Plant Domestication

Introductory group project

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Outline

1) Domesticated plants and wild plants
2) Process of artificial selection underlying phenotypic differences
3) Comparisons between natural selection and artificial selection
4) Study of plant domestication

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The plants we eat - domesticated plants

More examples?

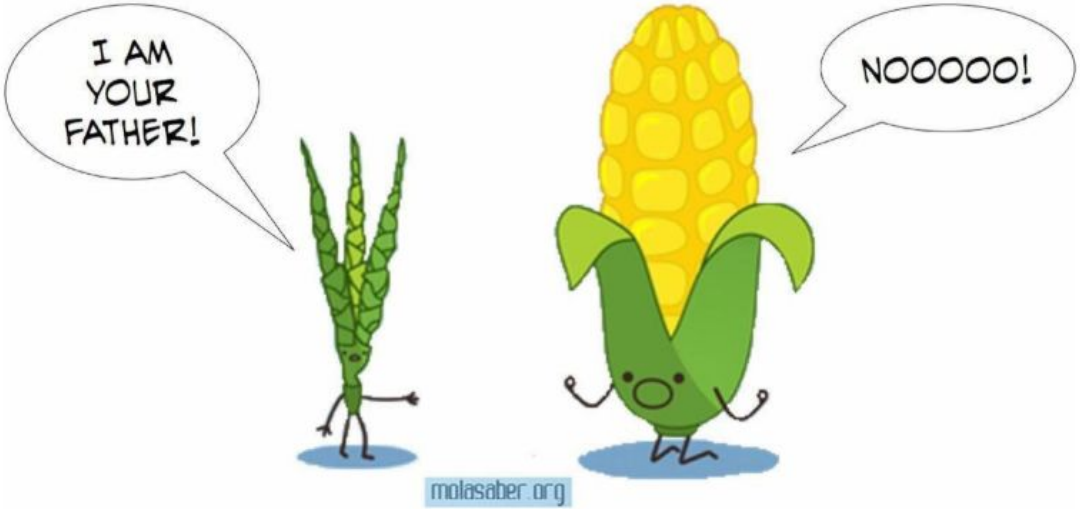
Corn

Retrieved from https://www.grainsa.co.za/pannars-yellow-hybrids-will-give-you-peace-of-mind

The close relatives of the domesticated plants- wild plants

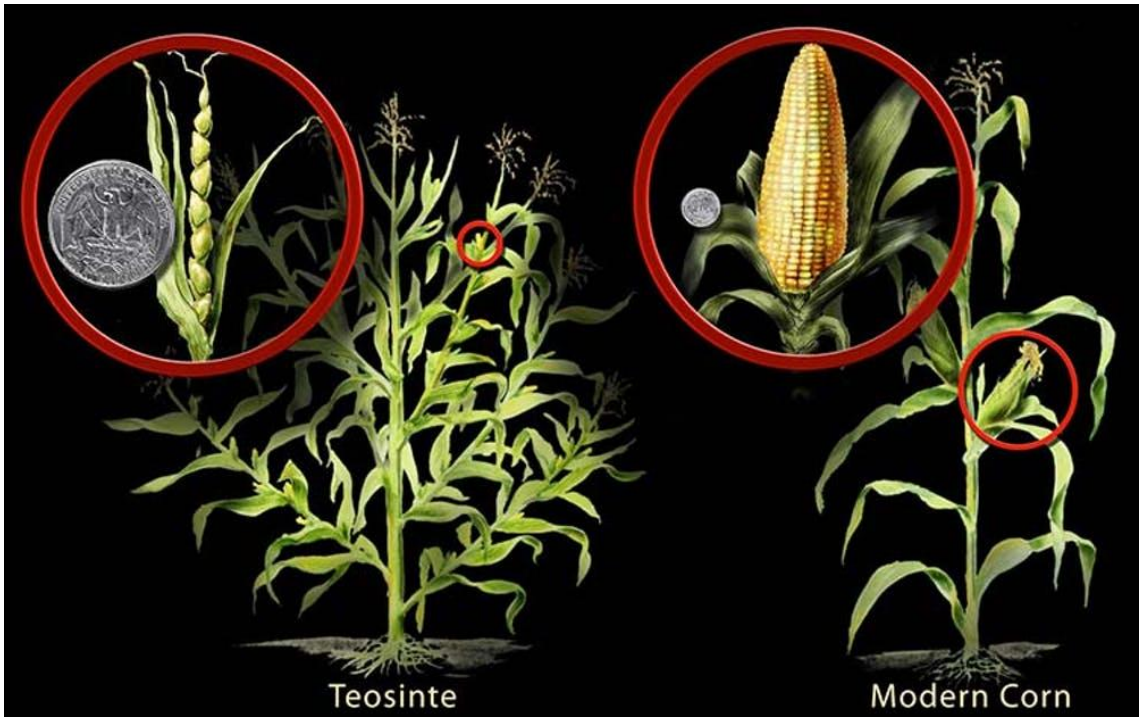
Where the corn comes from?

Who is the ancestor of the corn?



Retrieved from https://www.coursehero.com/tutors-problems/World-History/16327158-Control-of-seed-shattering-is-a-common-trait-we-find-in-domestication/

Wild plants vs domesticated plants



Retrieved from
http://agriculturers.com/genes-del-primo-silvestre-del-maiz-pueden-ser-clave-para-combatir-enfermedades-del-importante-cultivo/

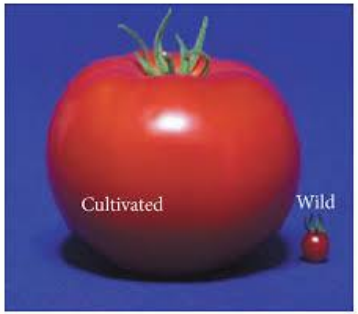
Differences between wild and domesticated plants?

What differences we observe?

-Larger fruits

-More fruits

-Tighter architecture



Tomato (Chaudhary, 2013)

Rice (Gross, 2012)

Maize (Credit: John Doebley)

Rice (Hua, 2015)

Differences between wild and domesticated plants?

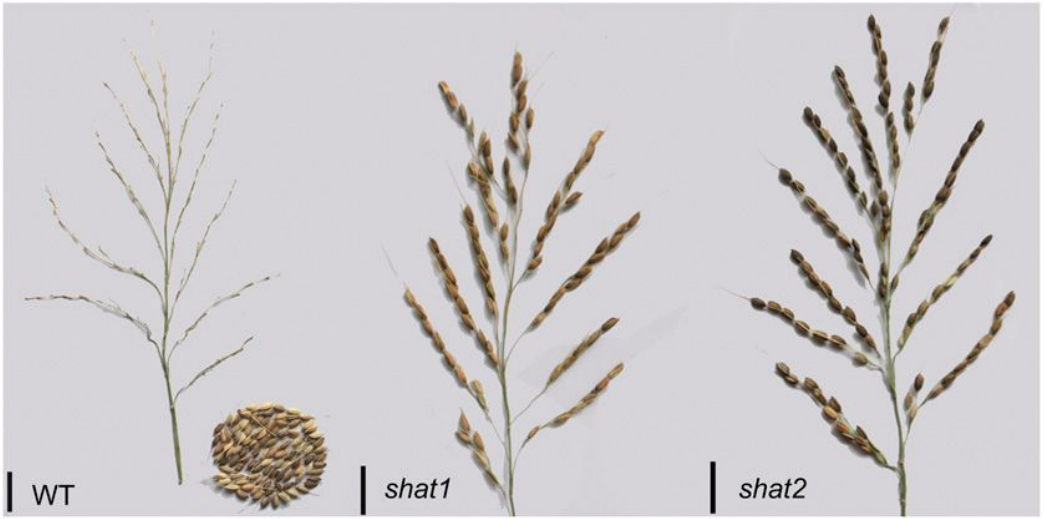
What other differences we can expect?

-Less toxic, better taste

-Easier to grow (seed dormancy)

-Widely grow in different areas (flowering time)

-Easier to collect (seed shattering)



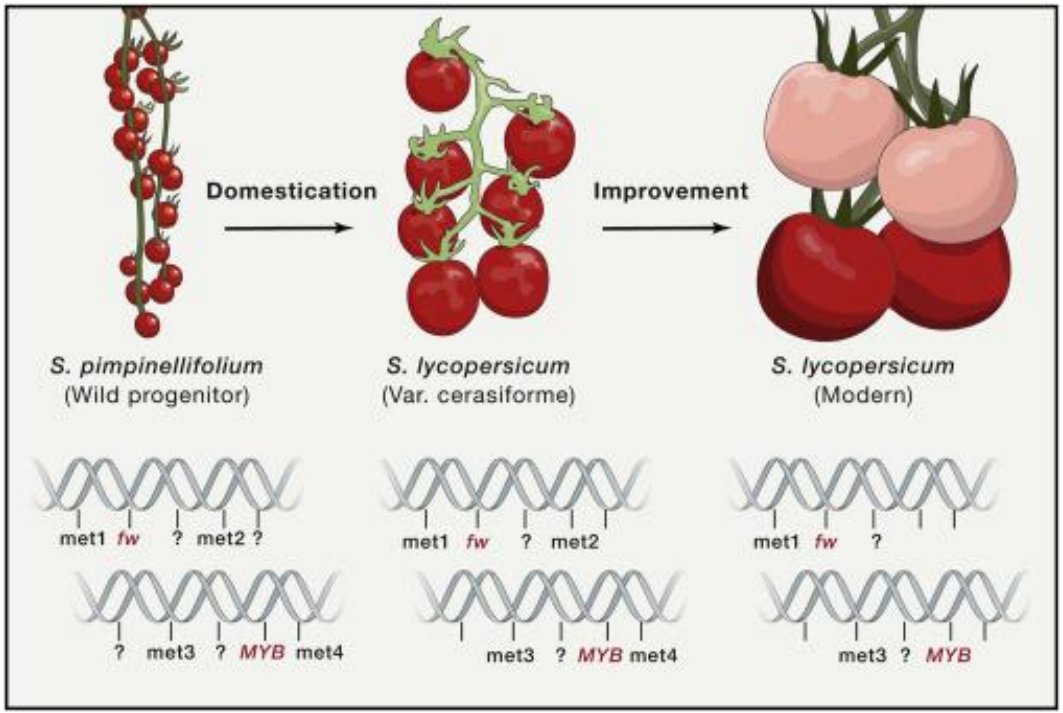
(Zhou, 2012)

In summary

More beneficial traits (to human) are found in the domesticated plants.

People selected these traits (purposely or unpurposely).

How this works in the genetic perspective?



(Giovannoni, 2018)

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Selection Game

You will be in charge of a population, represented by tokens

Within this population are the Red (R) and Yellow (Y) alleles that control the color of the token

- The alleles R and Y represent the **genotype**
- The token colors represent the **phenotype**

About the Game

Goal: see how the frequency of each allele and token color changes under different scenarios

Think about:

1. How many R and Y alleles (genetics) are there in the starting and ending populations?
2. What is the proportion of colored tokens (phenotypes) in the starting and ending populations?

Playing the Game

- Bank of tokens for 4 different groups
  - Red (RR)
  - Yellow (YY)
  - Orange (RY)
  - Pink (P) [this is a mutant allele used in mutation scenarios]
- Random number generator or a 4 sided die
  - https://www.google.com/search?q=random+number
- Instruction handout
- Class scorecard to record outcomes of each final population in each scenario

Playing the Game

Four scenarios

- -No selection
- -Selection for a standing variant
- -Selection against a mutation
- -Domestication of P

Class Scorecard

	Basic Game			Select for Red			Select against mutation				Domesticate P			
Student/Group Name	# R	# Y	# Red | Yellow | Orange	# R	# Y	# Red | Yellow | Orange	# R	# Y	# P	# Red | Yellow | Orange| Pink	# R	# Y	# P	# Red | Yellow | Orange| Pink
			| |			| |				| | |				| | |
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Questions you can bear in mind

No selection

- How has the population changed?
- Are there more individuals of 1 group than another?
- How different/similar is it to the starting population?

Selection for a standing variant

- How did the population change?
- Why might we see this happen in a wild population (the change of allele/trait frequencies)?

Selection against a mutation

- How did the Pink (P) group do?
- How is this similar or different from previous rounds of the game?

Domestication of P

- How did the Pink group do in this setting?
- How is it similar or different from other versions of the game?
- How is this similar to what happens in domesticated species versus their wild counterparts?

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Is domestication the only thing that can change genes and phenotypes?’

NO

Natural selection

Natural Selection

How natural selection contributes genetic and phenotypic traits to the population?

Traits affecting survival to reproduction

Traits affecting reproductive success

Traits affecting survival to reproduction

Traits that allow plants to survive persist in the population while traits that impede survival are bred out over generations.

Natural conditions such as
- drought,
- level of sunlight,
- predation by herbivores, etc.

Affect which plants survive to reproduce

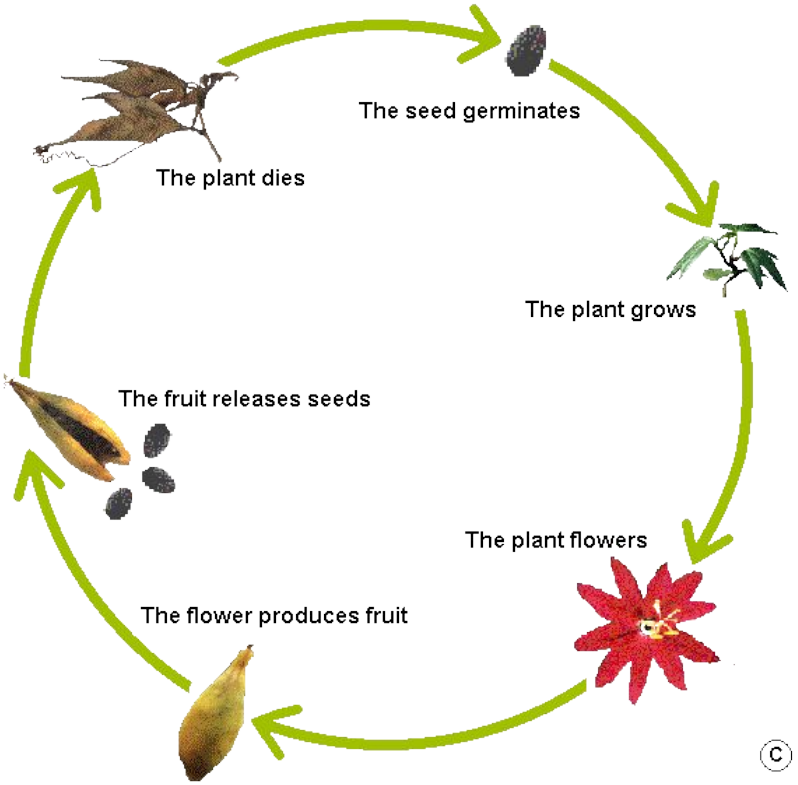

Image credit: The Seed Site

Traits affecting reproductive success

Traits that allow plants to create more offsprings

- Making more flowers
- Attracting pollinators
- Releasing seeds

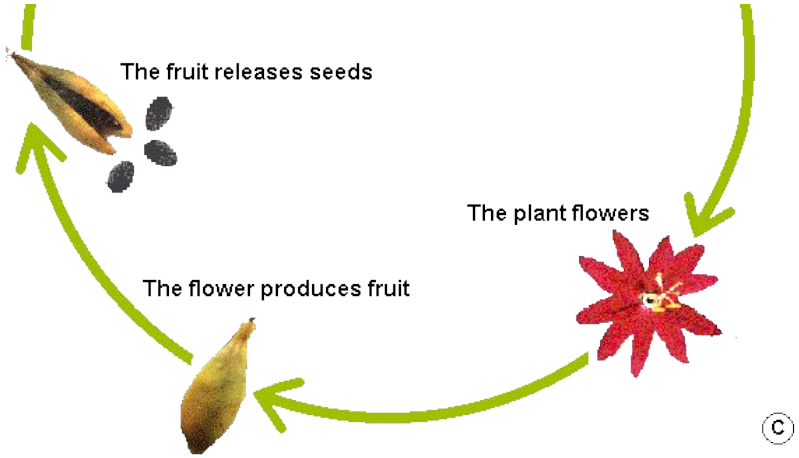

Image credit:The Seed Site

Artificial selection vs natural selection

Artificial selection follows predictable patterns genetically and phenotypically

- people are usually selecting for the same specific traits

Natural selection does not have as many predictable patterns because there are so many more environmental factors involved

- the same trait can be advantageous or disadvantageous depending on the environmental context

In domestication: clear traits and experimental populations makes studying the genes easier and helps connect genes to traits

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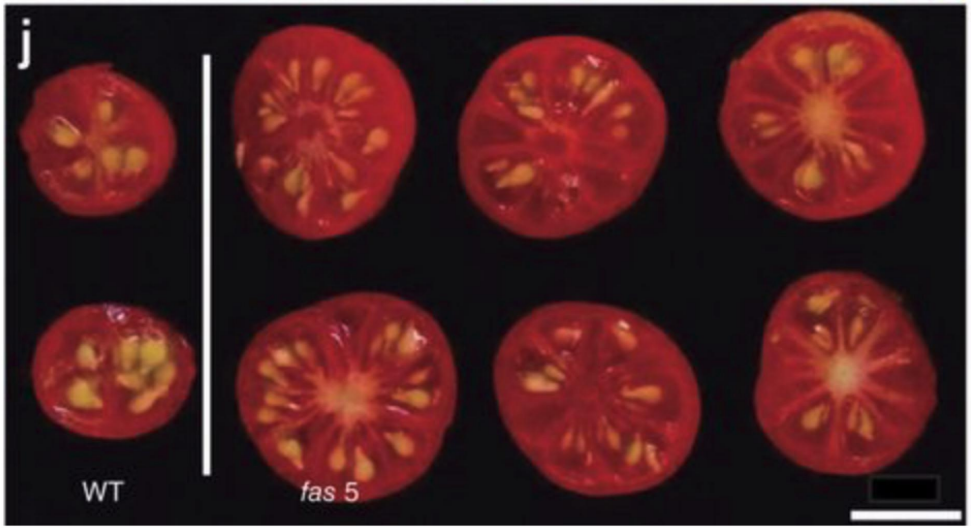
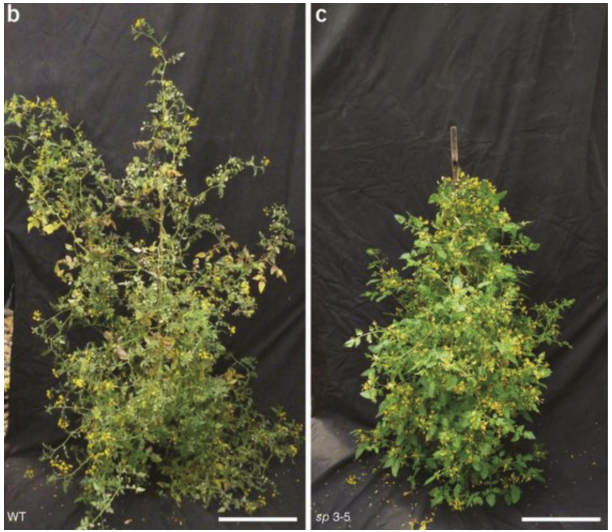
What real genes are involved in domestication?



The gene controls fruit size



The gene controls general growth habit

(Zsogon, 2018)

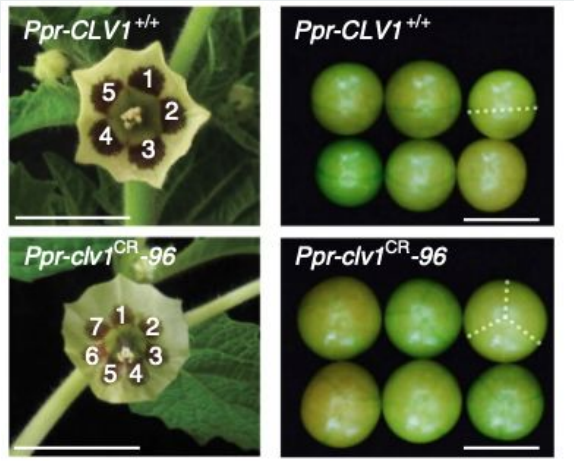
How could some of these genes be adaptive or maladaptive in a natural context?

Six loci important for key domestication traits in tomato

- General growth habit (*SELF-PRUNING*)
- Fruit shape (*OVATE*)
- Fruit size (*FASCIATED and FRUIT WEIGHT 2.2*)
- Fruit number (*MULTIFLORA*)
- Nutritional quality (*LYCOPENE BETA CYCLASE*)

(Zsogon, 2018)

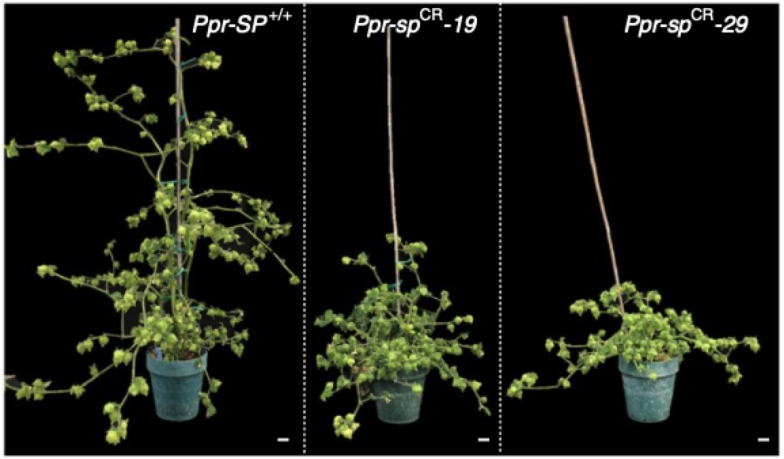
Potential of using these genes



Rapid improvement of domestication traits in an orphan crop (groundcherry) by **genome editing.**

Orphan crops, often have underdesiable characteristics resembling wild species.

Improve the genes that control plant architecture, flower reproduction and fruit size.



(Lemmon, 2018)

Thanks for your attentions