )
  - Anther height SS > LS ( $P < 0.0001$ )

# Ancillary traits

- Pollen grain size
  - SS > LS ( $P < 0.0001$ )

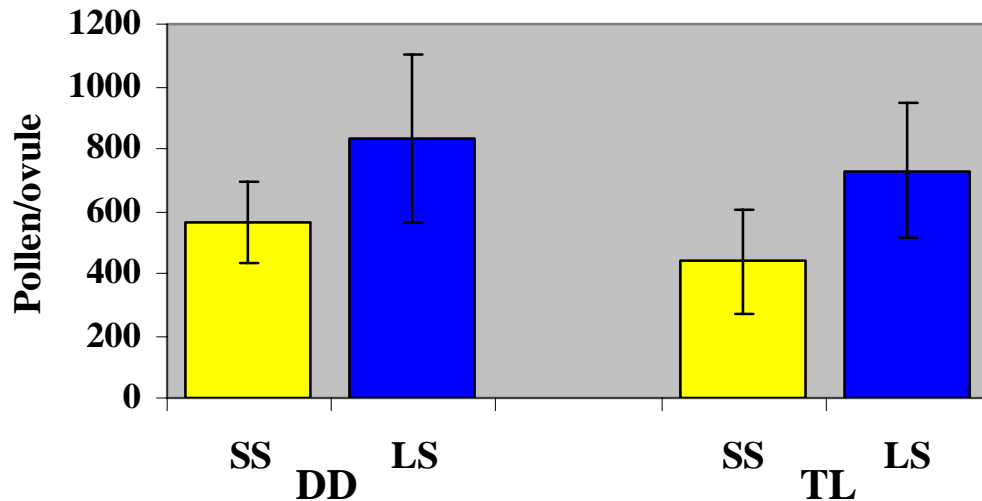


SS



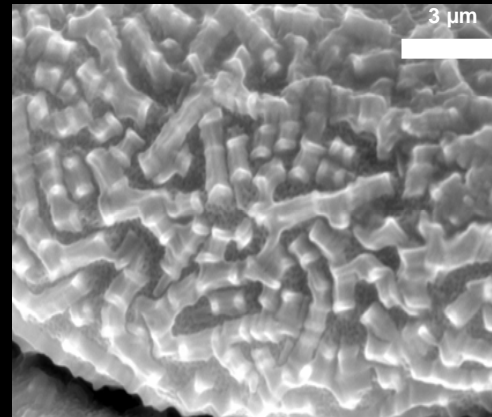
LS

## Pollen:ovule ratio

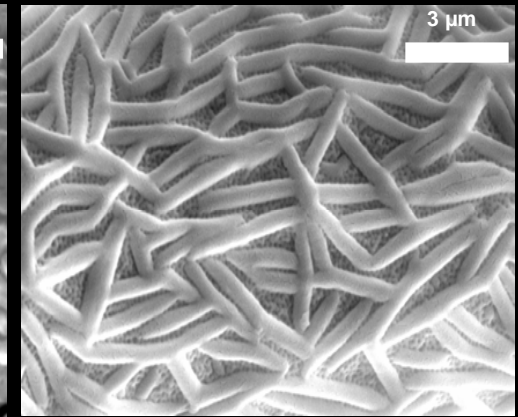


- Pollen grain number
  - SS < LS ( $P < 0.0001$ )
- Ovule number
  - SS > LS ( $P < 0.01$ )
- Pollen/ovule ratio
  - LS > SS
  - Out-crossing (Cruden 1977)

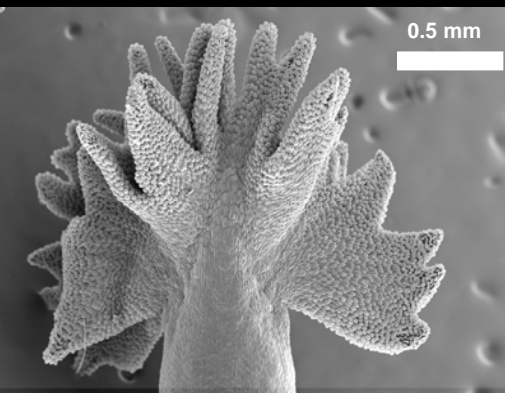
- Pollen grain exine



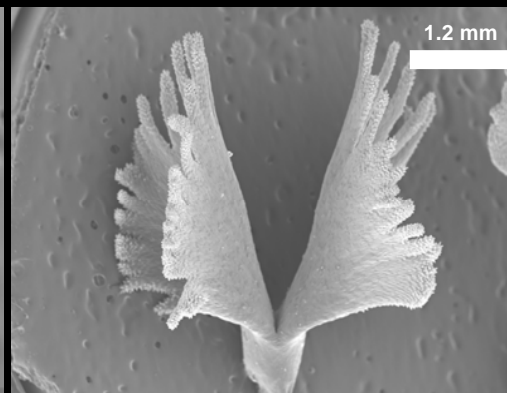
SS



LS



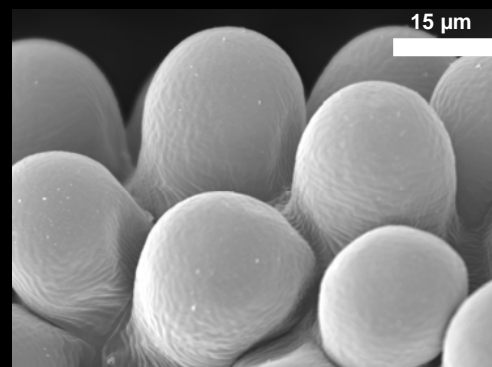
SS



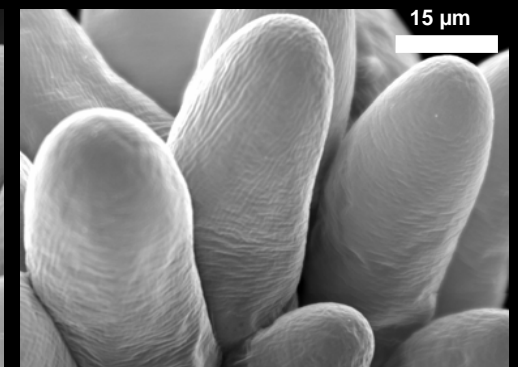
LS

- Stigma width & length
  - SS < LS ( $P < 0.0001$  &  $P < 0.05$ )
- Stigma area
  - SS: 2 lobes, 5 sub-lobes
  - LS: 2 lobes, 2 sub-lobes
  - SS > LS

- Papilla size & shape
  - SS: short & spherical
  - LS: long & cylindrical



SS

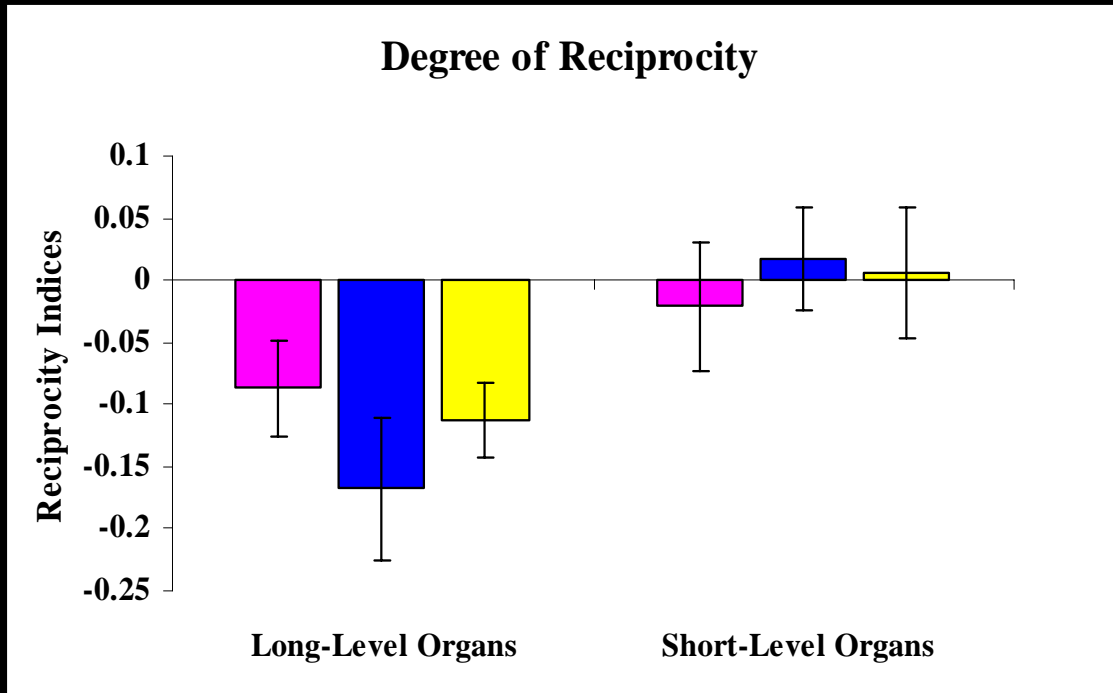


LS

# Reciprocity

- Perfect reciprocity

- $R = (A - S)/(A + S)$
- $R = 0$



■ DD

■ TL

■ GC

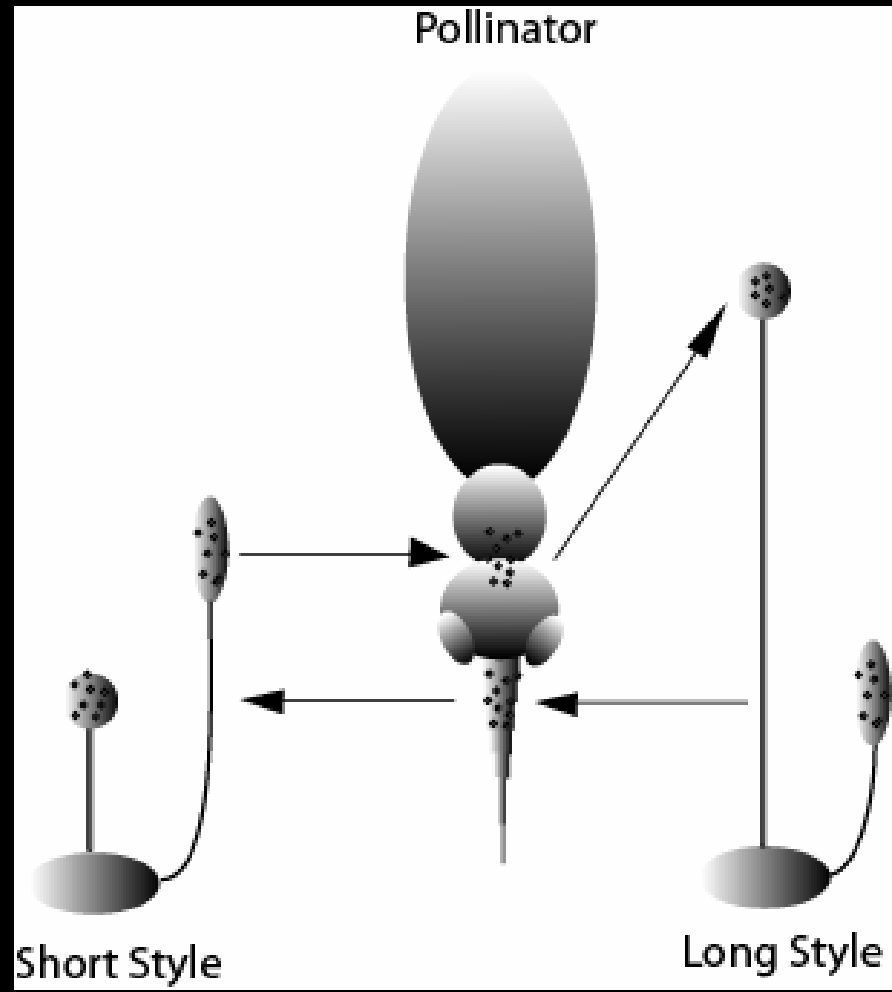
- Short-level organs

- $R = 0.00 - 0.02$  (All  $P > 0.05$ )

- Long-level organs

- $R = 0.09 - 0.17$  (All  $P < 0.0001$ )
- Weak reciprocity

- Consequences of weak reciprocity

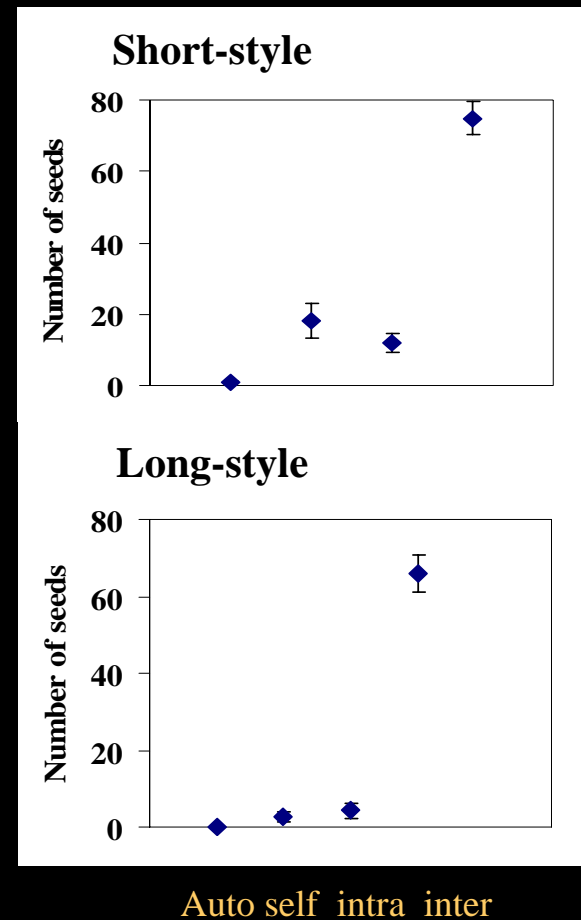


- Increase selfing in SS?
  - Reduced anther-stigma separation

- Imprecise cross-pollen transfer?
  - Not equivalent height

# Incompatibility system

- Pollinations
  - Inter-morph
  - Intra-morph
  - Selfing
  - Auto-fertility



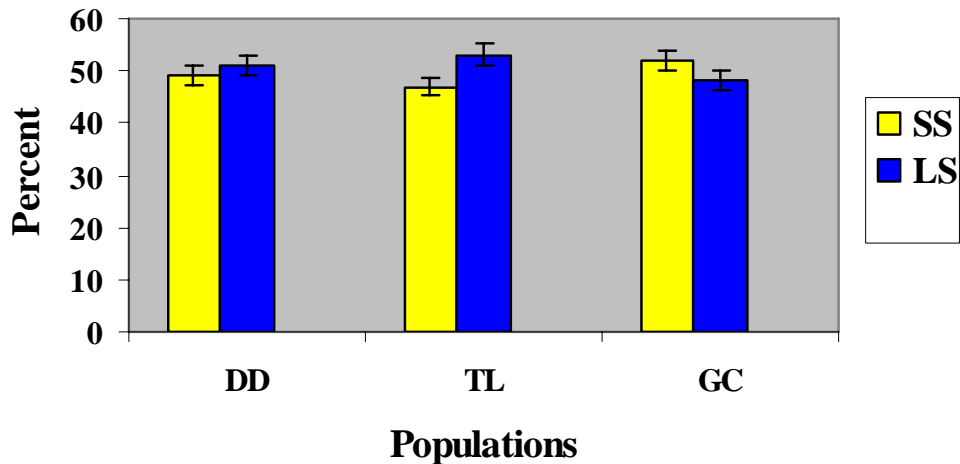
- Seed set
  - Inter-morph compatibility
    - SS = LS ( $P = 0.273$ )
  - Self- & intra-morph incompatibility
    - SS > LS ( $P < 0.0001$ )

# Floral morph ratio

- Transects (30-m<sup>2</sup>)



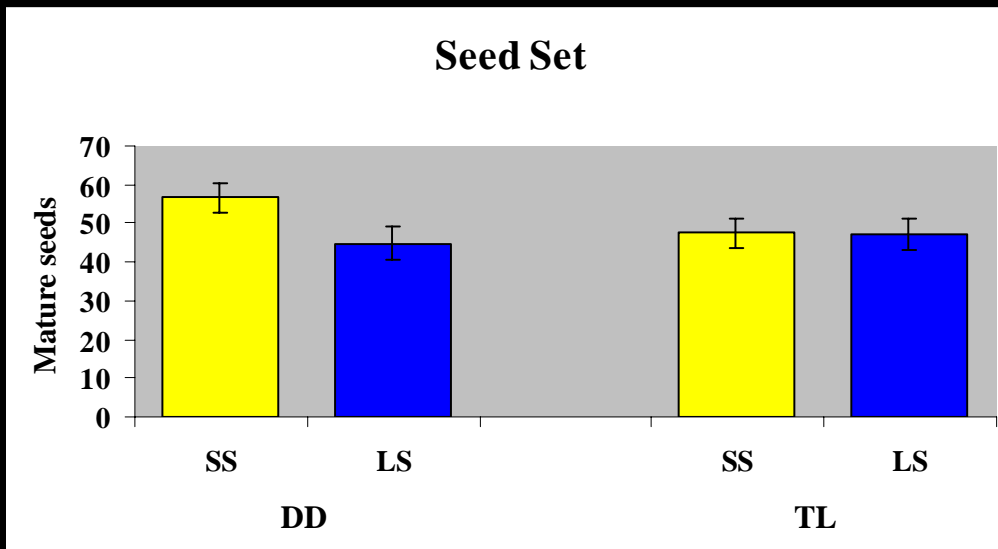
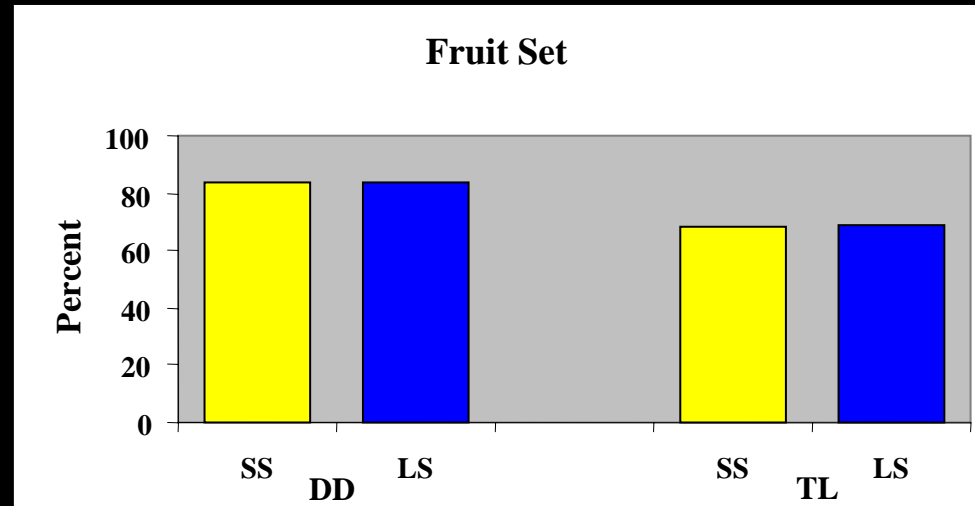
Morph Ratio



- 1 SS :1 LS ratio (All  $P > 0.05$ )
  - Balance between compatible phenotypes
    - Disassortative mating

# Open pollination

- Fruit set (Analysis of deviance)
  - SS = LS ( $P = 0.754$ )



- Seed set (ANOVA)
  - SS = LS ( $P = 0.482$ )

# Conclusions

- Consistent with other distylous taxa
  - Self- & intra-morph incompatible
    - But variable (seed set  $SS > LS$ )
  - Inter-morph compatible ( $SS = LS$ )
  - Stigma-anther position (primary traits)
  - 1:1 morph ratio: no significant deviations
  - Pollen & stigma dimorphism (ancillary traits)
- Self-sterility favors maintenance of distyly

- Distyly not perfect
  - Long-level sex organs: weak reciprocity
    - Imprecise cross-pollen transfer ?
  - Anther-stigma separation: reduced in SS
    - Potential for selfing in SS ?

# Research in progress

- Investigate breakdown of distyly
  - Compare distylous populations with
    - Asexual population (loss of sexual function)
    - Homostylous populations (reproductive assurance)

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