



# Asparagus Genome

From A to Z

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Presented by

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Intro to Genomics (485)

Spring 2020

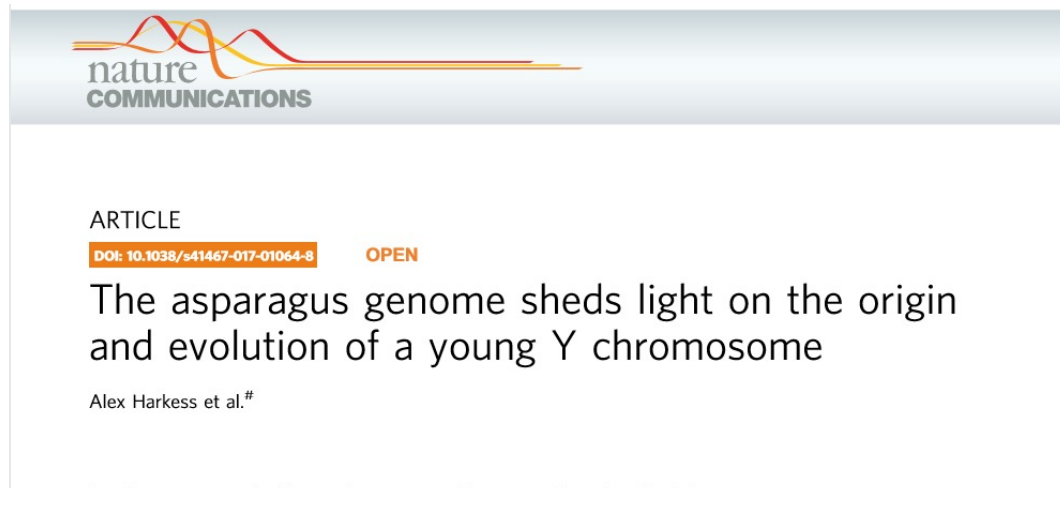


# Outline

- Genome paper
- Fun facts
- General information about the genome
- Sequencing strategy
- Sequencing methods
- Assembly
- Genome outcome
- Questions



# Genome paper



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# Fun Facts about Asparagus

- Its common name is garden asparagus, while its scientific name is *Asparagus officinalis L.*
- It is cultivated as a vegetable crop in most of Europe, northern Africa and western temperate Asia.
- Asparagus is a perennial flowering plant that can live up to 15 years.
- Newly planted asparagus will take up to 3 years to reach a harvestable level.



# Fun Facts cont'd

- Asparagus was first grown in Greece nearly 2,500 years ago. Ancient Greeks and Romans believed asparagus helped prevent bee stings and relieve toothaches.
- There is an ancient Latin phrase that was inspired by the love of Asparagus that says: "*velocius quam asparagi conquantur* ." which literally means "faster than asparagus is cooked.", it refers to anything done very quickly.
- In some parts of France, they grow the Asparagus under the soil to inhibit photosynthesis and produce **white** asparagus, which is known for its tenderness and delicate flavor.



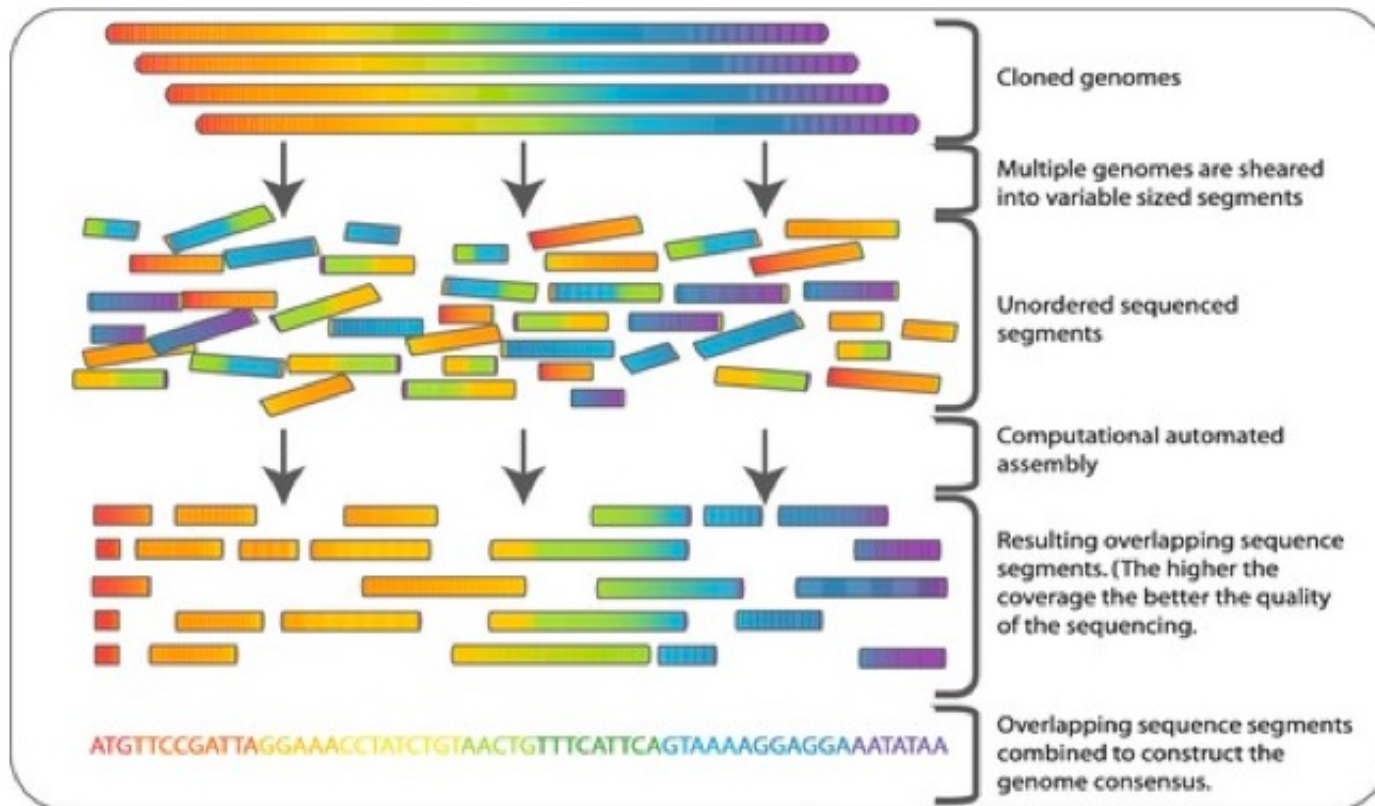
# General Information about the genome

- The genus *Asparagus* includes just over 200 species and the majority of them are hermaphrodites. However, ***Asparagus officinalis*** is dioecious, meaning that it has separate plants holding male flowers and female flowers, but sometimes hermaphrodite plants can be found. We will discuss this in the genome outcome.

Number of chromosomes	10
Genome copy number	2n
Genome size	1.32 Gb
Genome chemical identity	DNA
Genome physical architecture	linear

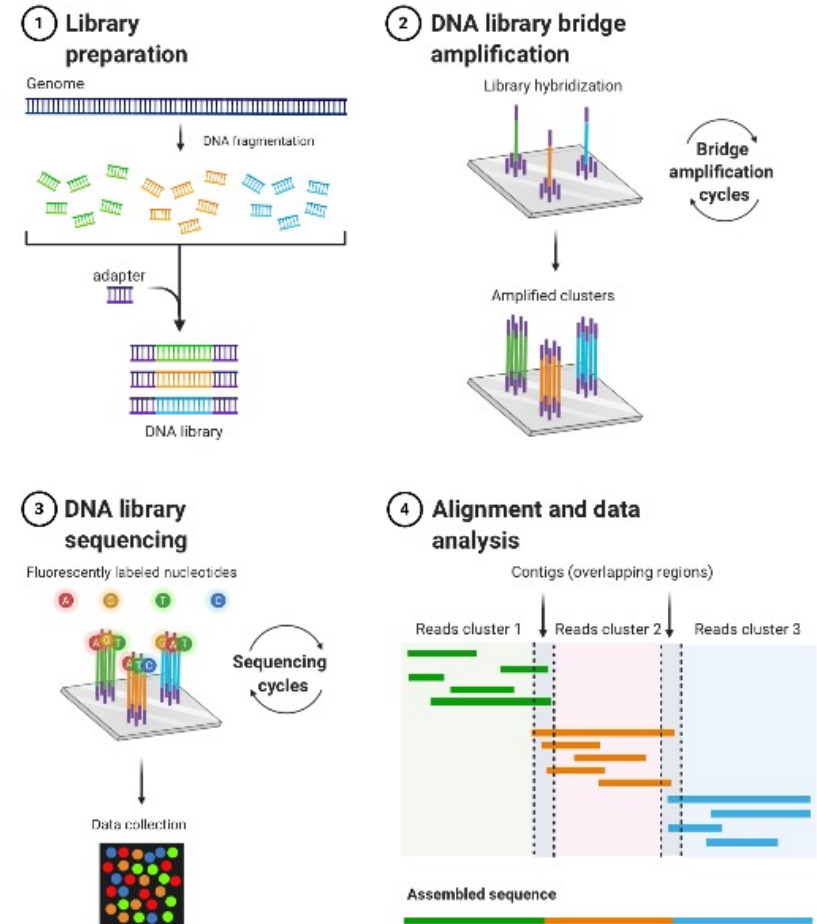
# Sequencing Strategy

- Whole genome shotgun sequencing strategy has been used in my paper.



# Sequencing Methods: Illumina

- **Illumina**: it is a sequencing method by **synthesis** and its detection method is **imaging**. It depends on terminating the chain synthesis by adding labeled dNTPs one type at a time.





# Sequencing Methods: PacBio

- **PacBio**: Pacific biosciences' single molecule real-time AKA SMRT, is a sequencing method by synthesis that uses labeled nucleotides but does not terminate the chain synthesis.
- PacBio is sensitive enough to sequence a single DNA molecule so we don't really need amplification of the DNA fragment.
- Whenever a labeled nucleotide is added to the complementary strand by polymerase, the fluorescent label is released giving a signal that can be detected through a movie (75 frame/second).
- It produces longer reads in shorter periods of time in comparison to illumina. However, it has a much higher error rate of 10-15%.

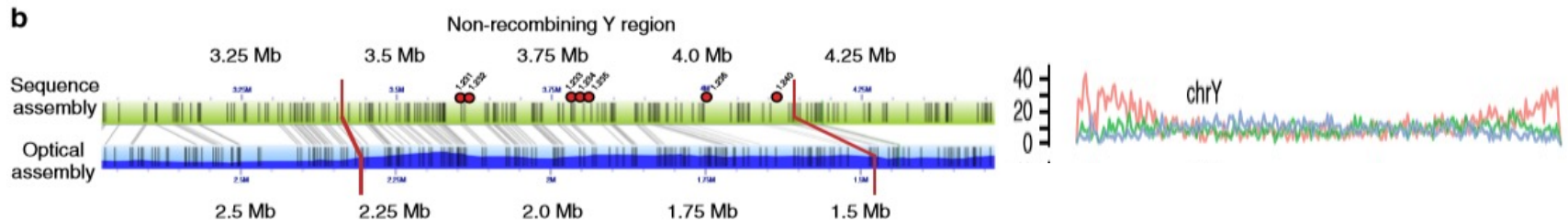
# Assembly

- SOAPdenovo and SSPACE were used.
- The genome size is 1.32 Gb

	Coverage/depth	N50 contig	N50 scaffold	GC%
<b>Illumina</b>	123.32X	21.12 Kb	301.04 Kb	-
<b>PacBio</b>	4.6X	88.16 Kb	303.52 Kb	39%

# Genome Outcome

- ***Asparagus officinalis*** is a dioecious plant despite the fact that most species that belong to *asparagus* genus are hermaphrodite. In this paper they discuss how sex chromosomes evolved from autosomal chromosomes and how can hermaphroditism appear in a dioecious plant.
- They found out that the evolution of an active Y chromosome involved at least two linked genes. One that suppresses female function, named SOFF. And another one that is essential for male function (TDF1) which is missing from X chromosome.
- They identified the sex determining region (non-recombining) that contains the sex determining genes on the Y chromosome which was largely hemizygous (Y-specific).



# Genome Outcome

- Experimental mutants were generated through cobalt-60 gamma irradiation and the following conclusions were drawn:
- **Male to female conversion** was due to the deletion of the whole non-recombining region of the Y chromosome including the SOFF and the TDF1 genes.
- **Male to hermaphrodite conversion** was due to a single base pair deletion in a coding exon of the SOFF female suppressor gene resulting in a frameshift mutation and a premature stop codon.



# Questions

- What causes the conversion of *Asparagus* from male to hermaphrodite?
- What genes are responsible for the evolution of an active Y chromosome?

