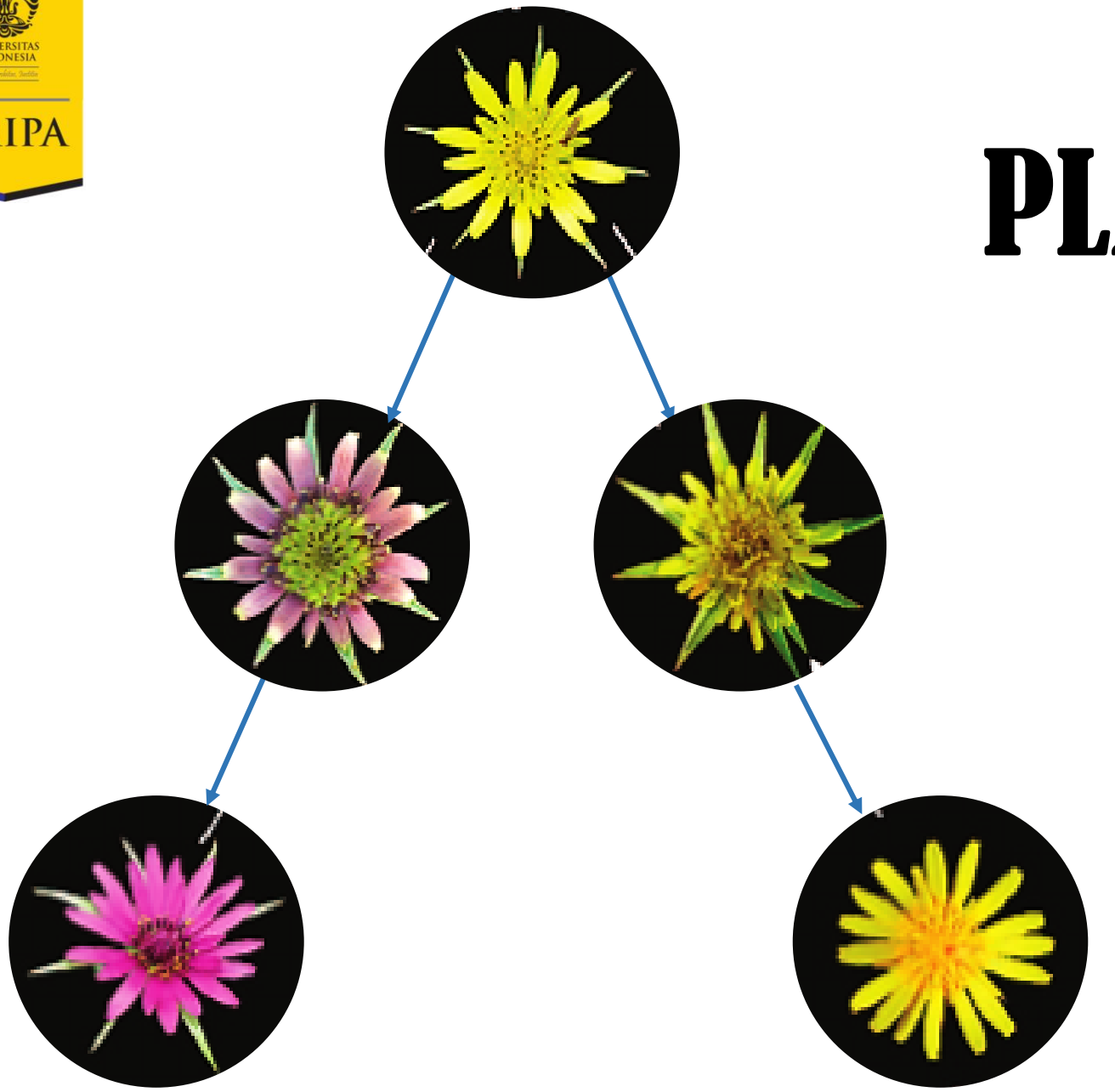

PLANT SPECIATION

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OUTLINE:

- Evolution
- Modes of plant speciation
- Features of plant evolution

EVOLUTION → SPECIES

Speciation

The **cumulative change** in the **heritable** characteristics of a population over time.

The **basic** biological unit around which classifications are based.

Speciation:

an evolutionary process by which a new species comes into being.

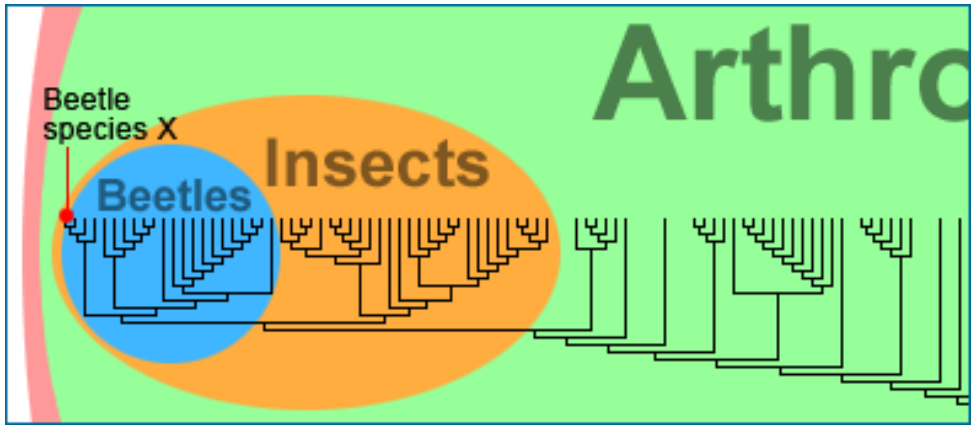
Evolution

Microevolution

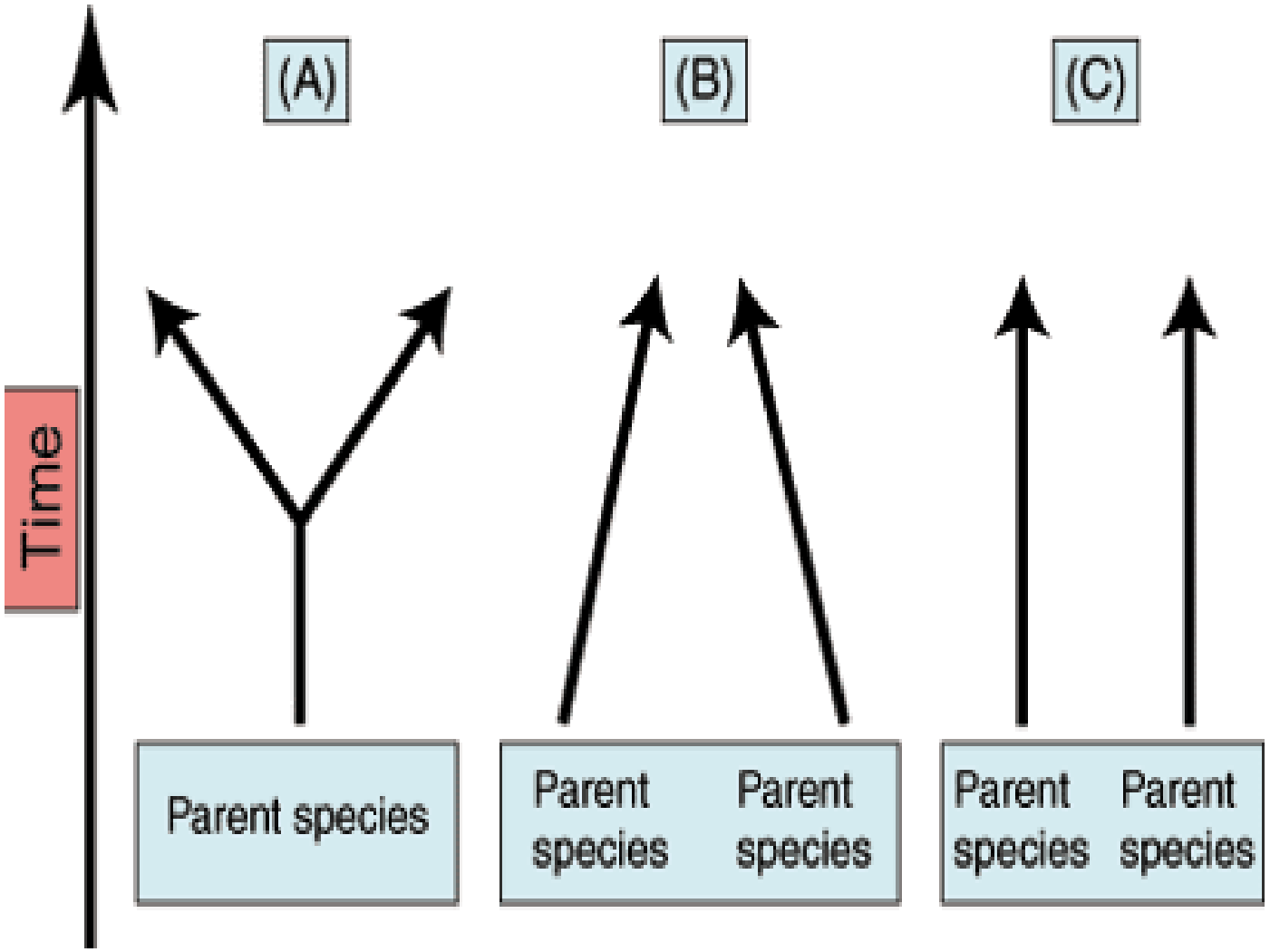
- Microevolution is a change in gene frequency in a population in short period of time.
- Processes that can directly affect gene frequencies in a population: (mutation, migration, genetic drift, non random mating, natural selection)

Macroevolution

generally refers to evolution above the species level.



Patterns of evolution:



A. **Divergent Evolution:** the two species gradually become increasingly different.
B. **Convergent Evolution:** species of different ancestry begin to share analogous traits because of a shared environment or other selection pressure
C. **Parallel Evolution**: two species evolve independently of each other, maintaining the same level of similarity. Parallel evolution usually occurs between unrelated species that do not occupy the same or similar niches in a given habitat.

How a new species originate:

- Species are created by **a series of evolutionary processes**.
- Classically, speciation has been viewed as a **three stage** process:
  - **Isolation** of populations.
  - **Divergence** in traits of separated populations (e.g. mating system or habitat use).
  - **Reproductive isolation** of populations that maintains isolation when populations come into contact again (secondary contact).

Isolating Mechanisms in Plants: (Grants, 1981)

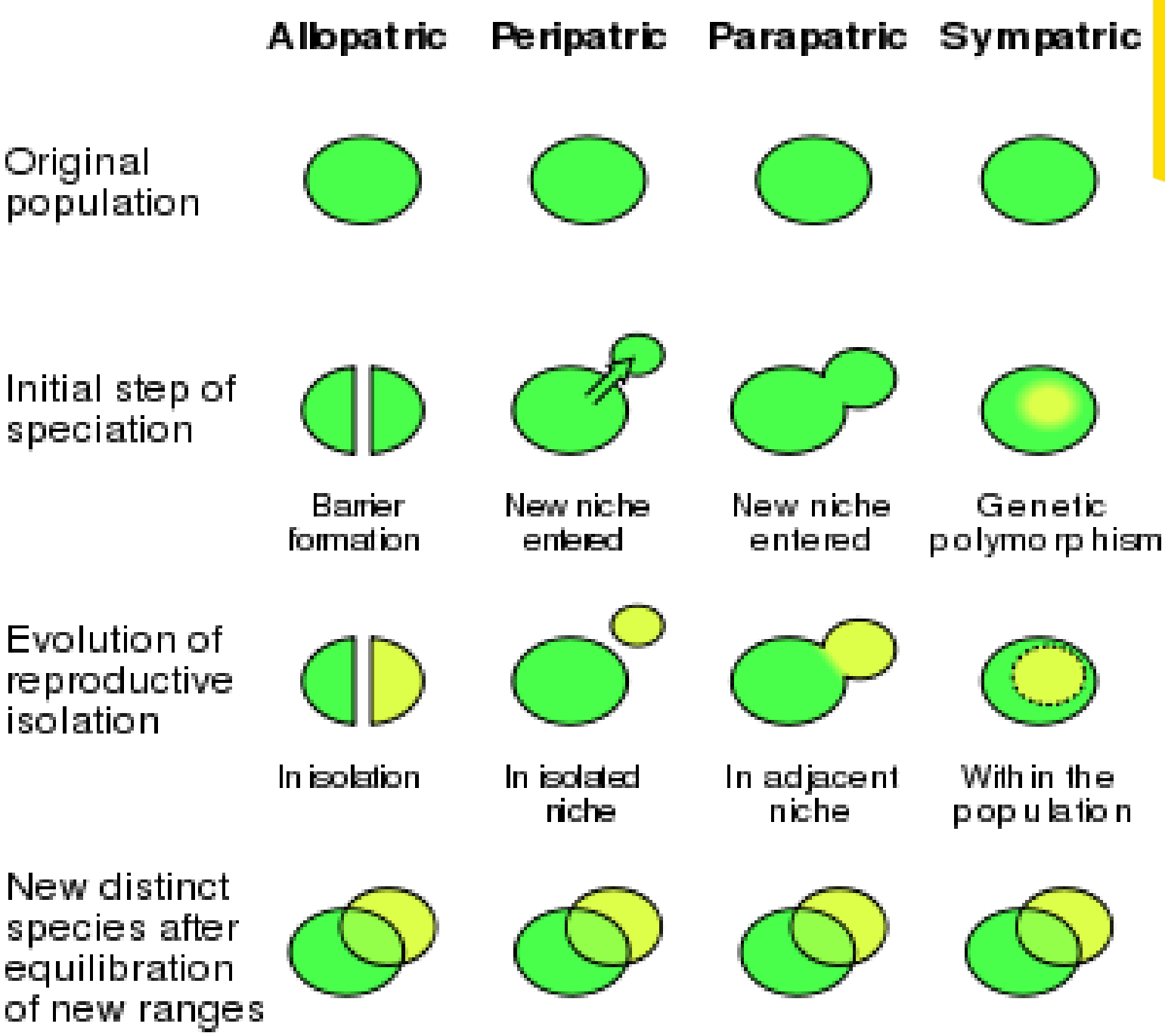
Spatial	Environmental	Reproductive (floral)

• Geographical isolation	• Ecological isolation	• External
		  • Temporal
		  • Mechanical
		  • Autogamy
		• Internal
		  • Incompatibility barriers
		  • Hybrid inviability, sterility

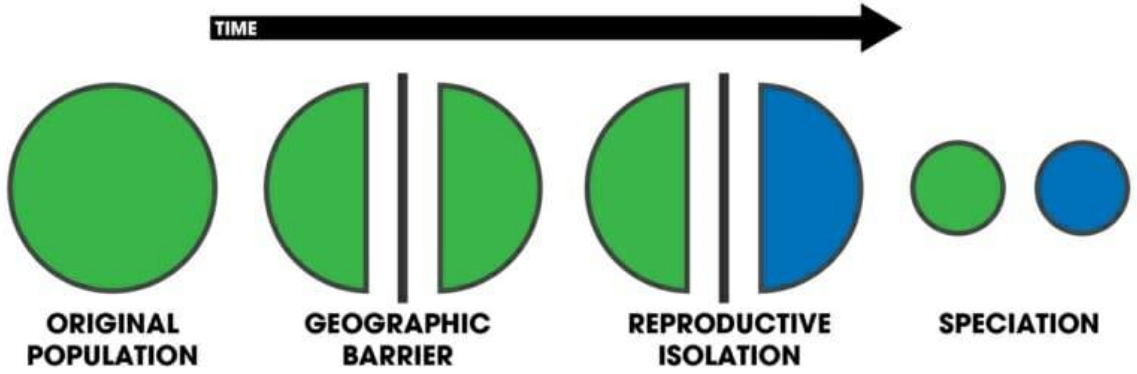
Reproductive isolation mechanisms:

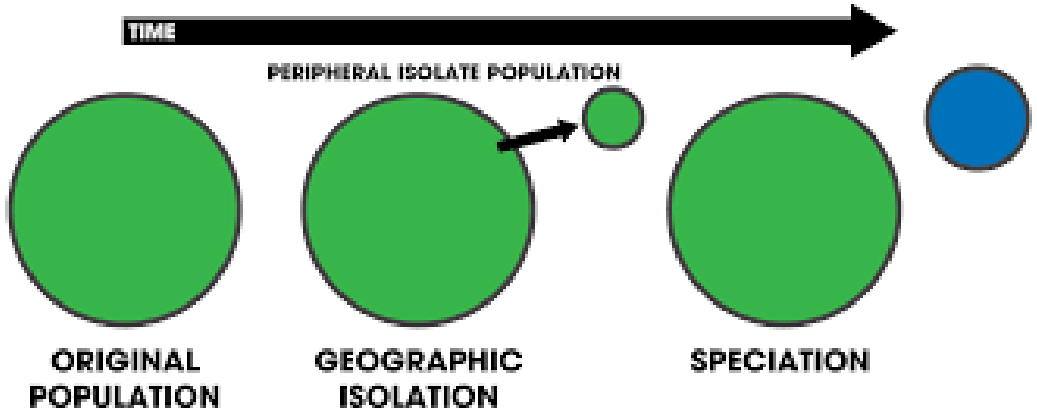
Pre-zygotic	Post zygotic
• Geographical • Ecological • Seasonal • Ethological • Mechanical	• Hybrid inviability • Hybrid sterility • Hybrid breakdown

Modes of plant speciation:



Allopatric VS Peripatric

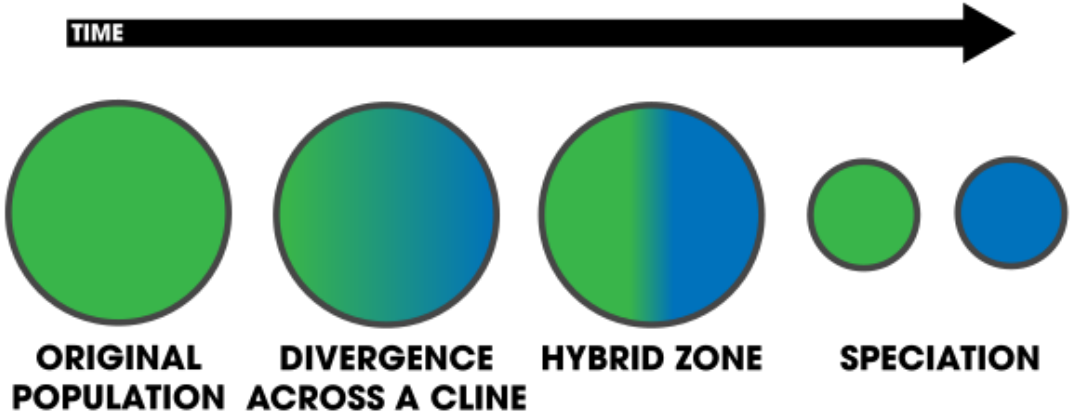


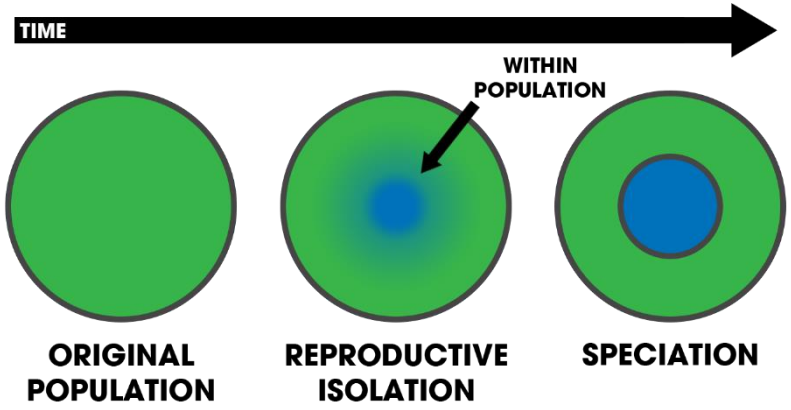


- A physical barrier occurs,
- Divides old population into two similar size of populations,

- A physical barrier occurs
- Few individuals (peripheral) break off from the main population,

Parapatric VS Sympatric

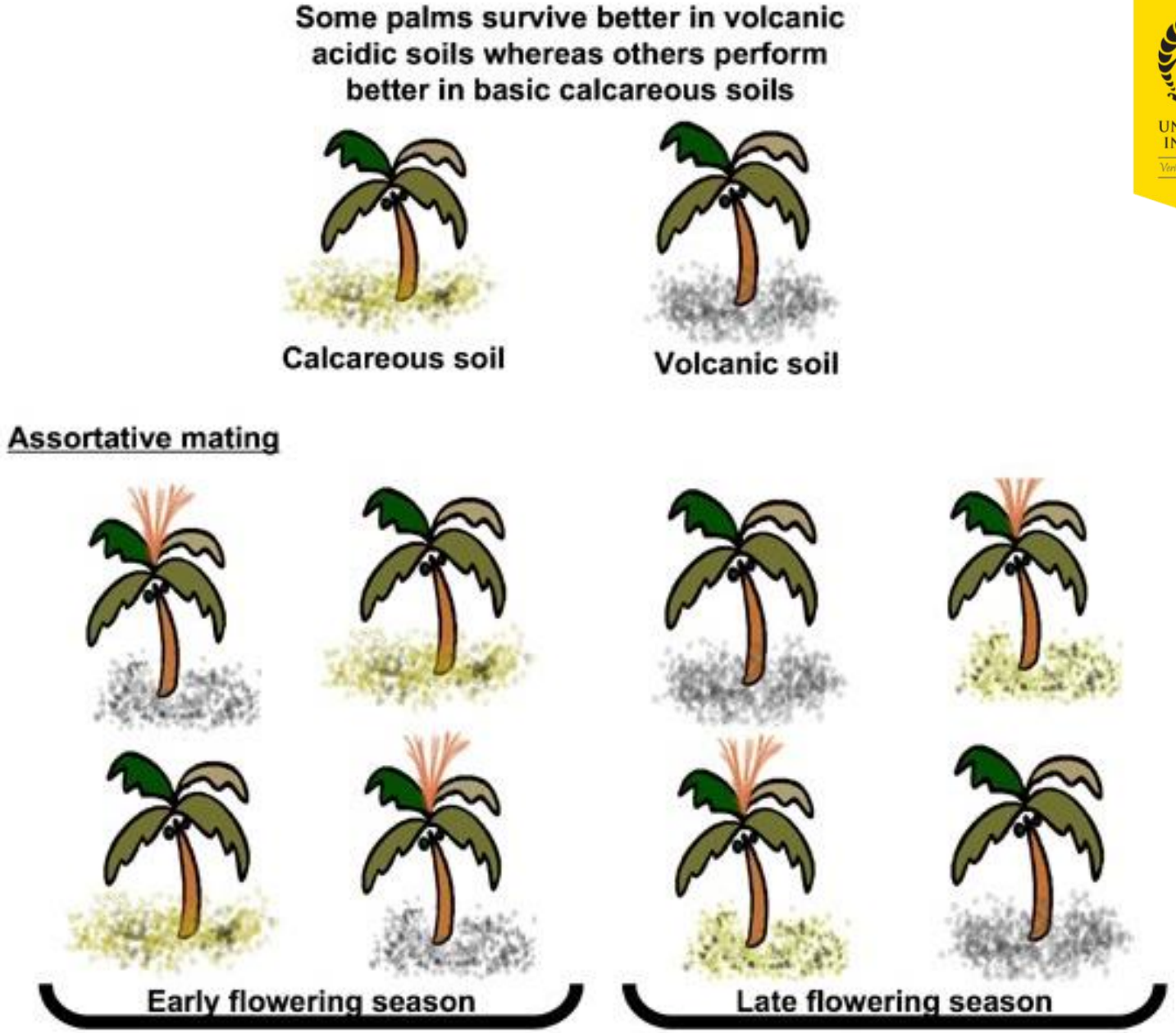




- No extrinsic physical barrier which separate a population
- Speciation occurs within population,
- Non random mating

- No physical barrier,
- Speciation occurs within population,
- Non random mating

Example of parapatric speciation



Features of plant evolution

Hybridization

Polyploidy

Domestication & artificial selection

1. Hybridization

- Refers to cross (mating) between different genotypes in genetic, or different species to transfer one character or some characters
- Common among plants, rather than animals.
- Hybridization produces a hybrid.

Helianthus annuus X *H. petiolaris* → *H. anomalus*
(homoploid hybrid)

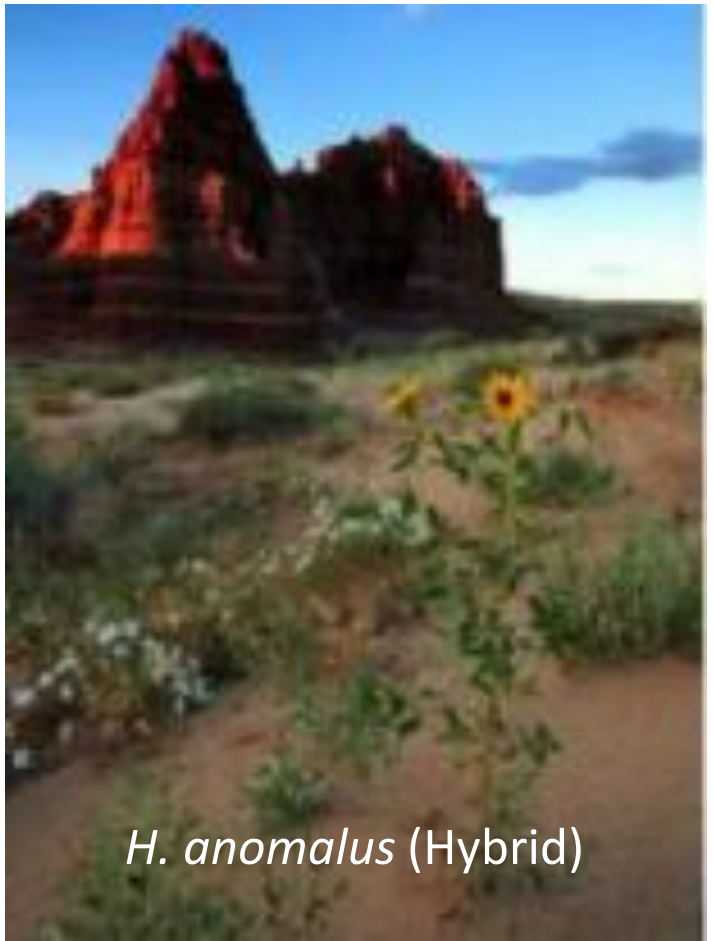
Widespread, prefers more mesic, clay-based soils

Occurs in stabilized sand sheets

Restrictied to sand dune habitats in the desert

H. annuus

H. petiolaris



H. anomalus (Hybrid)

2. Polyploidy

- caused by the **addition of one or more complete chromosome sets** to the normal diploid complement.
- In the animal kingdom polyploidy is lethal in nearly every case, but it is **relatively common** in plants.
- Between 30 percent and 70 percent of extant angiosperms are polyploid.
- Common in nature and **provide major mechanisms for adaptation** and speciation
- Many **crop plant undergone polyploidy** during their evolutionary process

Modifications caused by hybridization and ploidy change...

A

Diploid species A
2n = 2x

Diploid species B
2n = 2x

Allopolyploid species
2n = 4x

B

Diploid species A'
2n = 2x

Autopolyploid species
2n = 4x

C

Diploid species A
2n = 2x

Diploid species B
2n = 2x

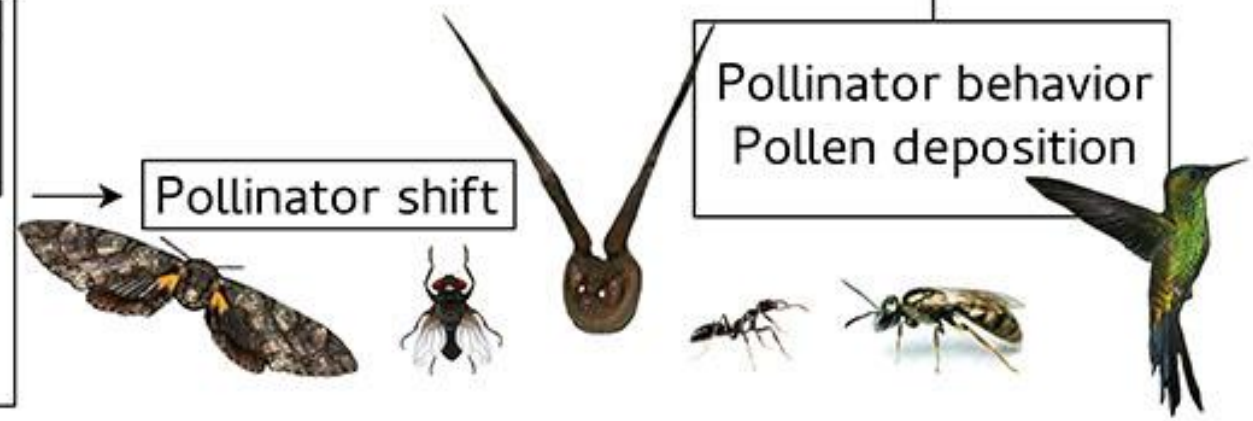
Homoploid species
2n = 2x

... could affect ...

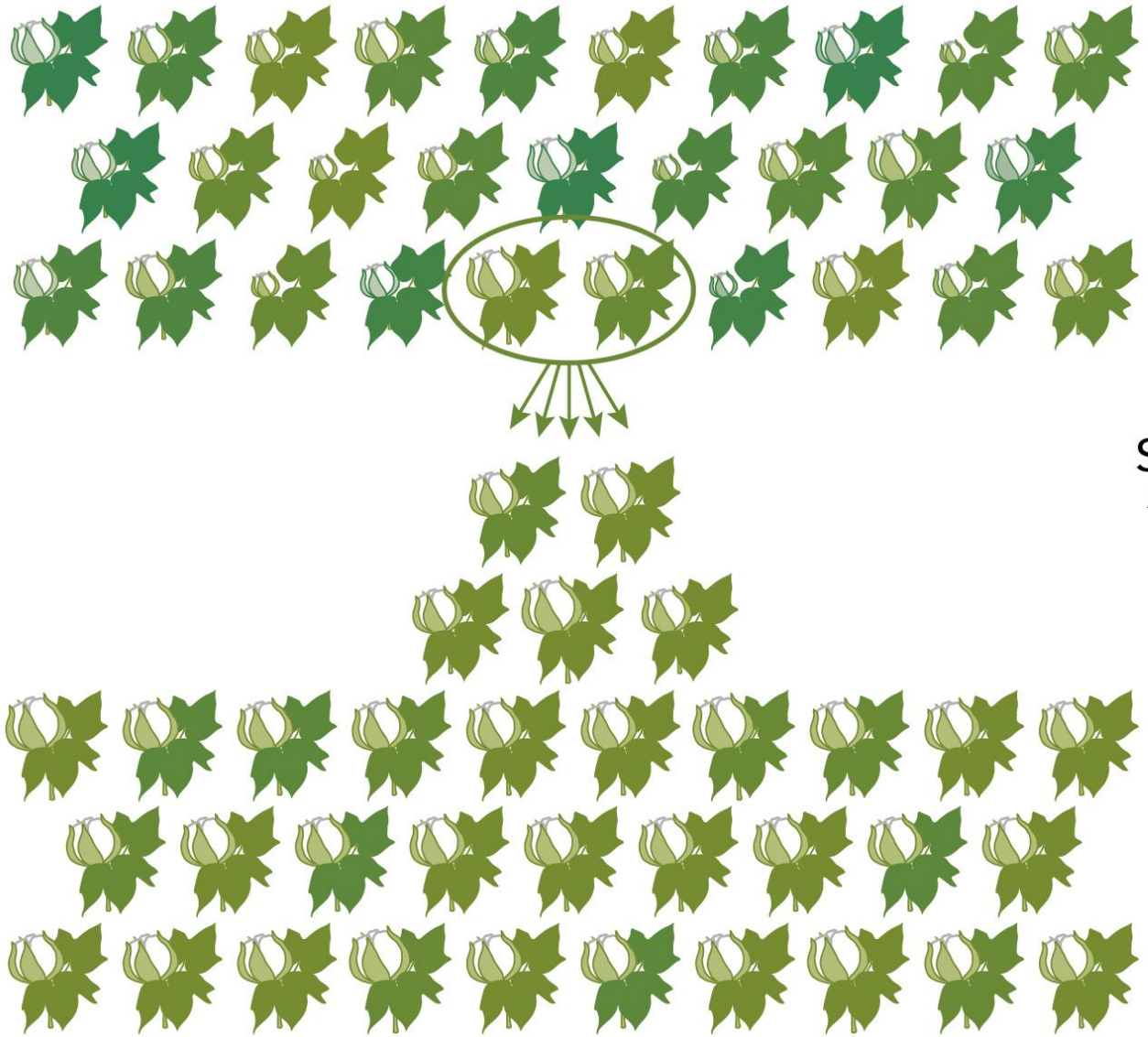
- Flower
  - morphology
  - phenology
  - color
- Floral
  - scent
  - reward
  - display

→ Pollinator shift

Pollinator behavior
Pollen deposition



3. Domestication & artificial selection



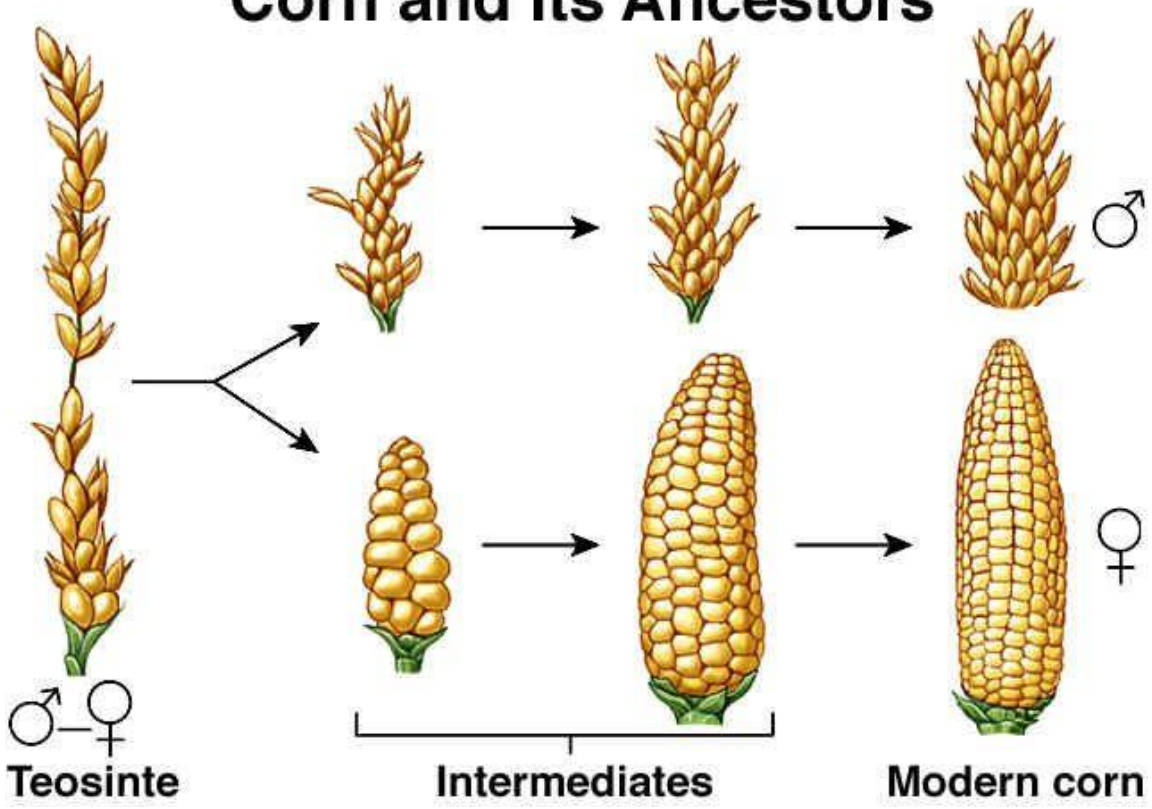
Wild population
Lots of genetic diversity

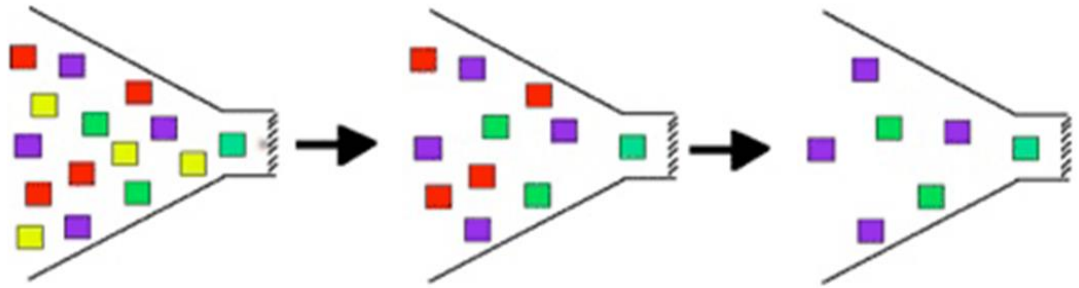
Selective breeding
A few individuals are chosen and propagated

Domesticated population
Less genetic diversity

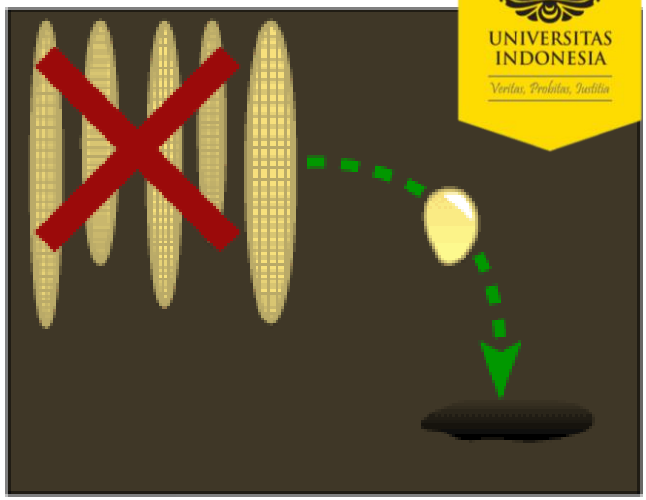
Domestication decreases genetic diversity

Corn and Its Ancestors

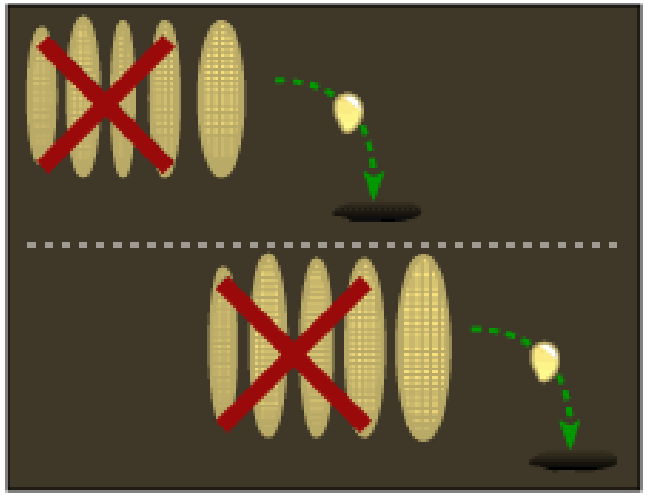




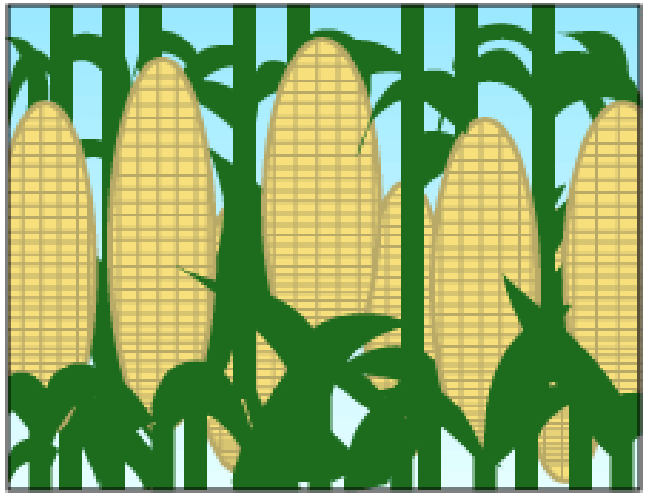
1. Natural variation occurs in the wild population.



2. Seeds for the next generation are chosen only from individuals with the most desirable traits.



3. Repeat this process for several generations.



4. Over time, the quality of the crop increases.

DO YOU KNOW?

5 COMMON FOODS BEFORE AND AFTER HUMANS DOMESTICATED THEM

Wild watermelon

Judging by paintings of the fruit dating to the 17th century, watermelons may have once had seeds arranged in **swirly geometric patterns.**

Modern watermelon

Over time, humans have bred watermelons to have a **bright red,** juicy interior. The **seeds are often removed** by preventing the plants from being fertilized by pollination.

Wild banana

The first bananas may have been cultivated at least **7,000 years ago** in what is now Papua New Guinea, and were **stocky and hard,** with large, tough **seeds** throughout the fruit's interior.

Modern banana

Today's tastier bananas are **hybrids** of two wild banana varieties, **Musa acuminata** and **Musa balbisiana.**

SOURCES: Dan L. Perlman/EcoLibrary; "History and Iconography of Eggplant," Chronica Horticulturae; "Tracing antiquity of banana cultivation in Papua New Guinea," The Australia & Pacific Science Foundation; Vox; World Carrot Museum

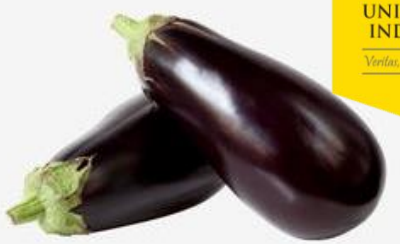
INSIDER

Wild eggplant

Eggplants once came in a wide array of shapes and colors, from **blue to yellow,** and some were **round** rather than oblong. Primitive eggplant varieties had a **spine** where the modern plant's stem connects to its flowers.

Modern eggplant

Selective breeding has made the **sp** **disappear** and left us with the **oblo** vegetable we're familiar with.



Wild carrot

The first carrots were likely cultivated around the 10th century in Asia Minor and were either **white or purple** with thin, forked roots and a **strong flavor.**

Modern carrot

Carrots today are large, **bright orange,** and tasty.

Wild corn

One of the most standout examples of selective breeding is North American sweet corn, which was bred from the barely edible **teosinte plant.** Natural corn was first domesticated around 7,000 BC and was thought to have been as **dry as a raw potato.**

Modern corn

The corn we eat now is **1,000 times bigger** and much easier to grow and peel. A majority of these changes started taking shape after the 15th century, when **European settlers** started farming it.

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Conclusions:

- As a sessile organism, it is important for a plant to develop various adaptation strategies as its responses toward environmental changes.
- However, if the environment changes, either by nature or human, leading an isolation of a population from the others, an evolution may occurs.
- Evolution is an important process that increase plant diversity.

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Thank you