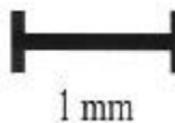


Plant of the day: Marshelder

- Close relative of ragweed and sunflower
- Domesticated in eastern North America as an oilseed
- Domesticated form now extinct



Marshelder (*Iva*)



Iva annua

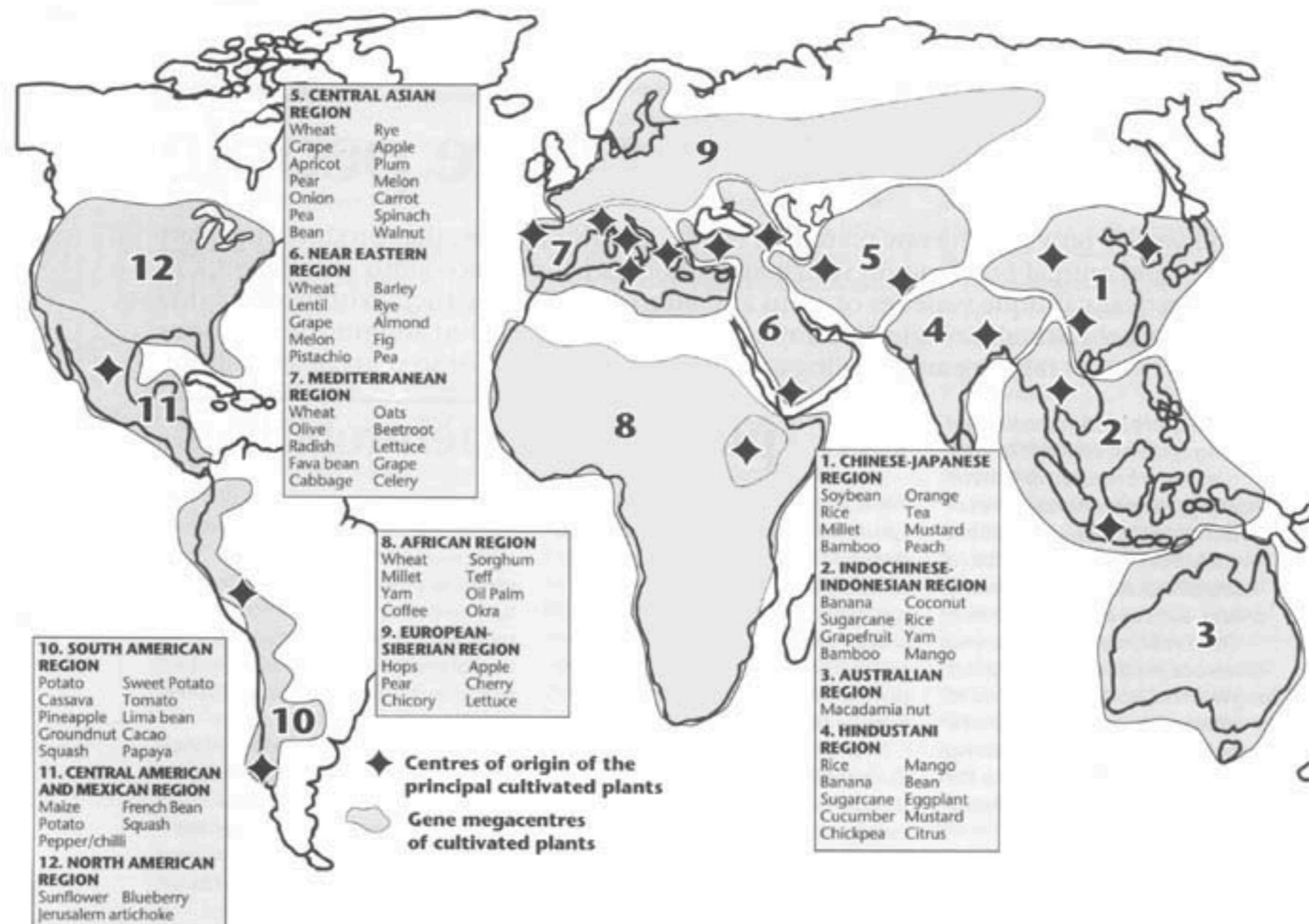
Crop domestication



Big Questions:

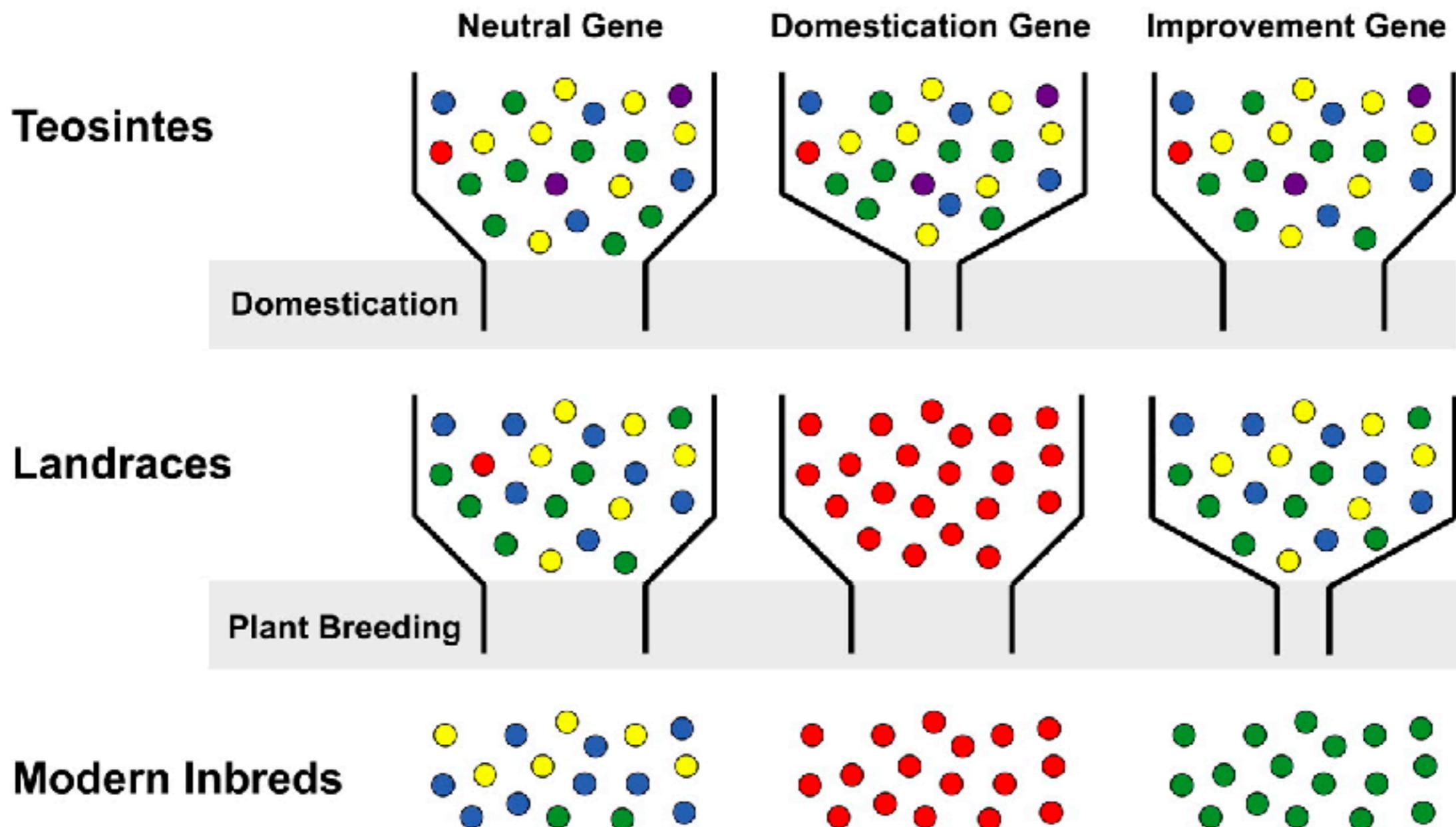
- Why, where and when were plants domesticated?
- How quickly were they domesticated?
- What were the selection pressures that caused domestication?
- What kinds of genetic changes are under selection during domestication?
- Do analyses of evolution under domestication inform us about evolution under natural selection?

Centres of domestication



Archaeological evidence suggests that hunter-gatherers independently began cultivating food plants in at least 11 regions of the world (Doebley et al. 2006)

Domestication bottlenecks



Domestication Bottlenecks

- Breeding between cultivars or with wild progenitors can restore diversity.
- The level of bottleneck depends on the species and the level of domestication

Domestication Syndrome

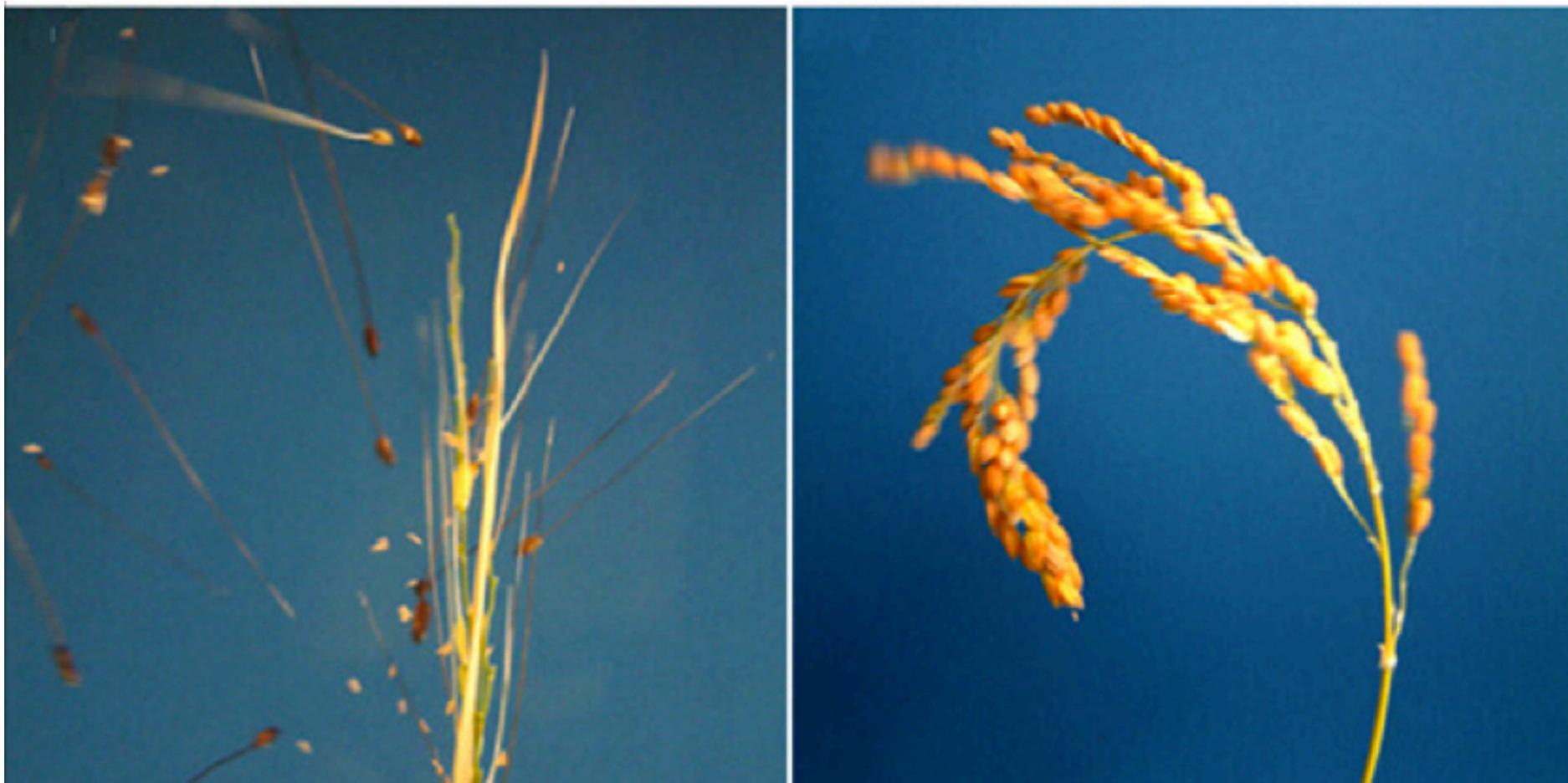
A domestication syndrome describes the properties that distinguish a certain crop from it's wild progenitor.

THINK - PAIR - SHARE

What are some domestication traits?
What about for seed crops vs. root crops vs. fruit crops?

Domestication traits

A lack of shattering



Domestication traits

Less branching



Domestication traits

Fewer larger fruits



Domestication as a process

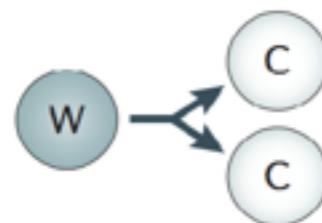
- The distinction ‘domesticated’ or ‘not domesticated’ is an oversimplification
- Some crops have moved further along this process further than others.
- We can recognize different levels of domestication
- How can we decide which level?

Domestication process

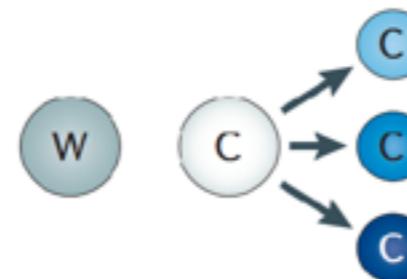
a Stage 1:
Onset of
domestication



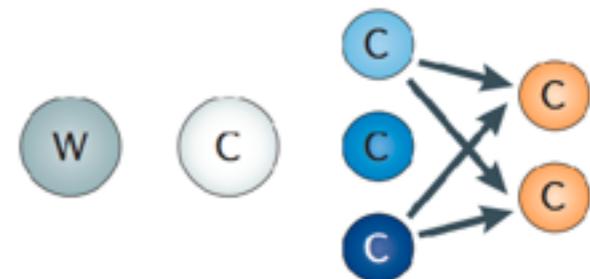
b Stage 2:
In situ increase in frequency
of desirable alleles



c Stage 3:
Formation of cultivated populations that are
adapted to new environments and local preferences



d Stage 4:
Deliberate breeding



Domestication

Diversification

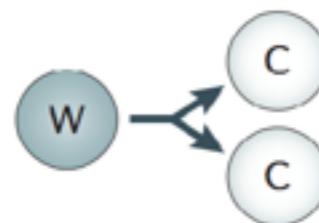
Improvement

Domestication process

a Stage 1:
Onset of
domestication

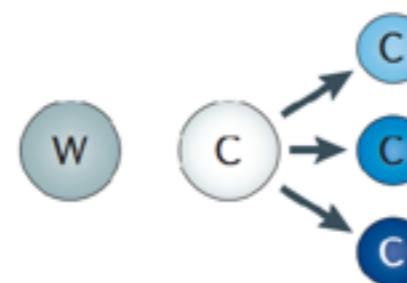


b Stage 2:
In situ increase in frequency
of desirable alleles



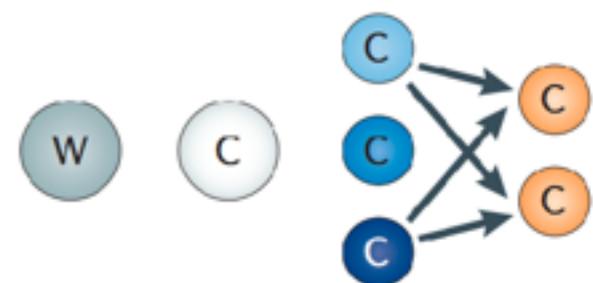
Domestication

c Stage 3:
Formation of cultivated populations that are
adapted to new environments and local preferences



Diversification

d Stage 4:
Deliberate breeding

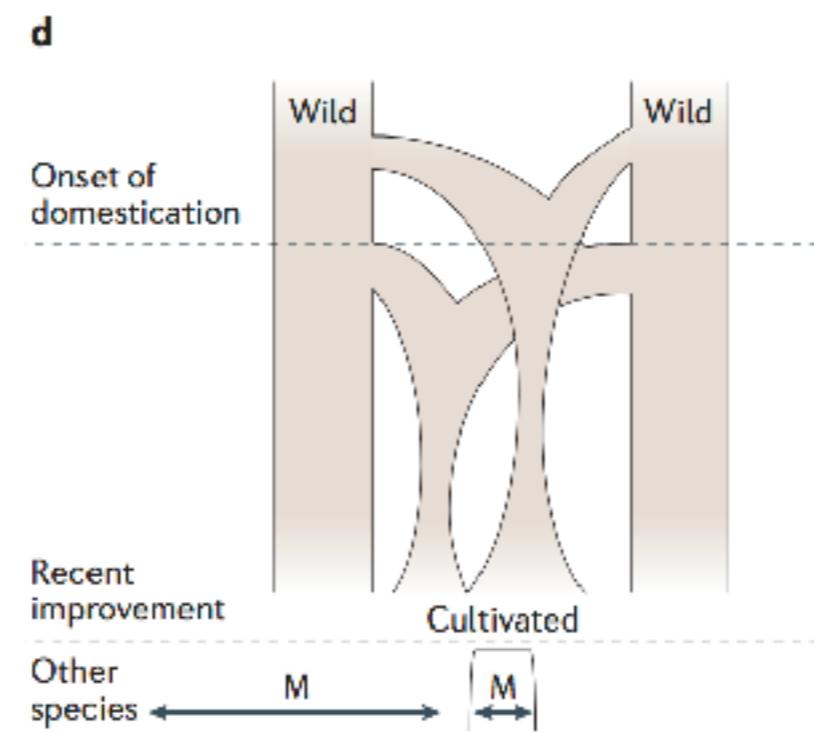
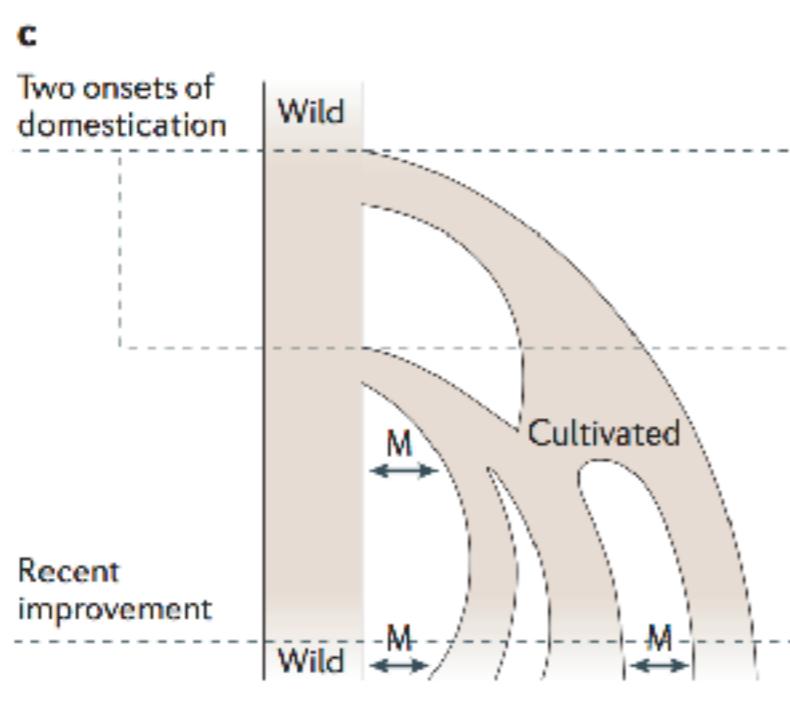


Improvement

**How might improvement traits be different from
domestication traits?**

Domestication process

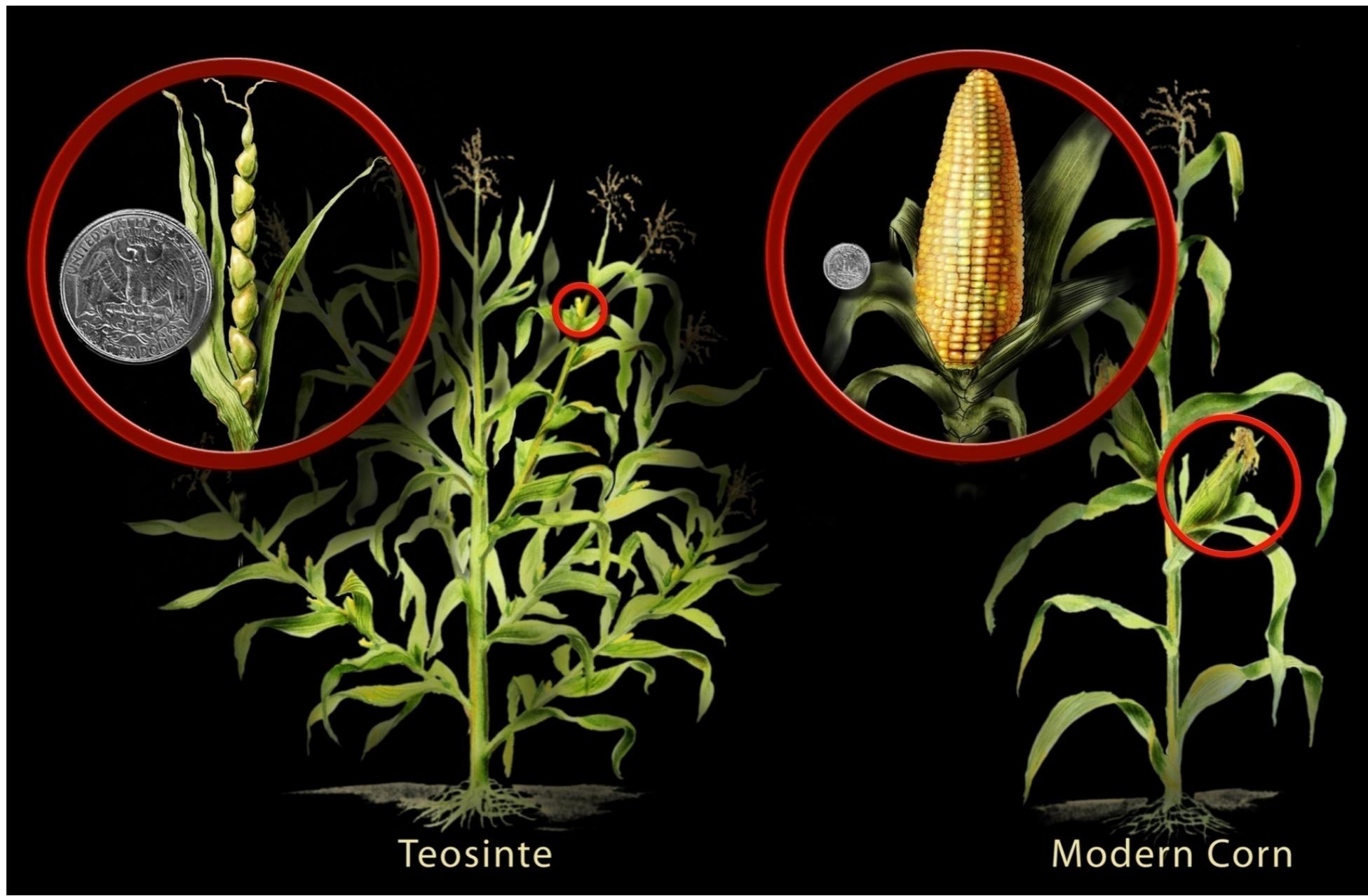
Older view



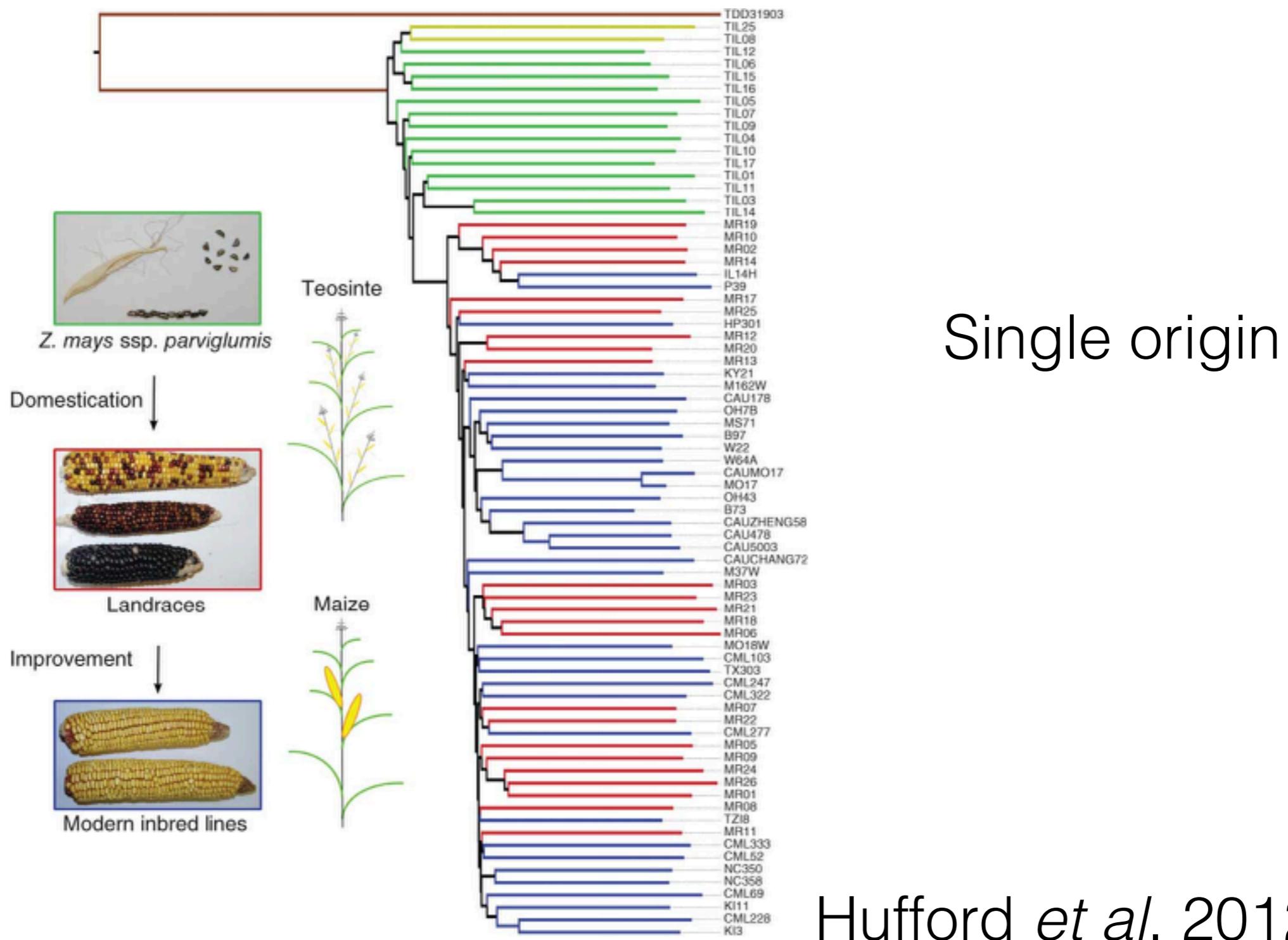
Domestication process

- Plants can have multiple origins of domestication
 - Barley, bottlegourd, coconut, common bean
- Gene flow between cultivate crops and wild progenitors during domestication is also possible

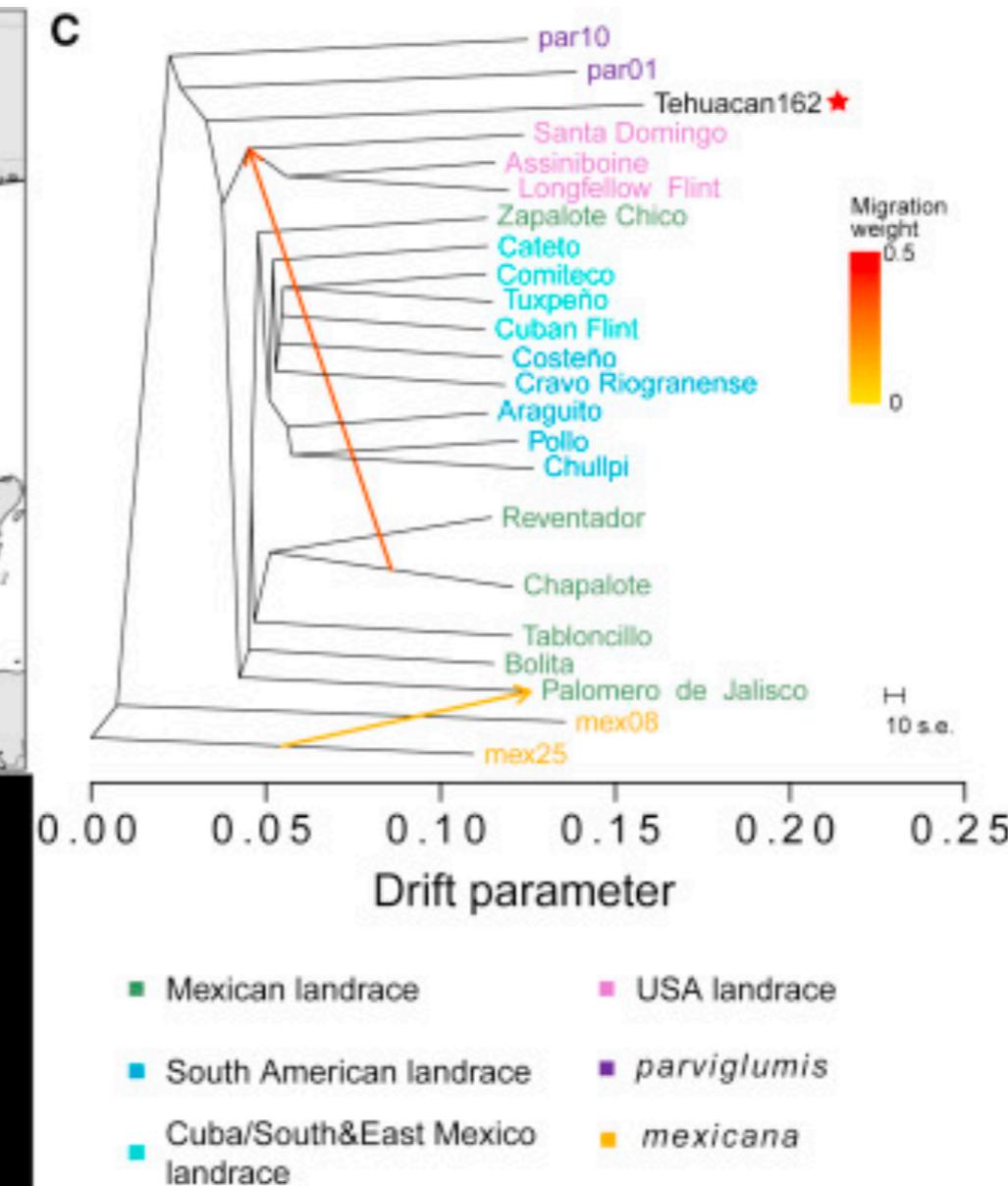
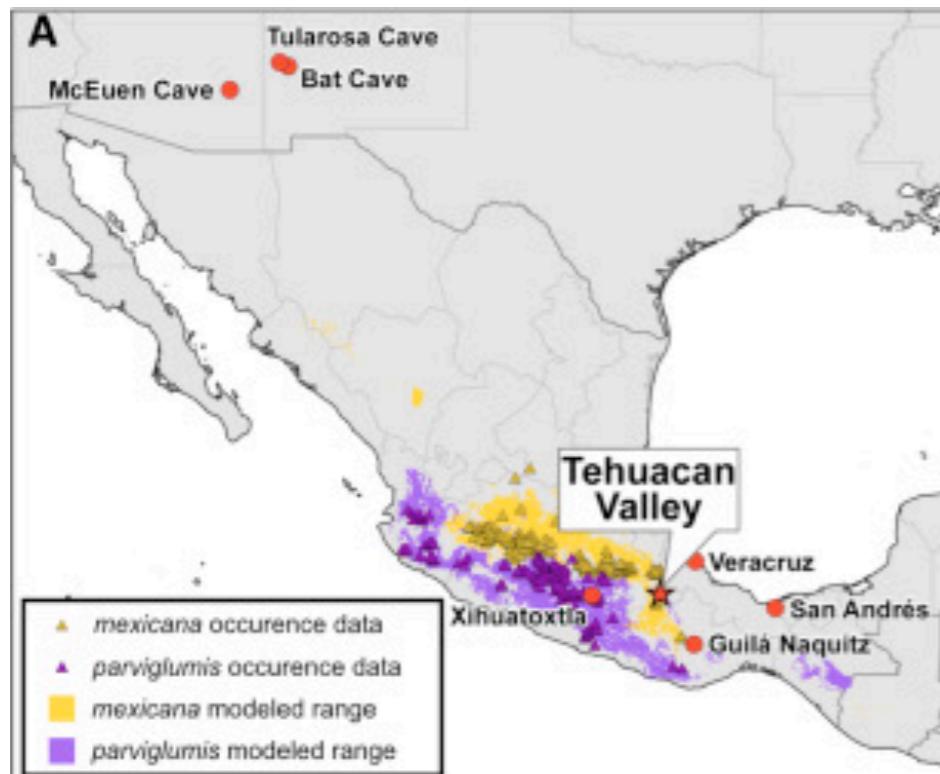
Maize domestication



Maize domestication



Maize domestication

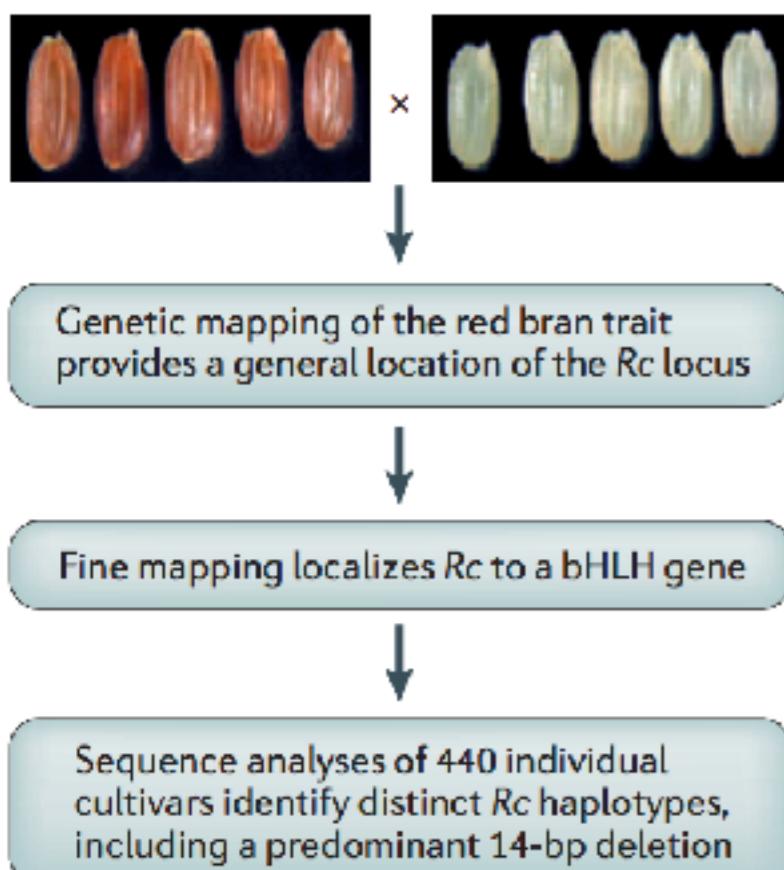


5310 year old maize cob!

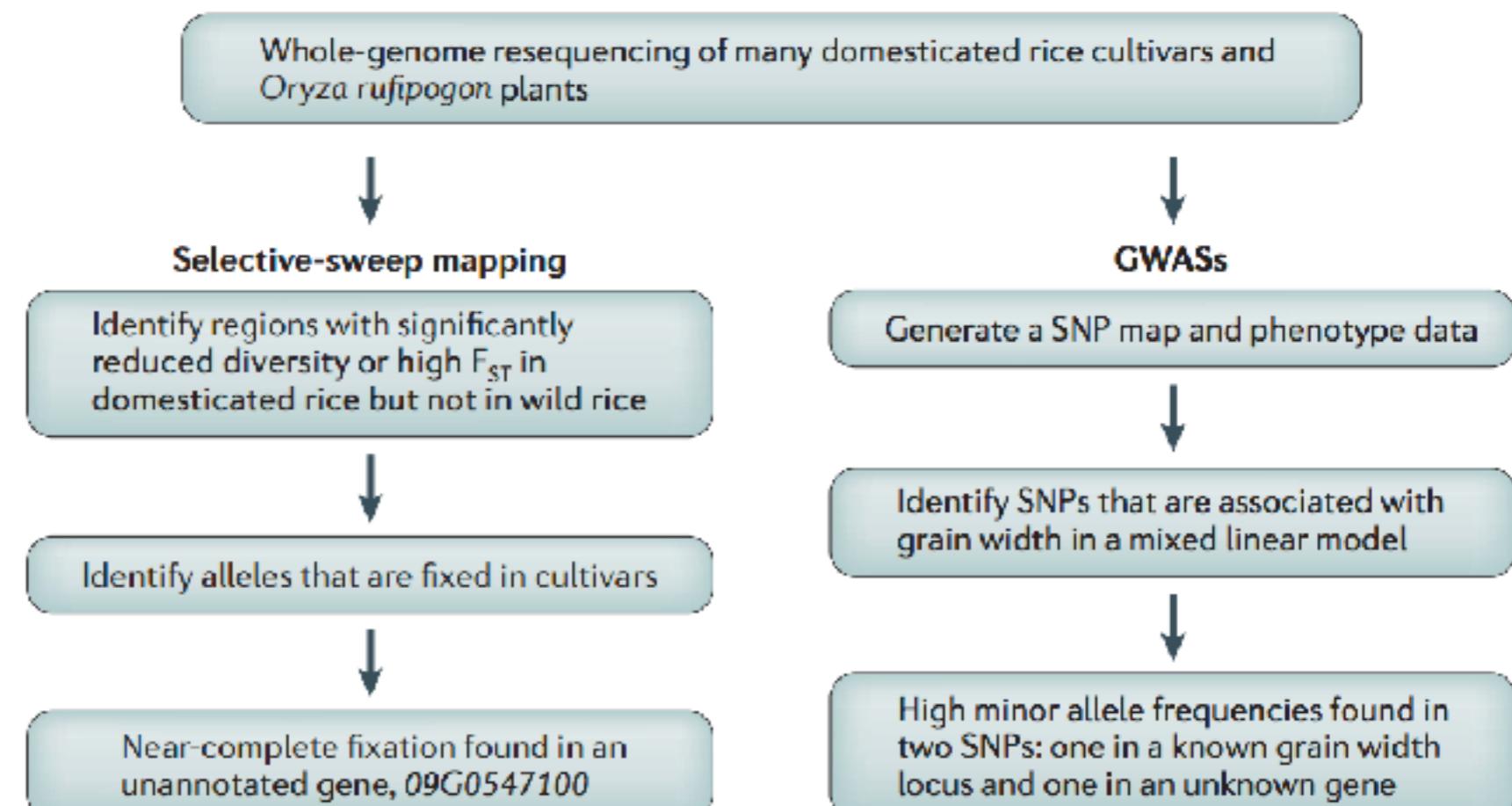
Ramos-Madrigal *et al.* 2016

Detecting domestication genes

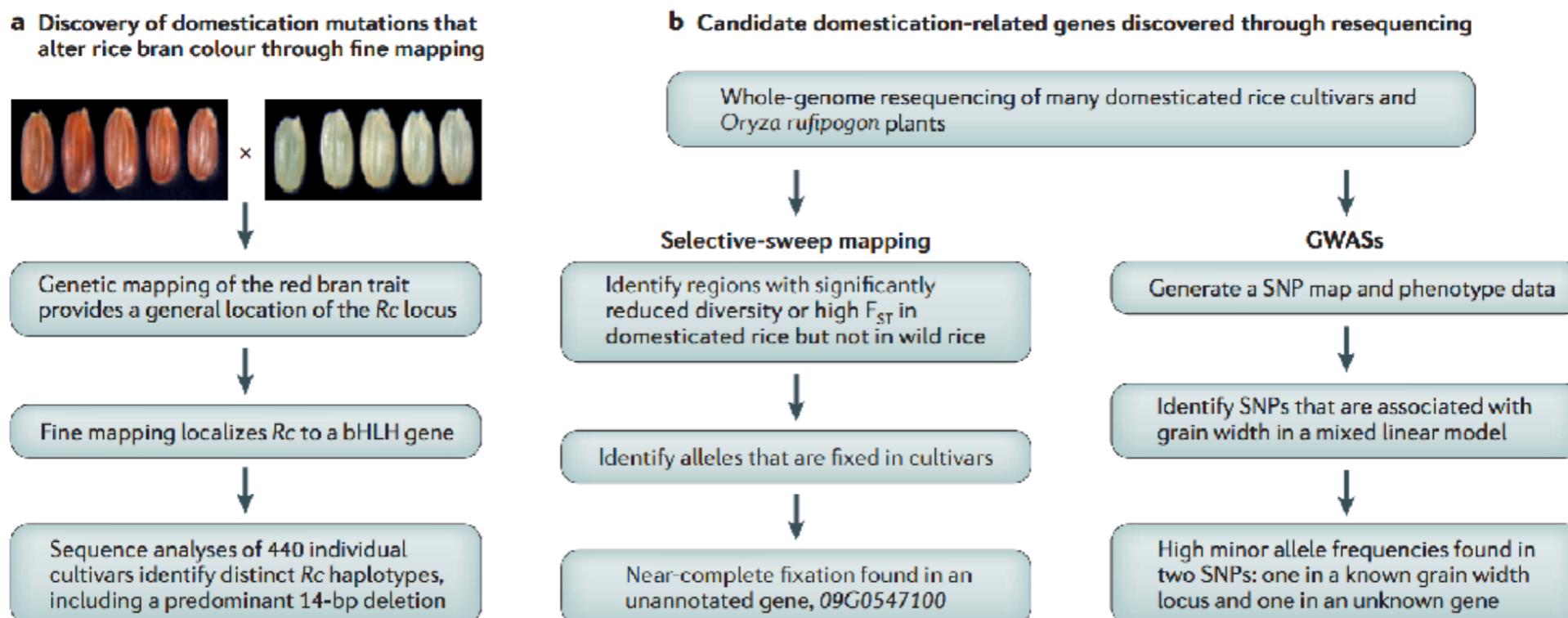
a Discovery of domestication mutations that alter rice bran colour through fine mapping



b Candidate domestication-related genes discovered through resequencing



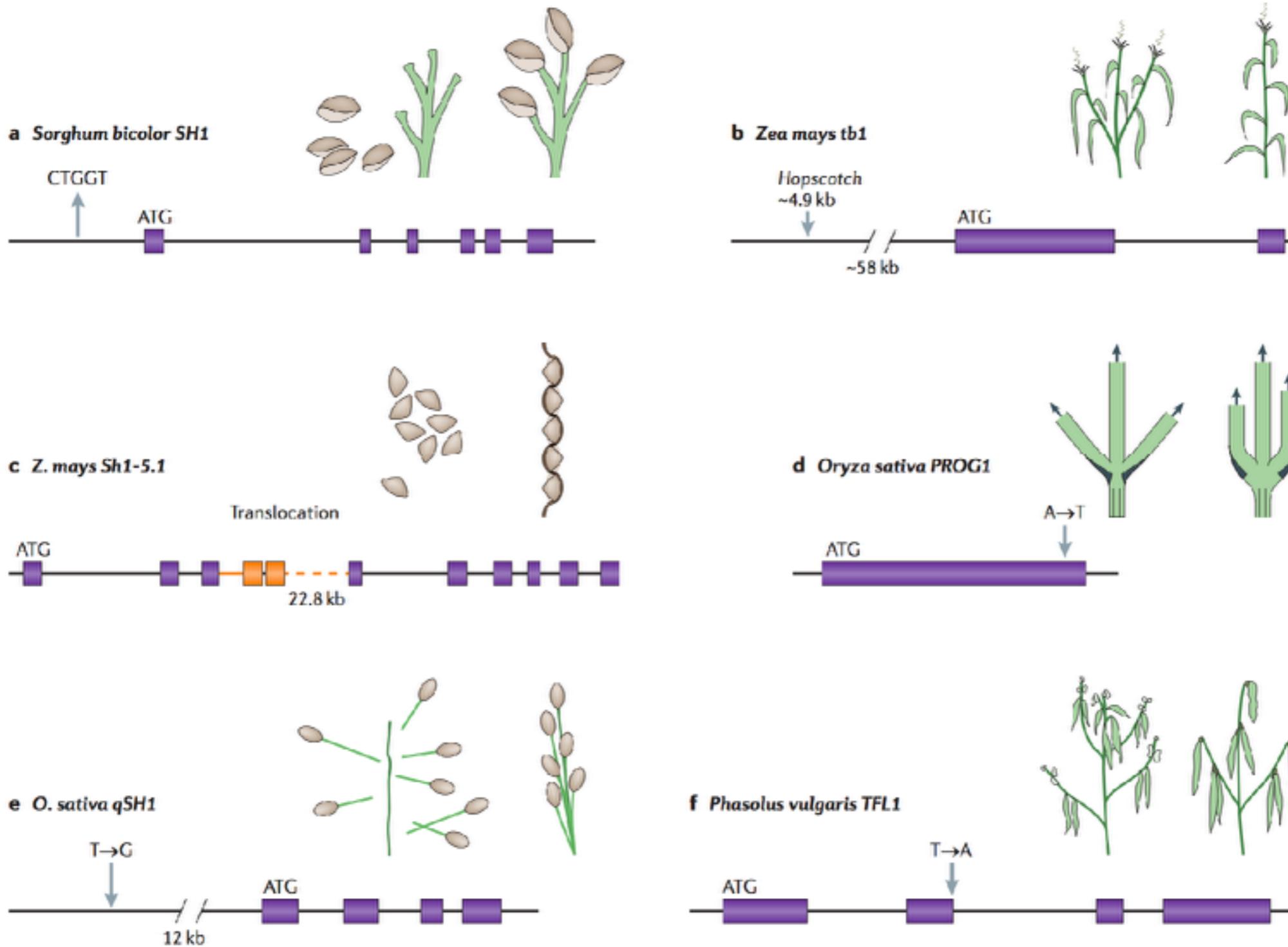
Detecting domestication genes



THINK - PAIR - SHARE

What are some weakness of each method?

Domestication genes



Domestication genes

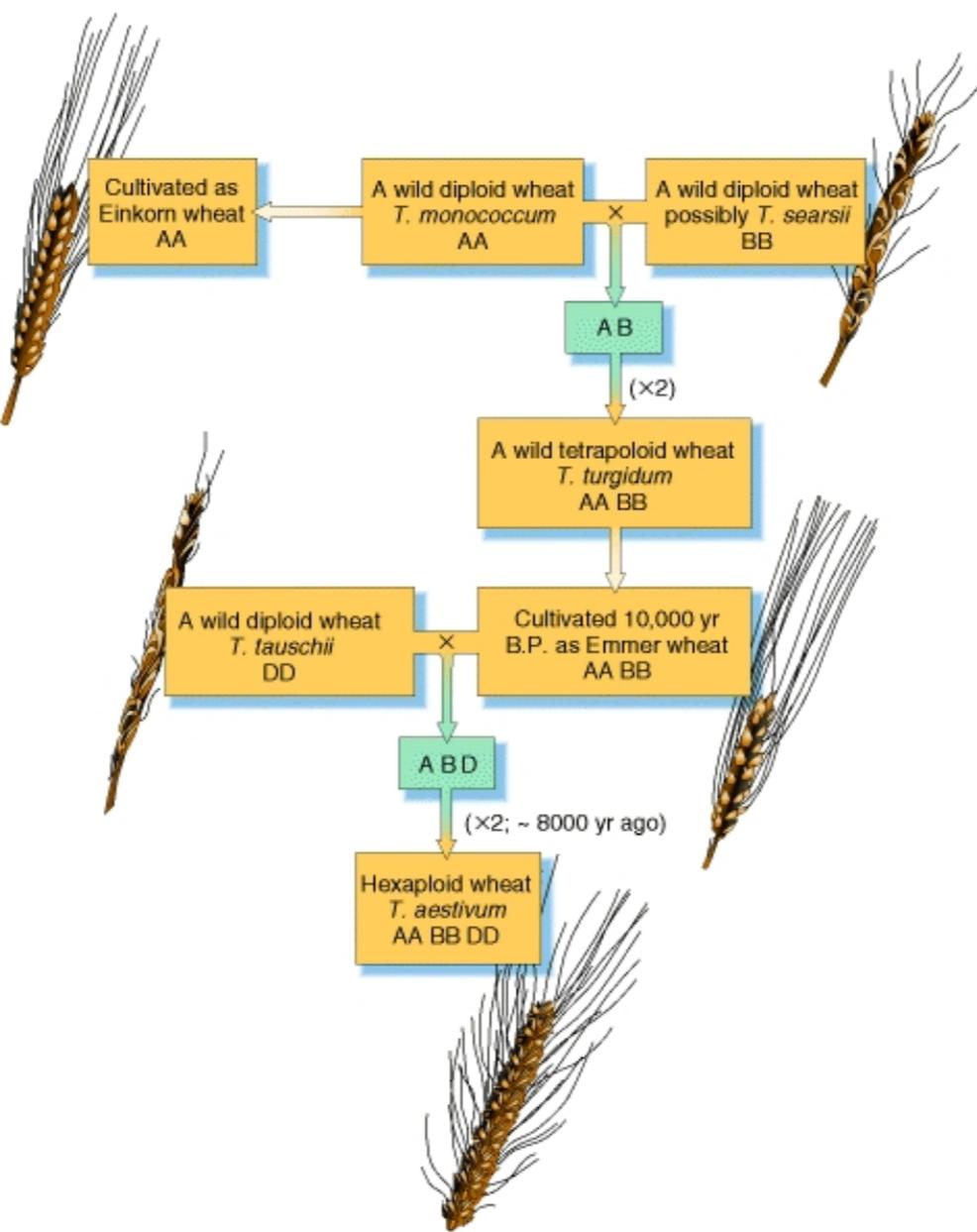
- A majority of domestication genes are transcription factors
- Are enriched for genes of large effect (loss of function alleles)
- Can be new mutations or be found in the wild progenitor

Genetic parallelism

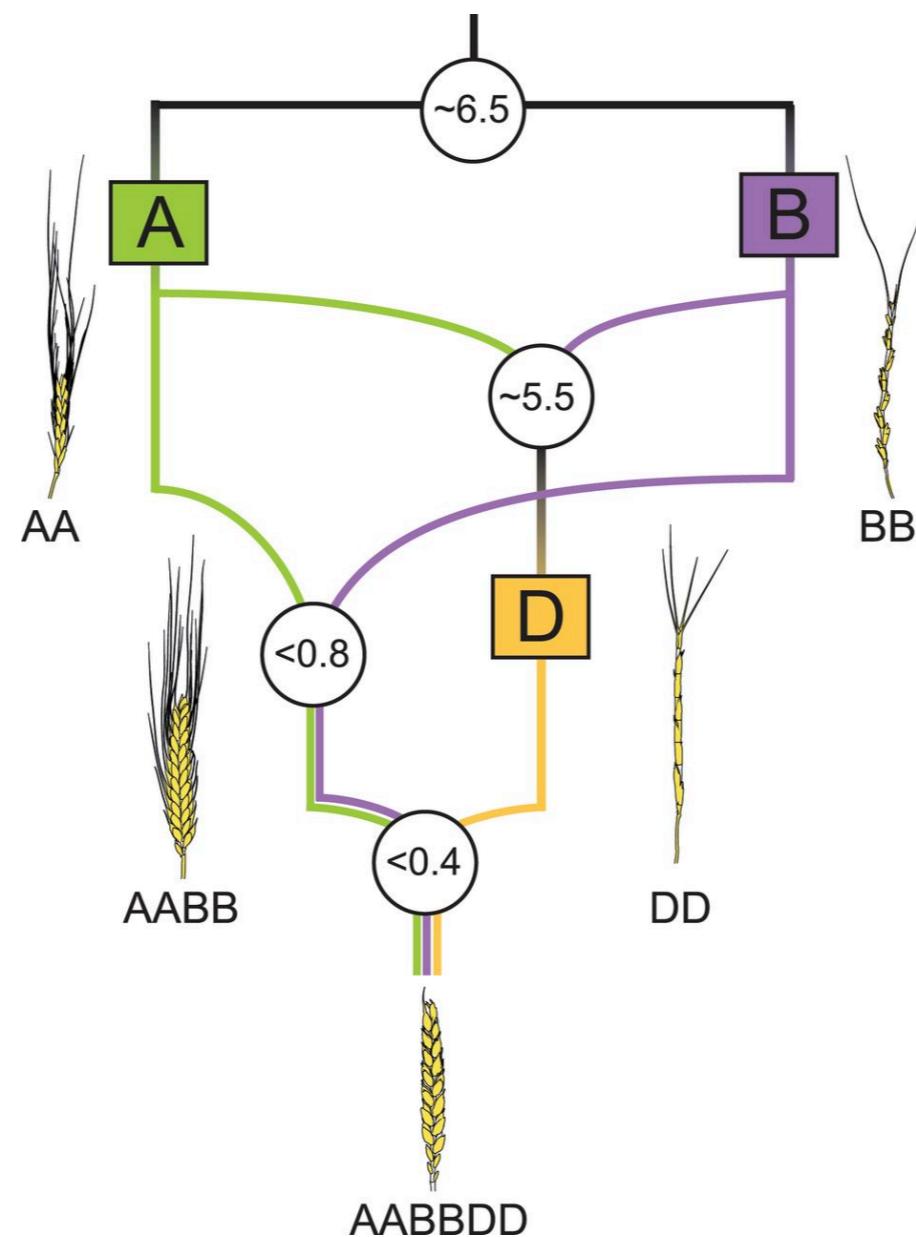
- Sticky rice is caused by a mutation in the WAXY gene
- Mutations in the same gene cause sticky varieties in broomcorn millet, foxtail millet and three *Amaranthus* spp. pseudocereals



Polyplody and domestication



Polyplody and domestication



Unanswered questions

- Why are some crops only weakly domesticated?
- Are the major effect domestication genes/mutations cloned so far representative of other crops/genes/mutations?
- What is the role of reproductive isolation in domestication? What about gene flow from wild relatives?
- Do domesticated plants carry high levels of genetic load?