

Genetics and Genomics

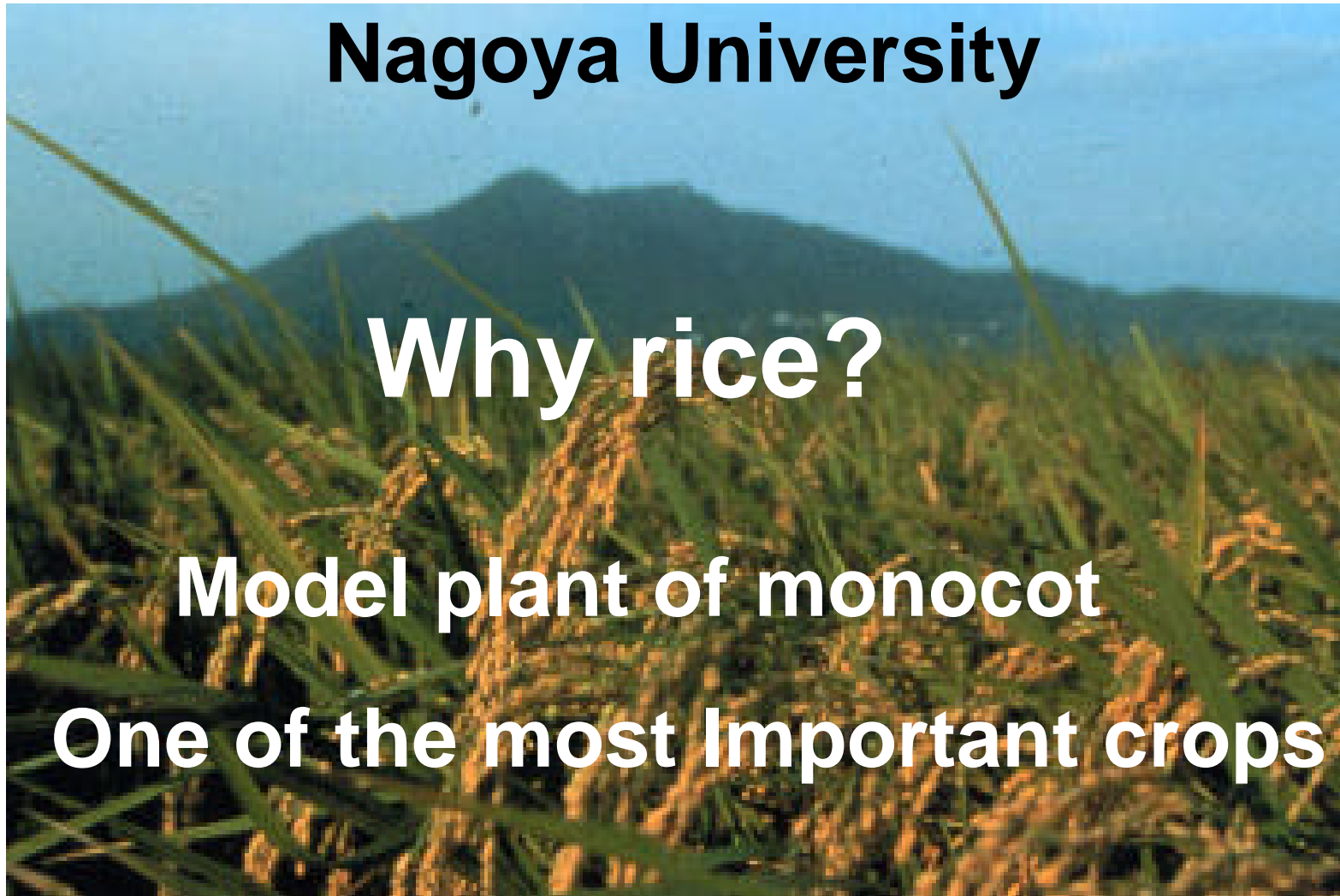
Motoyuki Ashikari

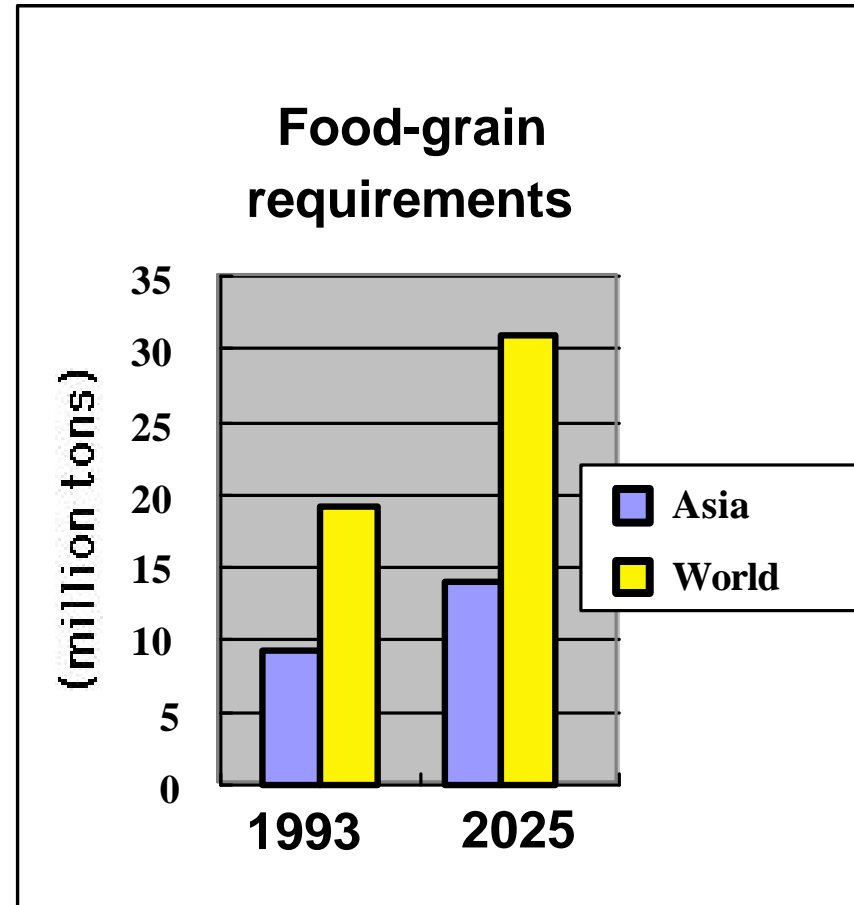
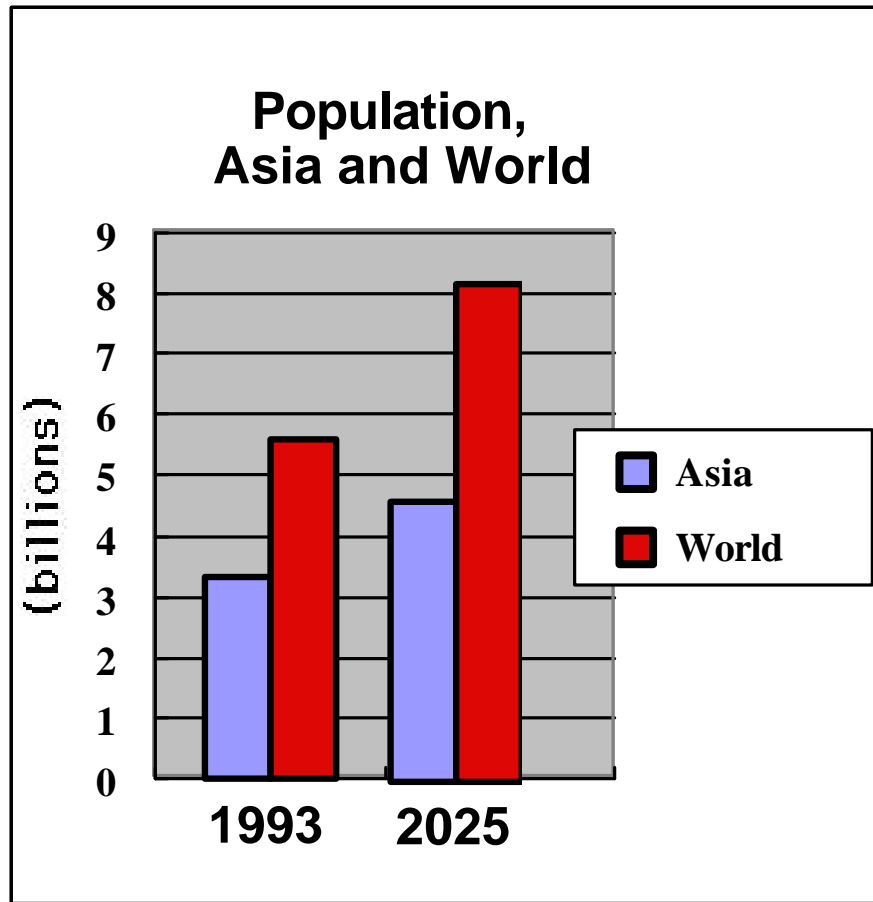
Nagoya University

Why rice?

Model plant of monocot

One of the most important crops

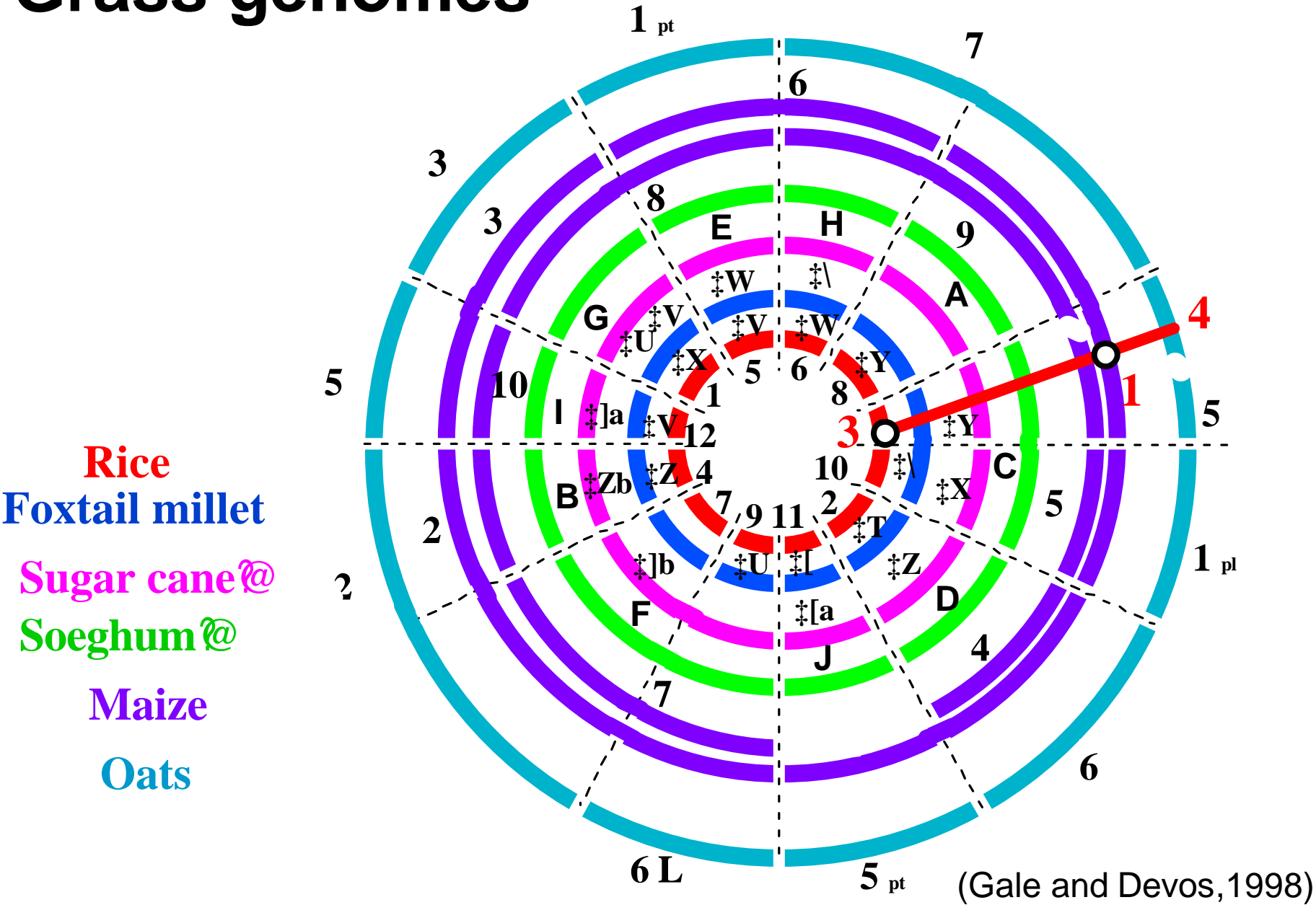




**80 million people are increasing a year, An annual growth rate is 1.4 %
 90 % of this increasing occurring in the developing countries in Asia and Africa
 Require**

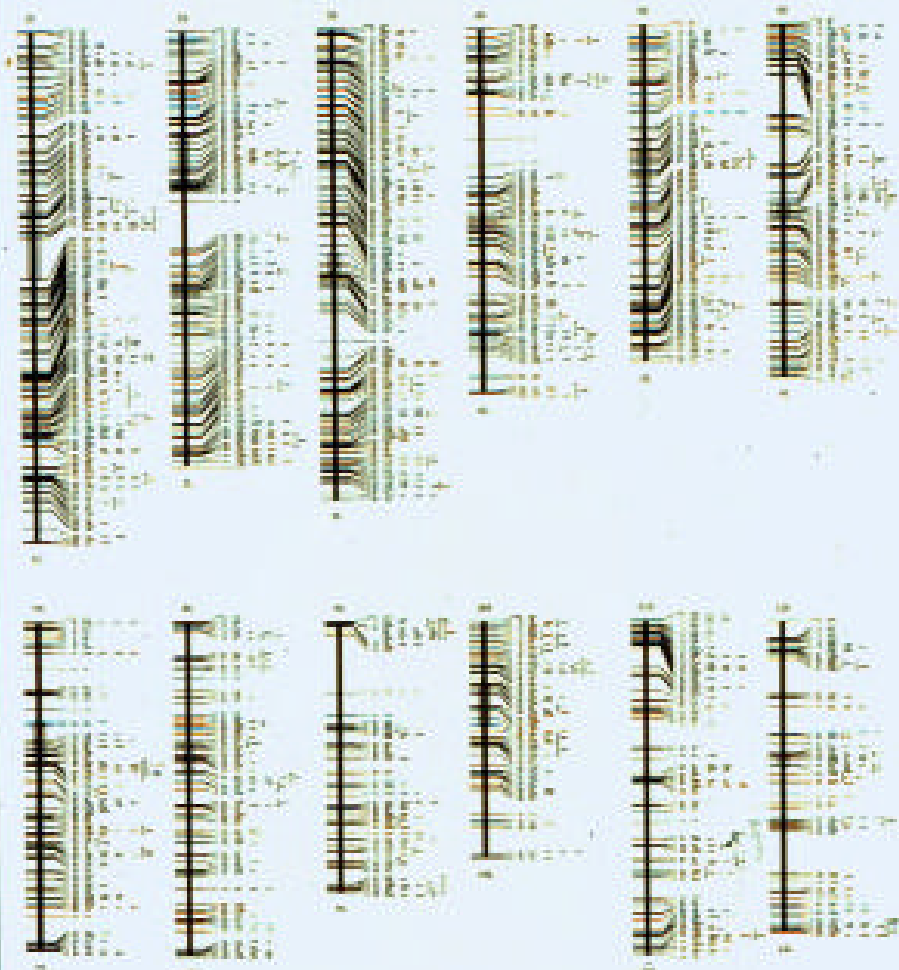
**World food grain production must increase by 50 % until 2025.
 An expansion in world grain production of 26 million tons per year.**

Grass genomes





RFLP Linkage map



An RFLP Linkage Map of Rice 9603

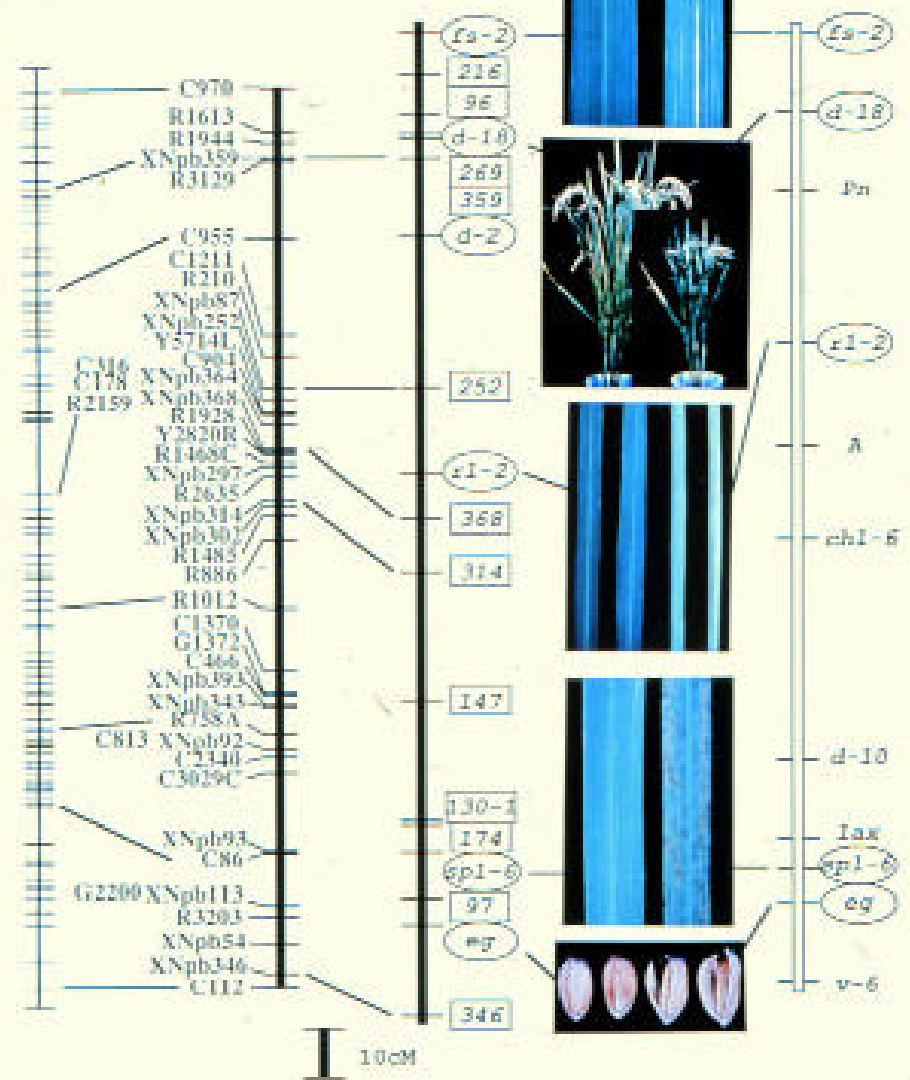
for Genetic Research Program

IRRI/STAFF



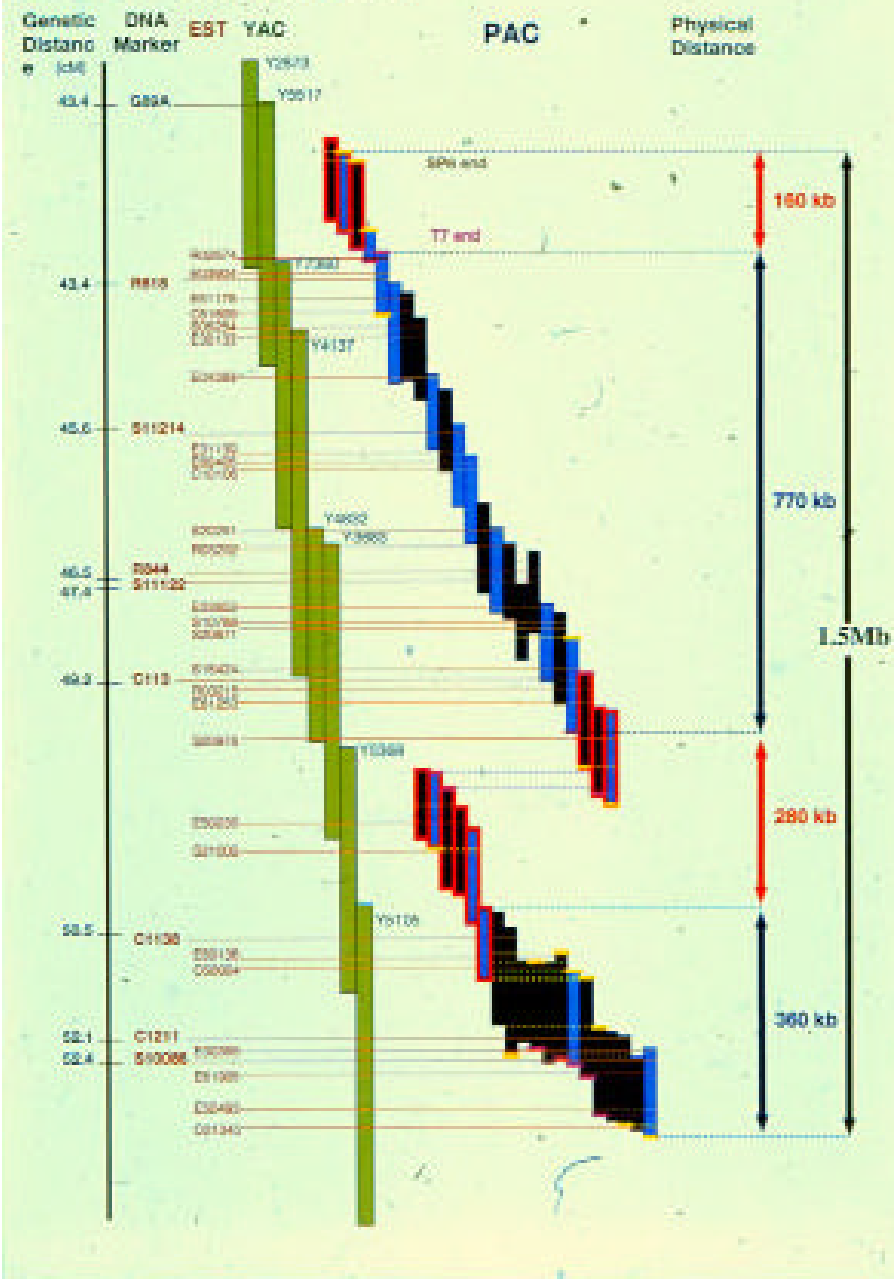
Integrated map

Chromosome 1

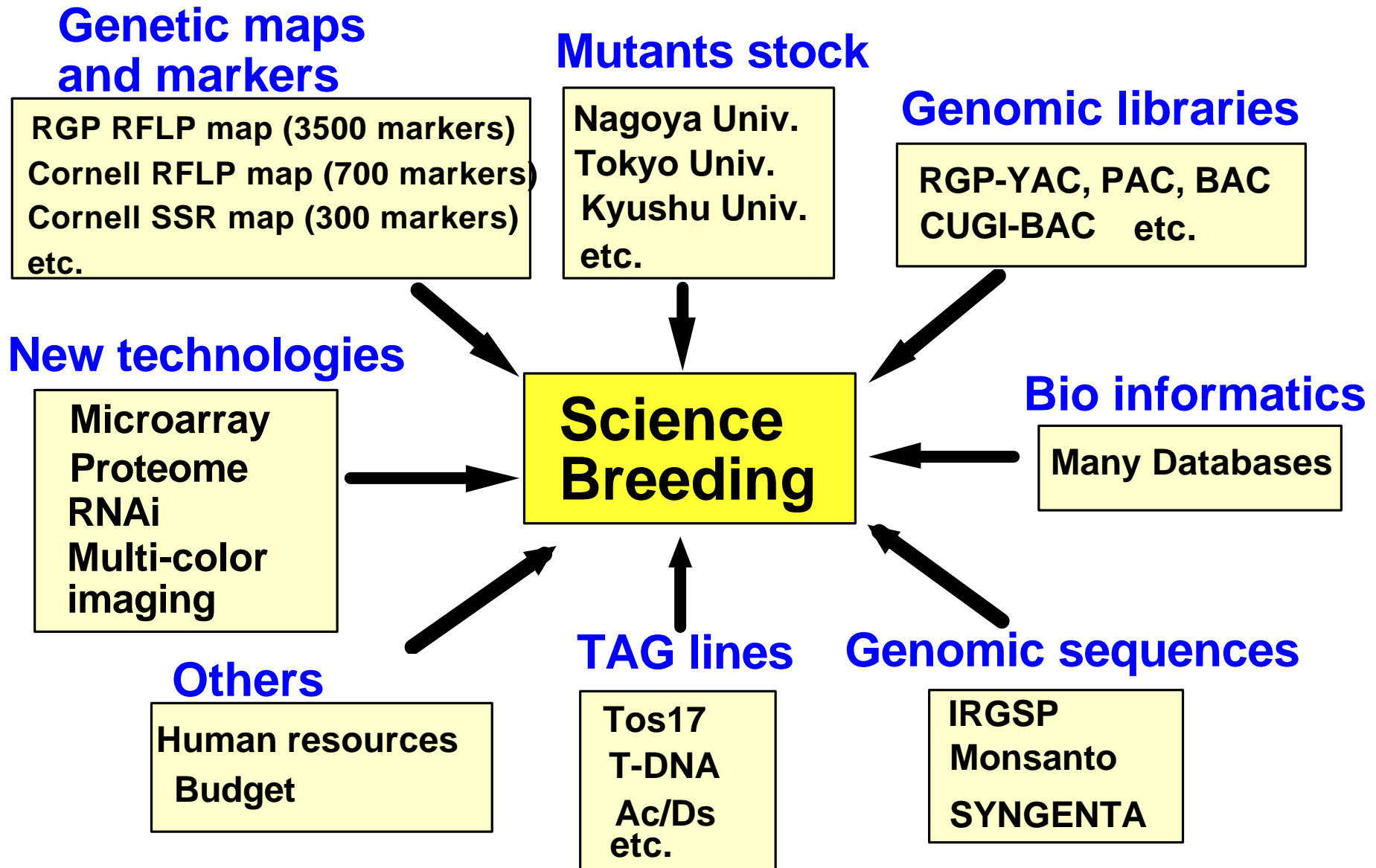


RGP map RI map Integrated map Classical map

RGP Chromosome 1



Rice genomic tools for Science and breeding



Genetics and Genomics

Motoyuki Ashikari

- 1. Basic genetics ; linkage**
- 2. Genomics; application for science
(Mapping and cloning genes)**
- 3. Application for breeding**

Mendelian laws; Mendelism

1. Law of segregation

2. Law of independence

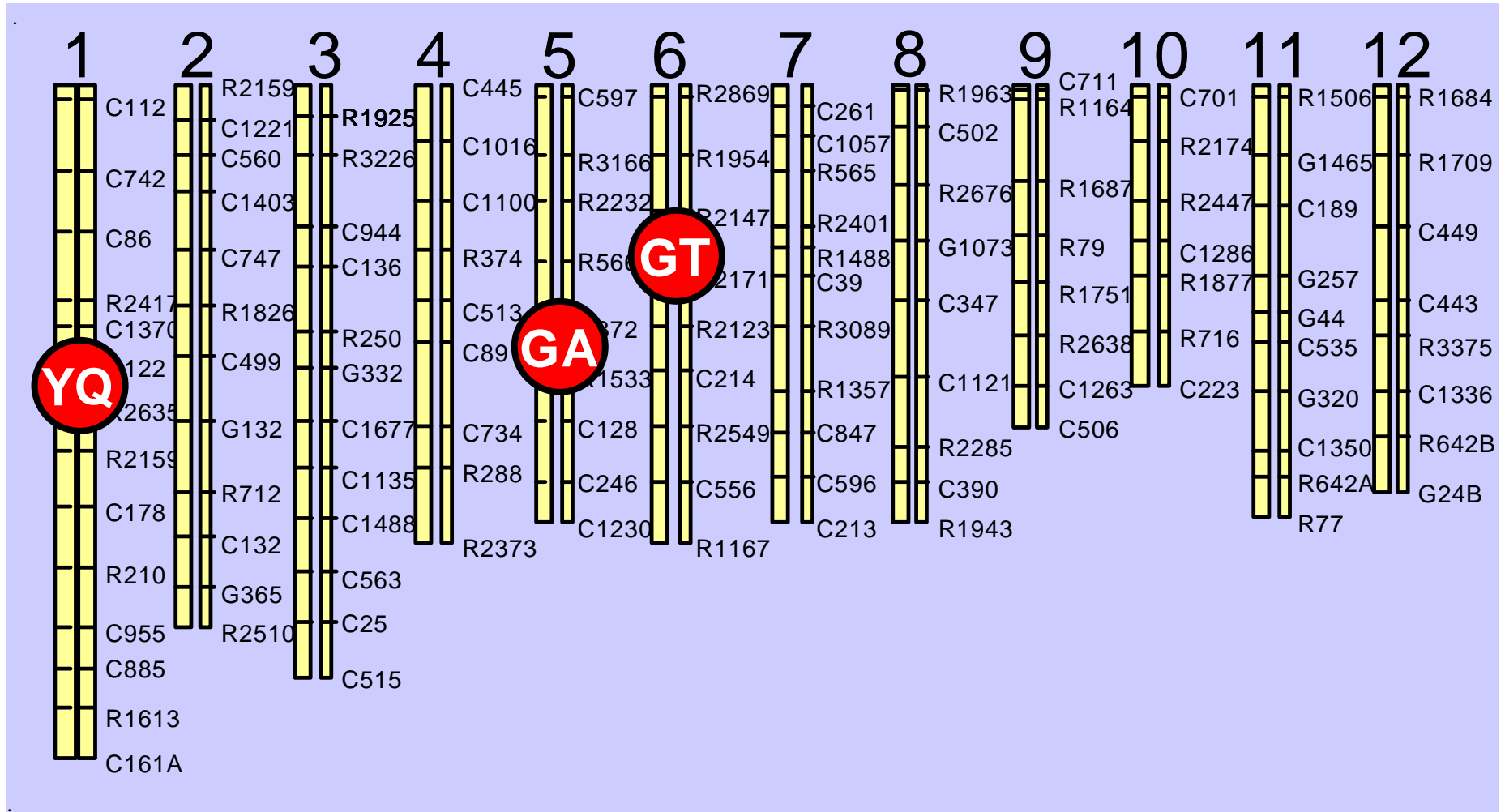
3. Law of dominance



Science and Breeding

Linkage analysis

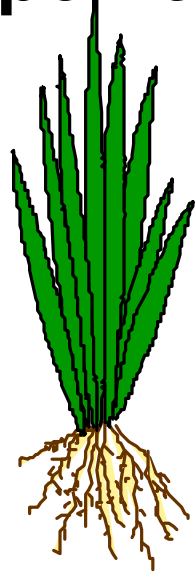
Rice chromosomes



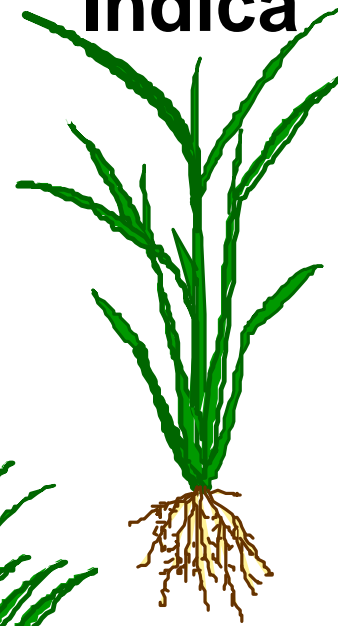
Crossing : Japonica and Indica

Japonica

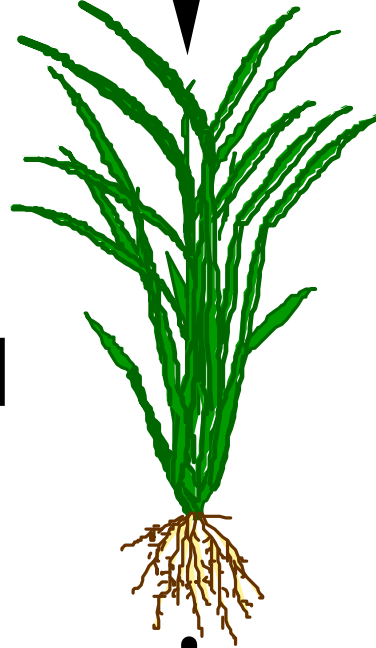
Indica



X



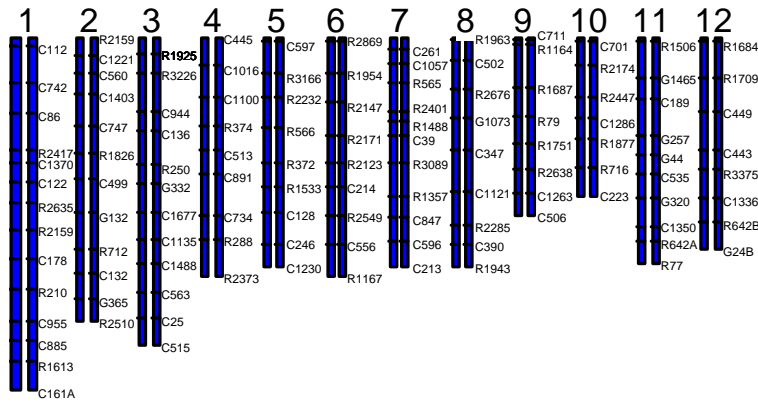
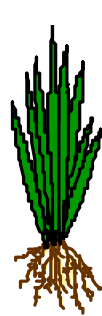
F1



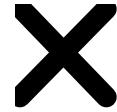
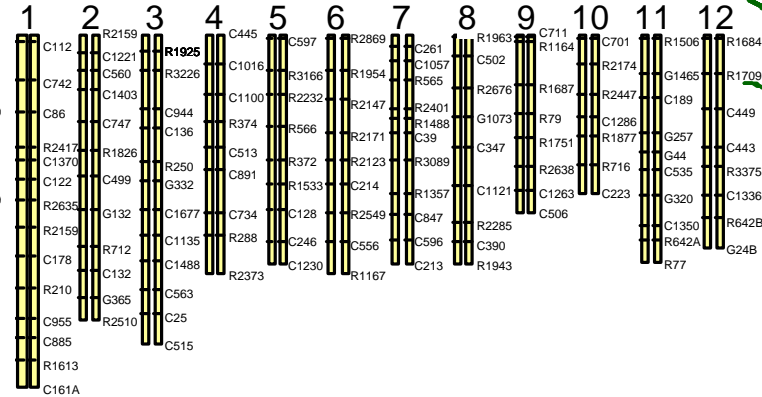
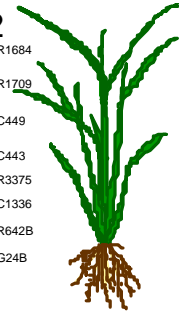
Self

Crossing (graphical genotype)

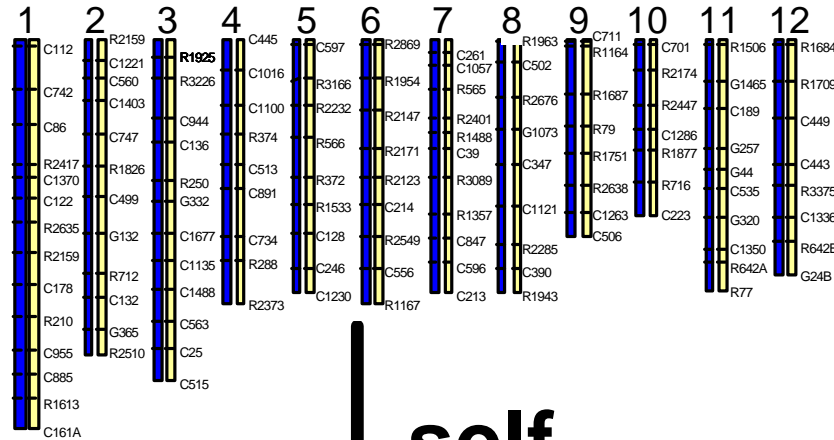
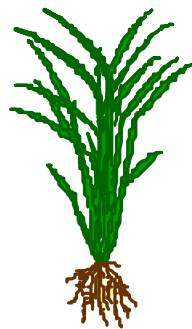
Japonica



Indica

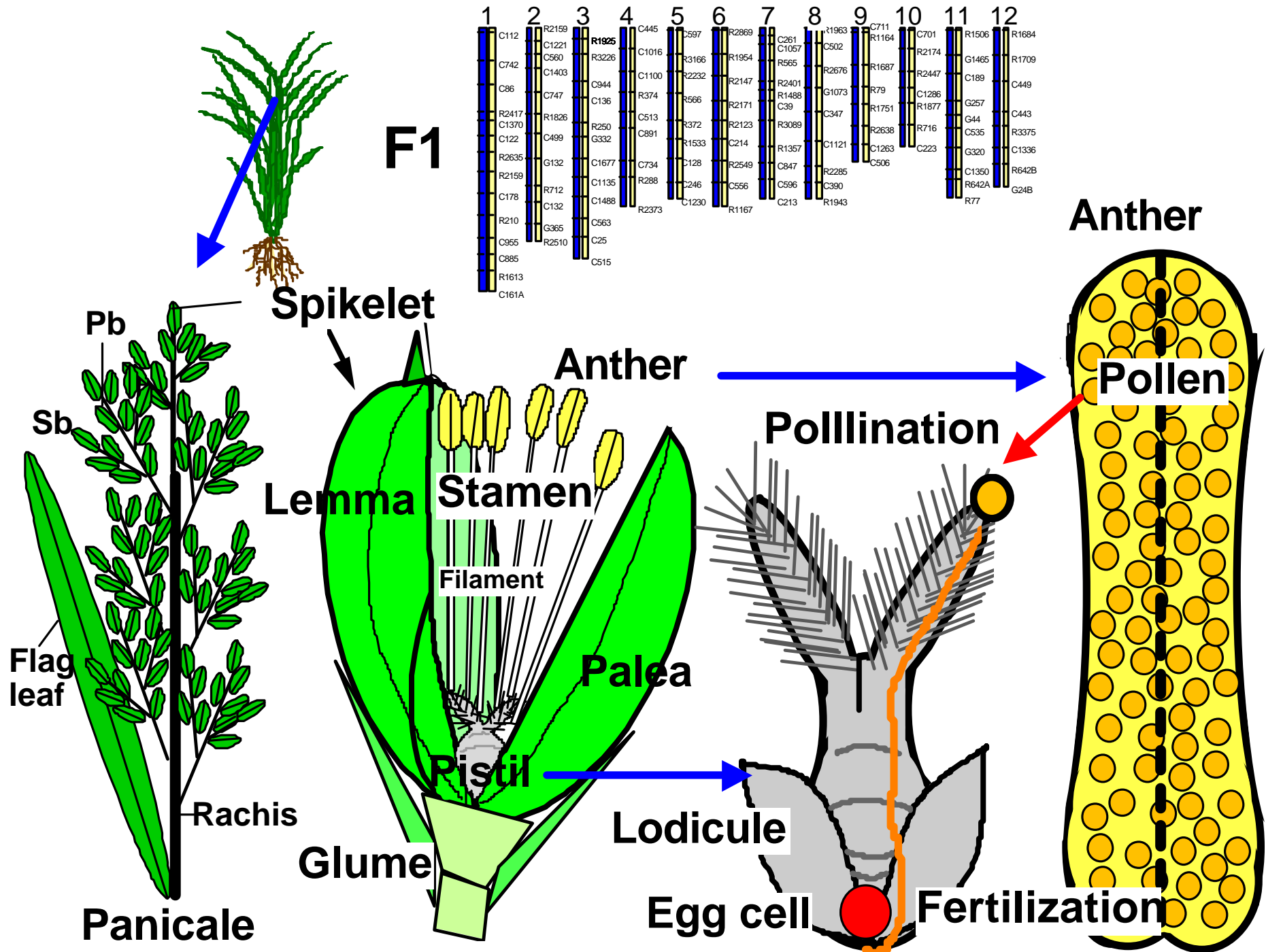


F1



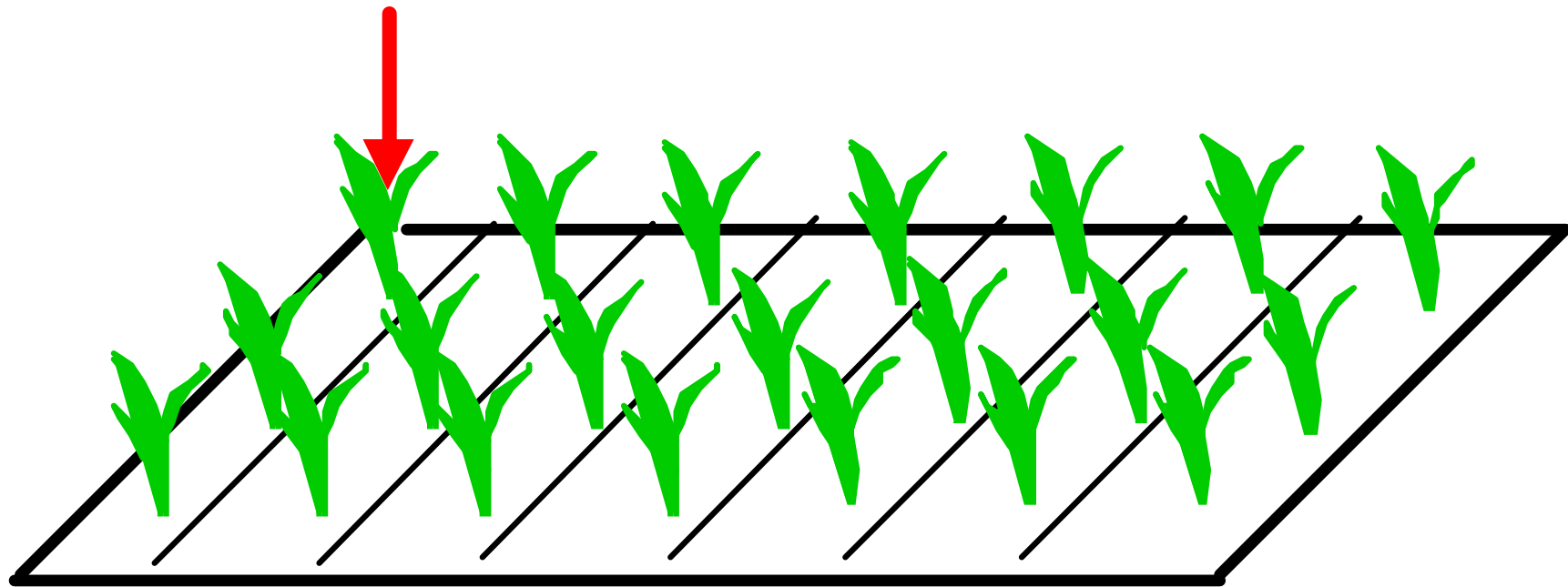
self





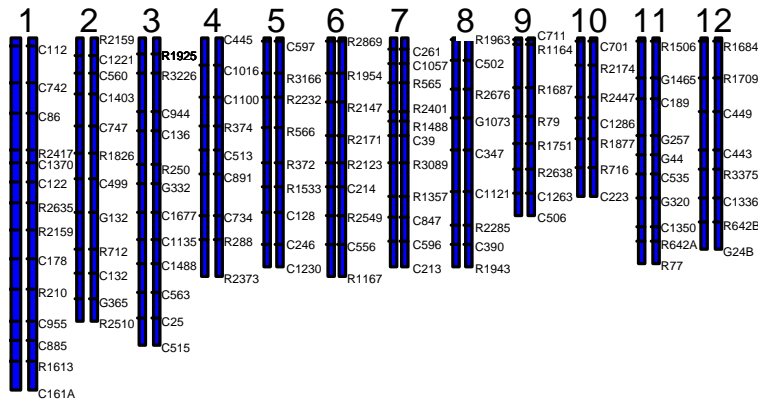
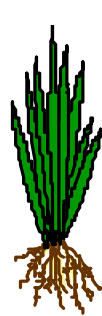
F₂ plants derived from the F₁ self fertilization

What kind of genotypes in F₂ plants

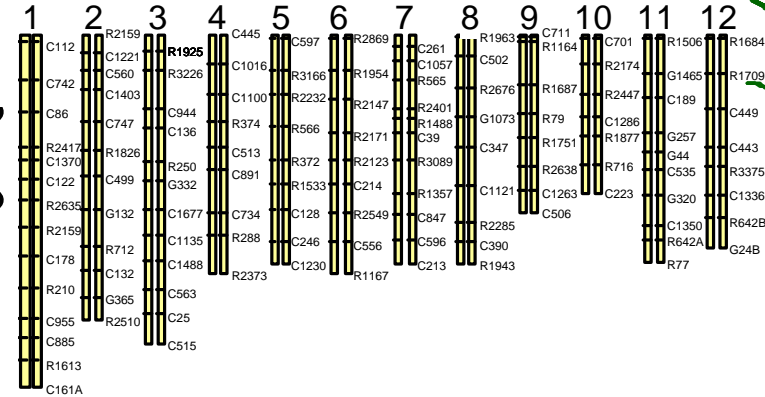
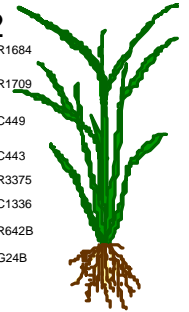


Crossing (graphical genotype)

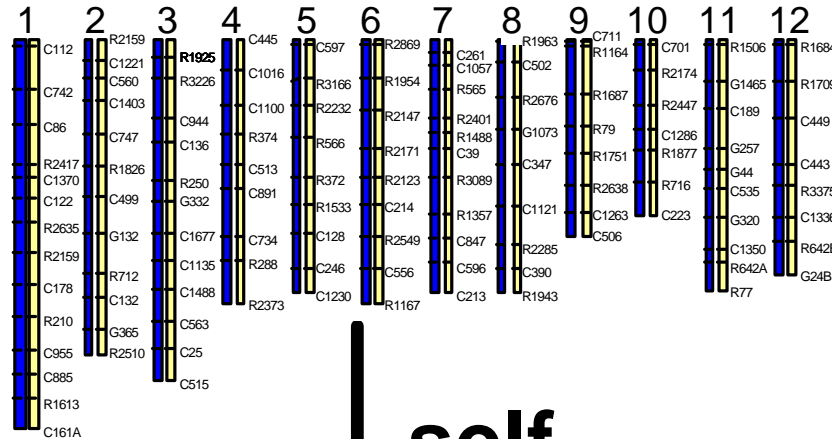
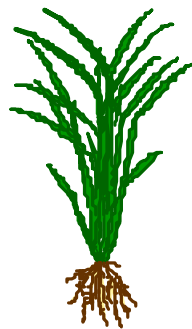
Japonica



Indica

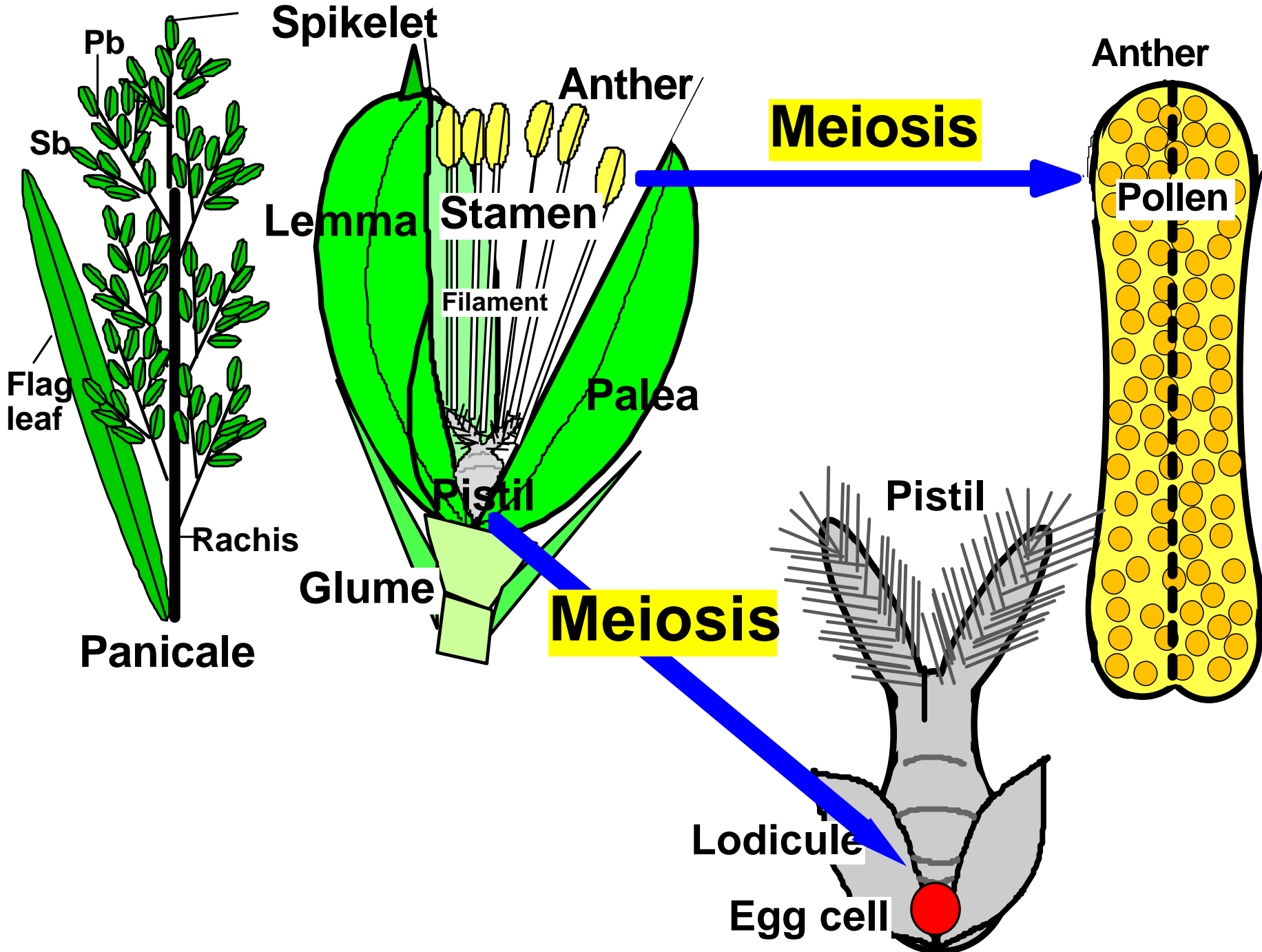


F1

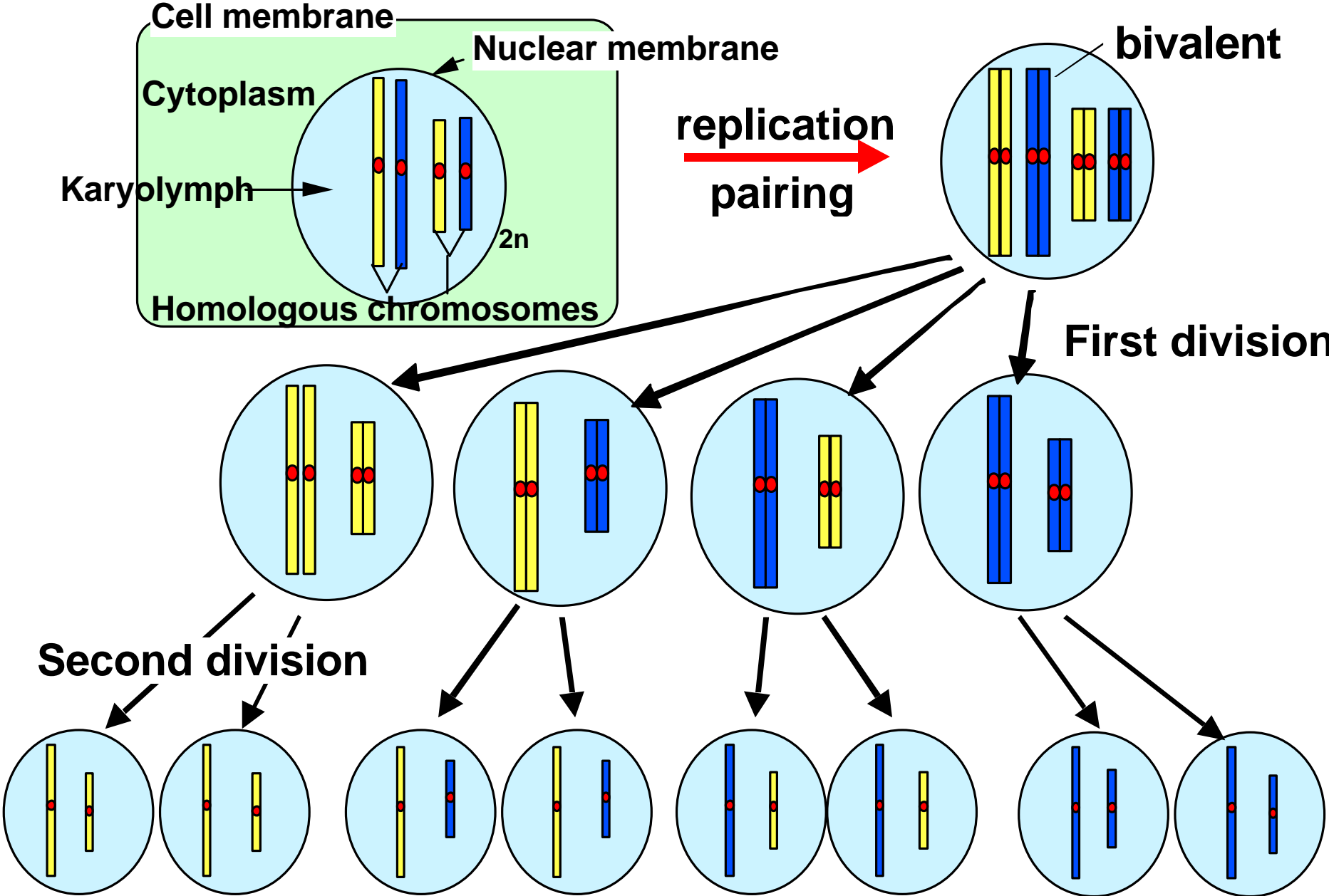


self

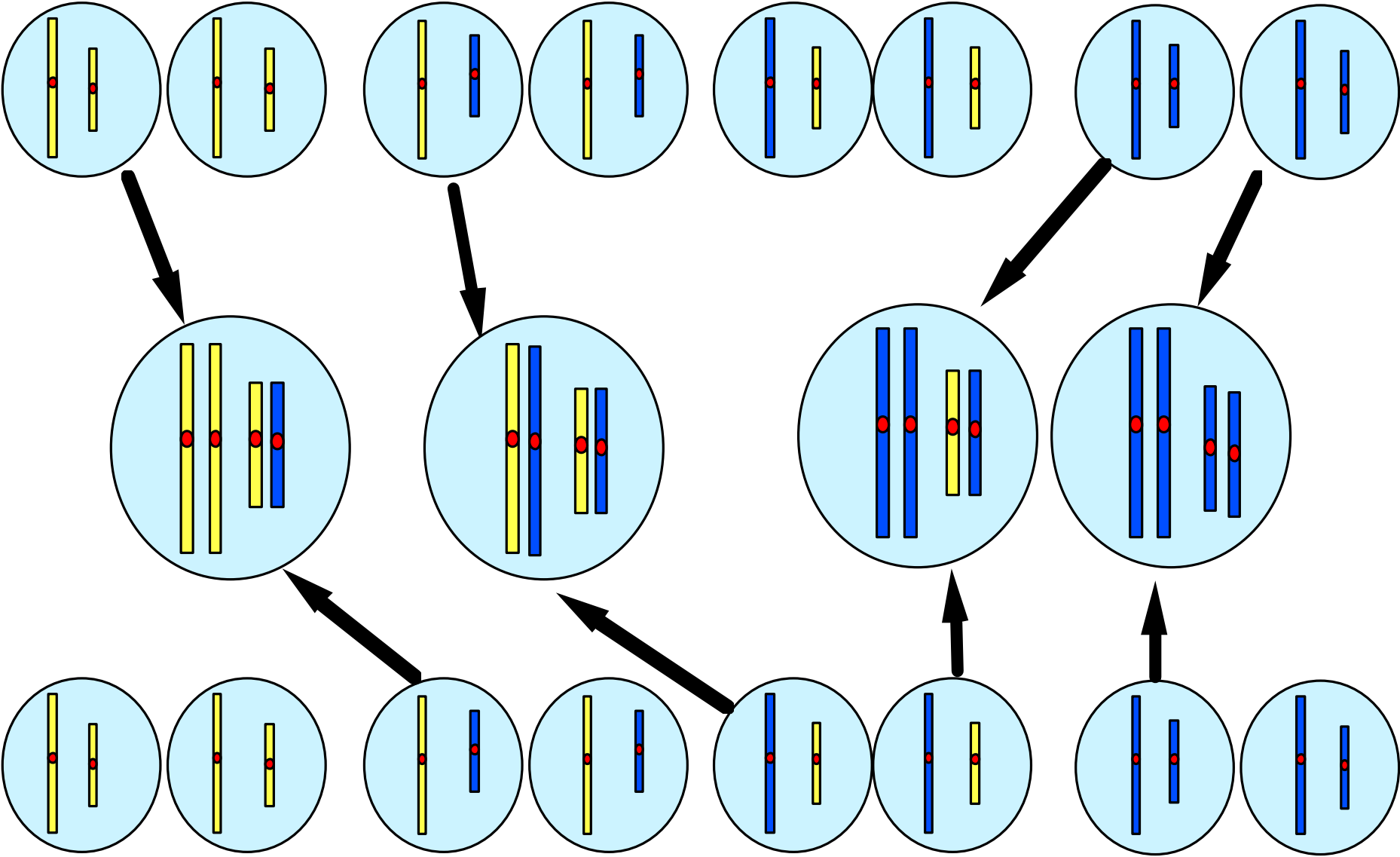




Cell division - meiosis

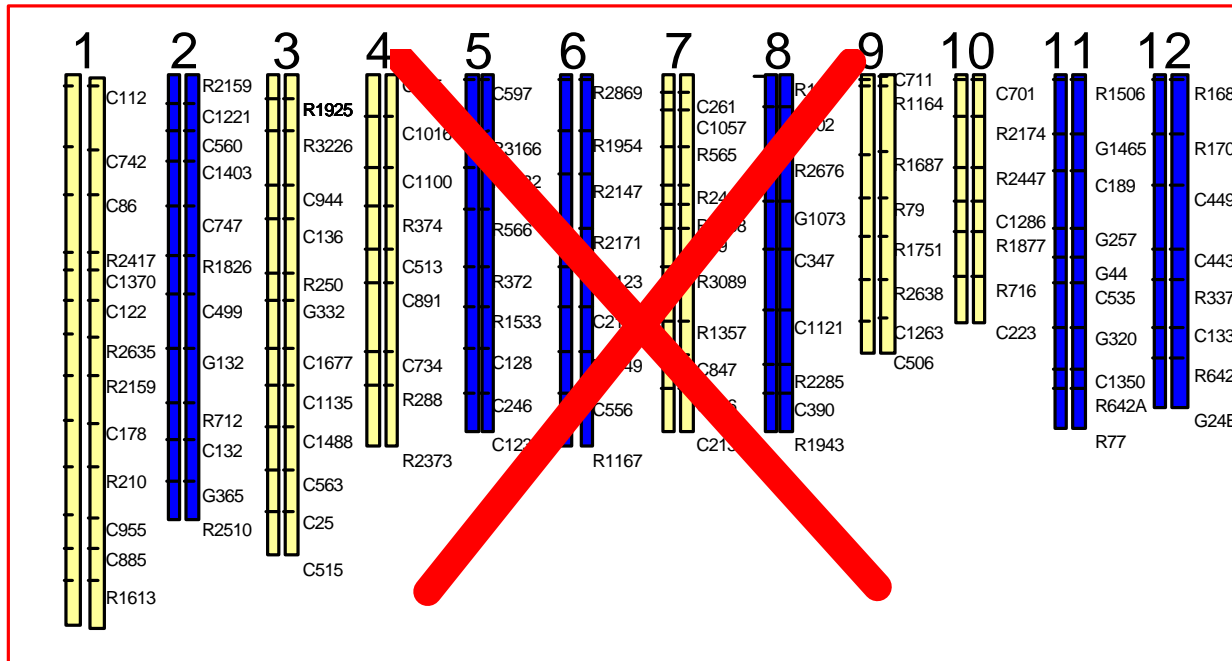


Gametes of pollen



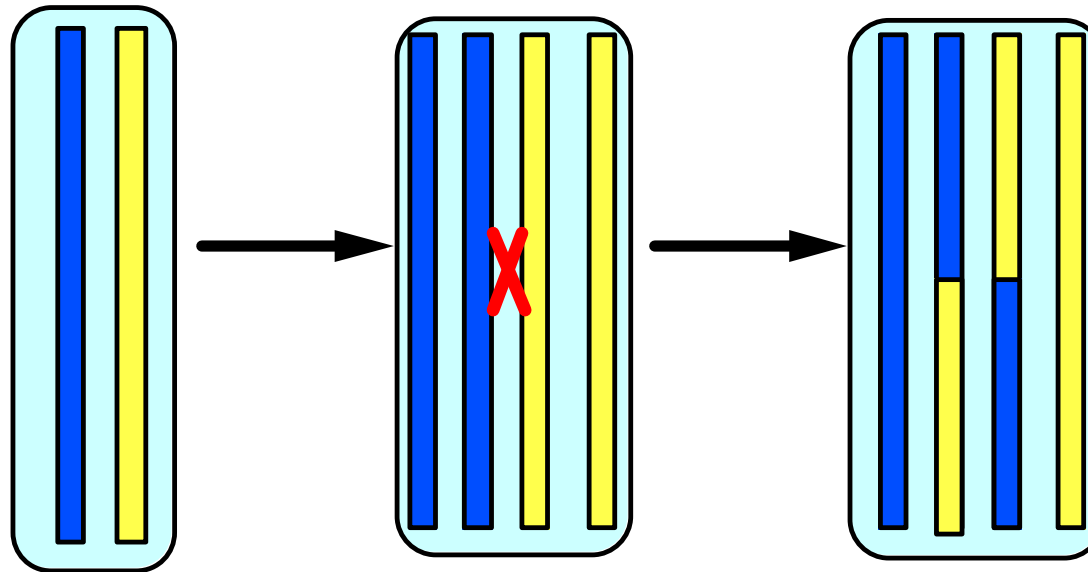
Gametes of embryo cell

Graphical genotype in F₂ plant

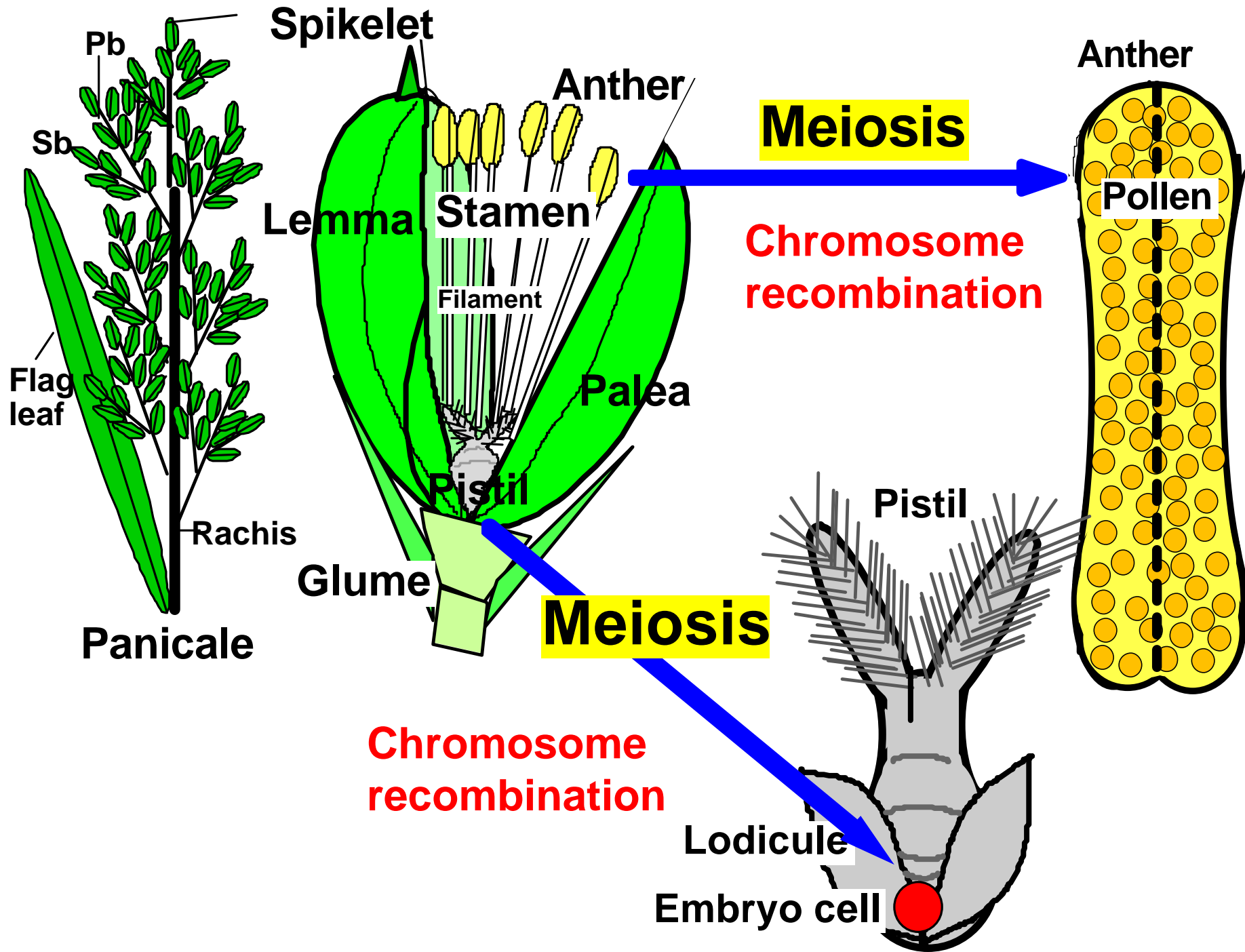


Why not ?

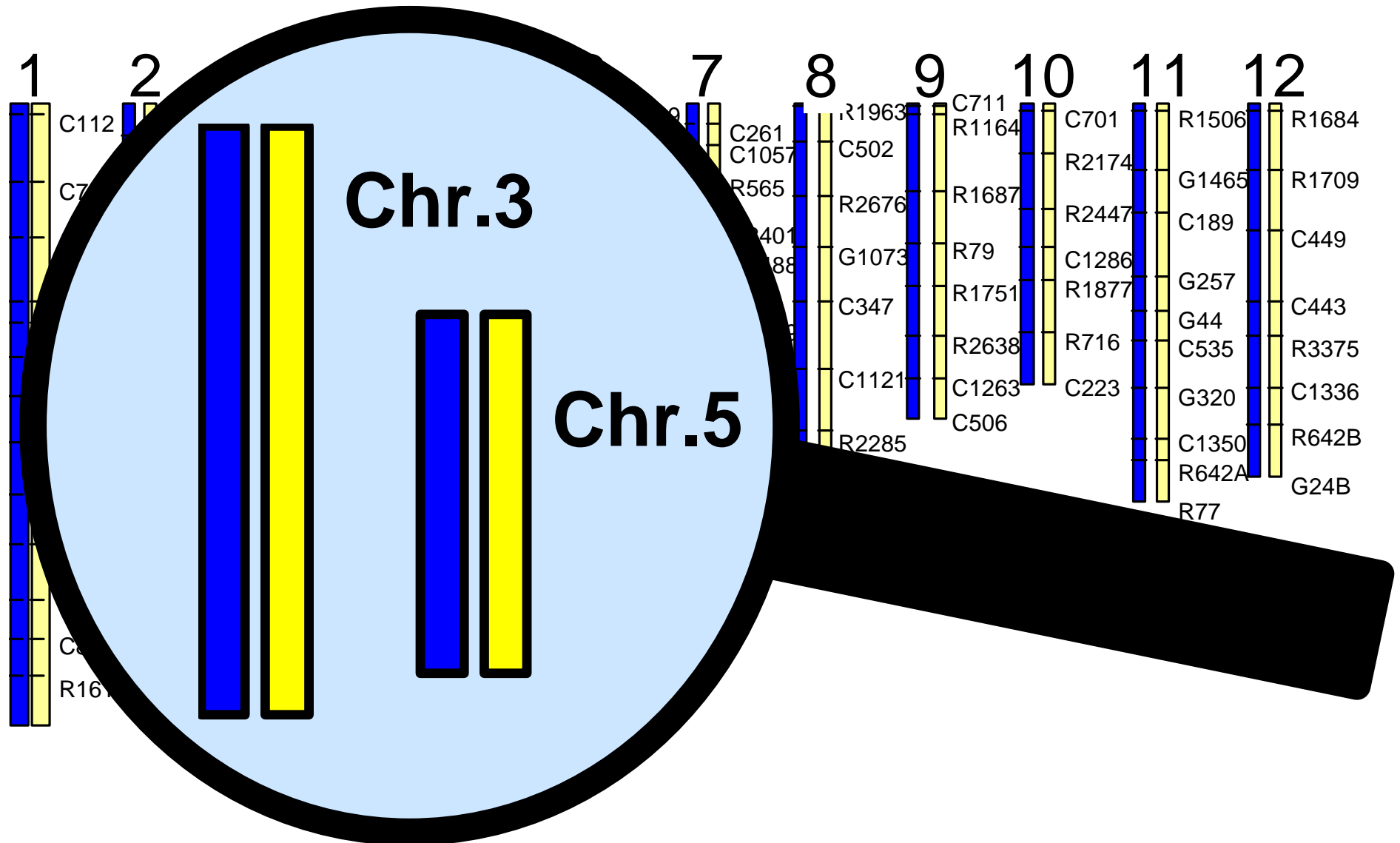
Because of chromosome recombination



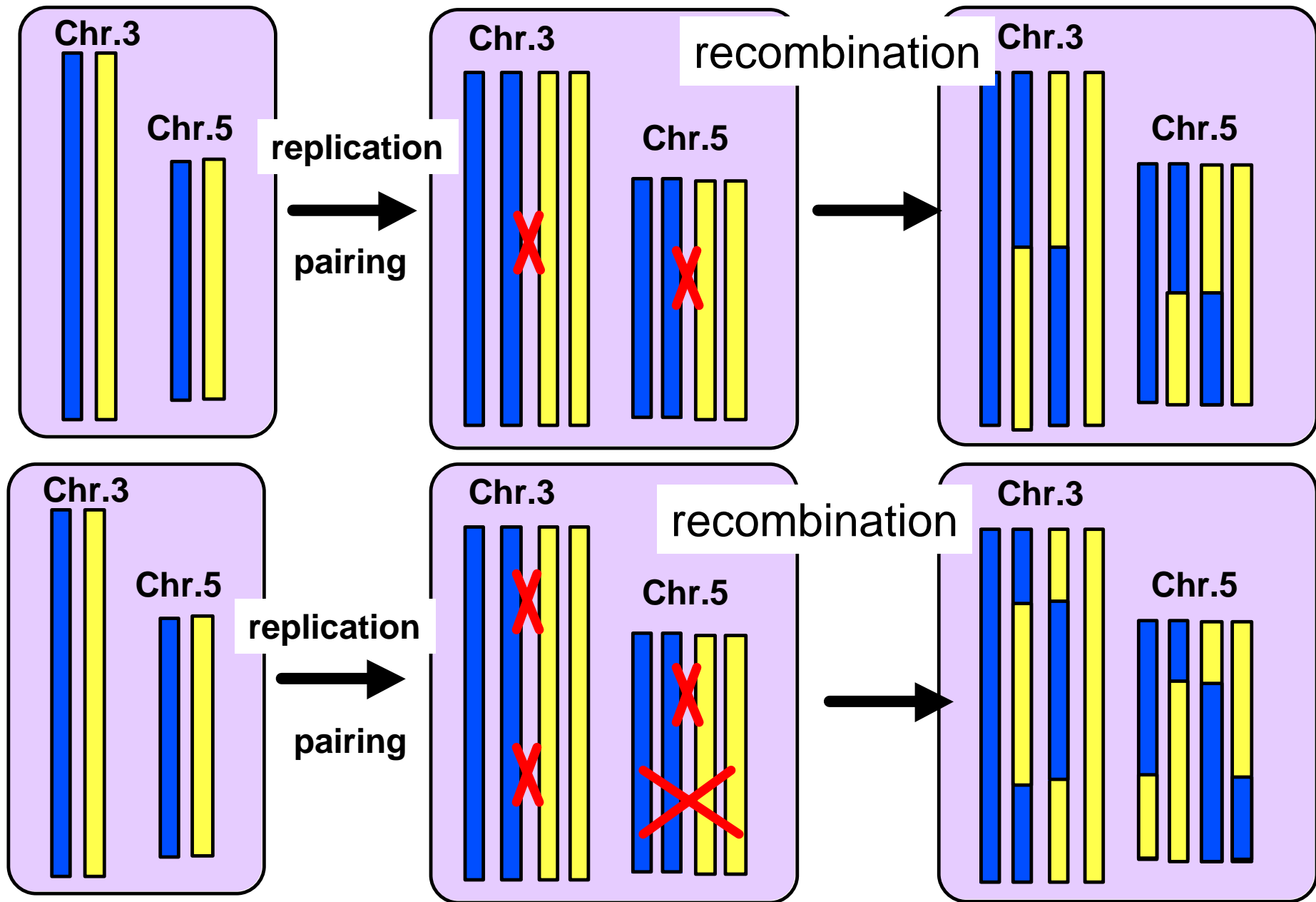
**You understand chromosome recombination,
you can do apply anything: Cloning genes, QTL analysis,
Maker assisted selection and so on.**



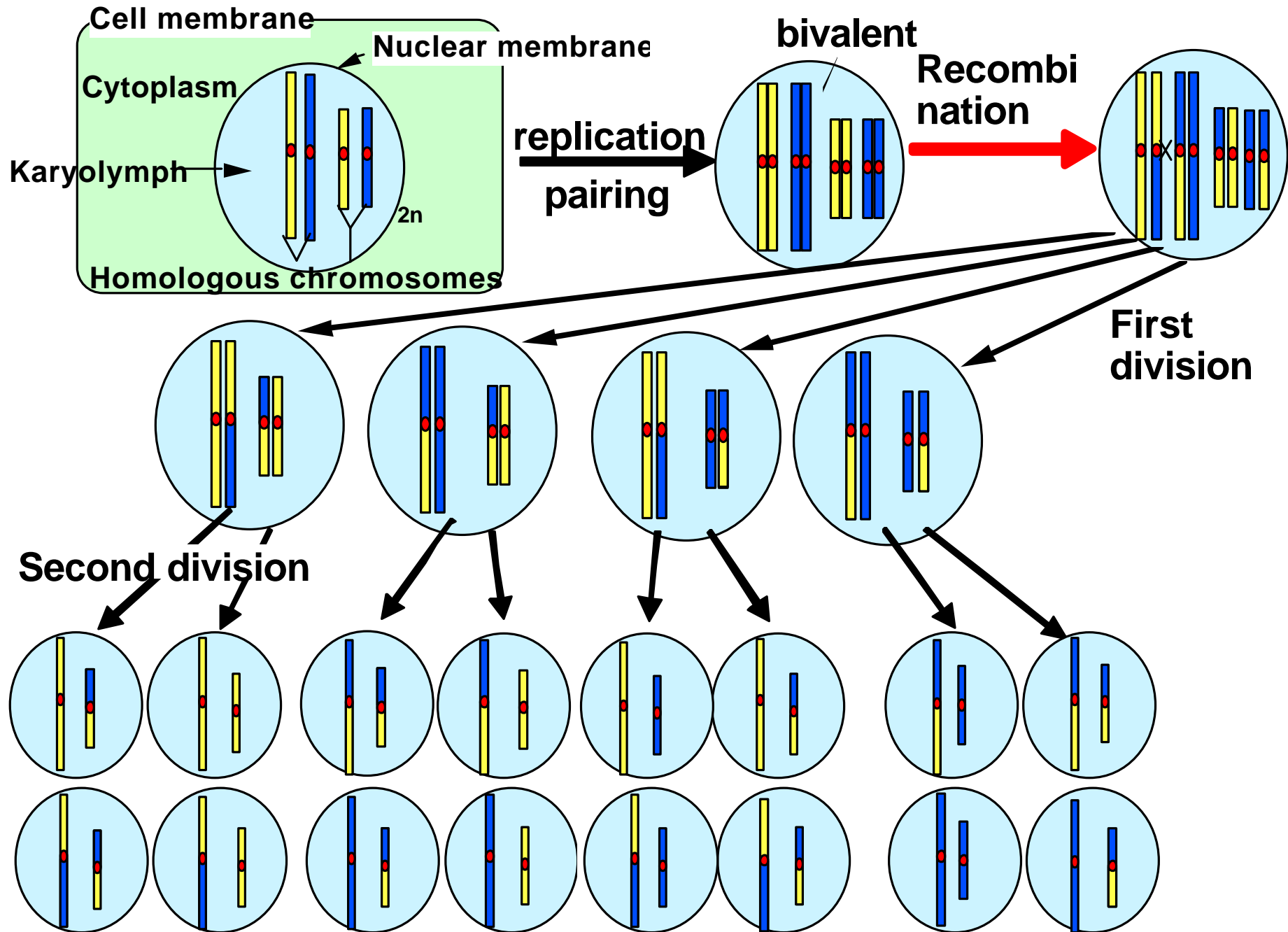
Graphical genotype in F1 plant

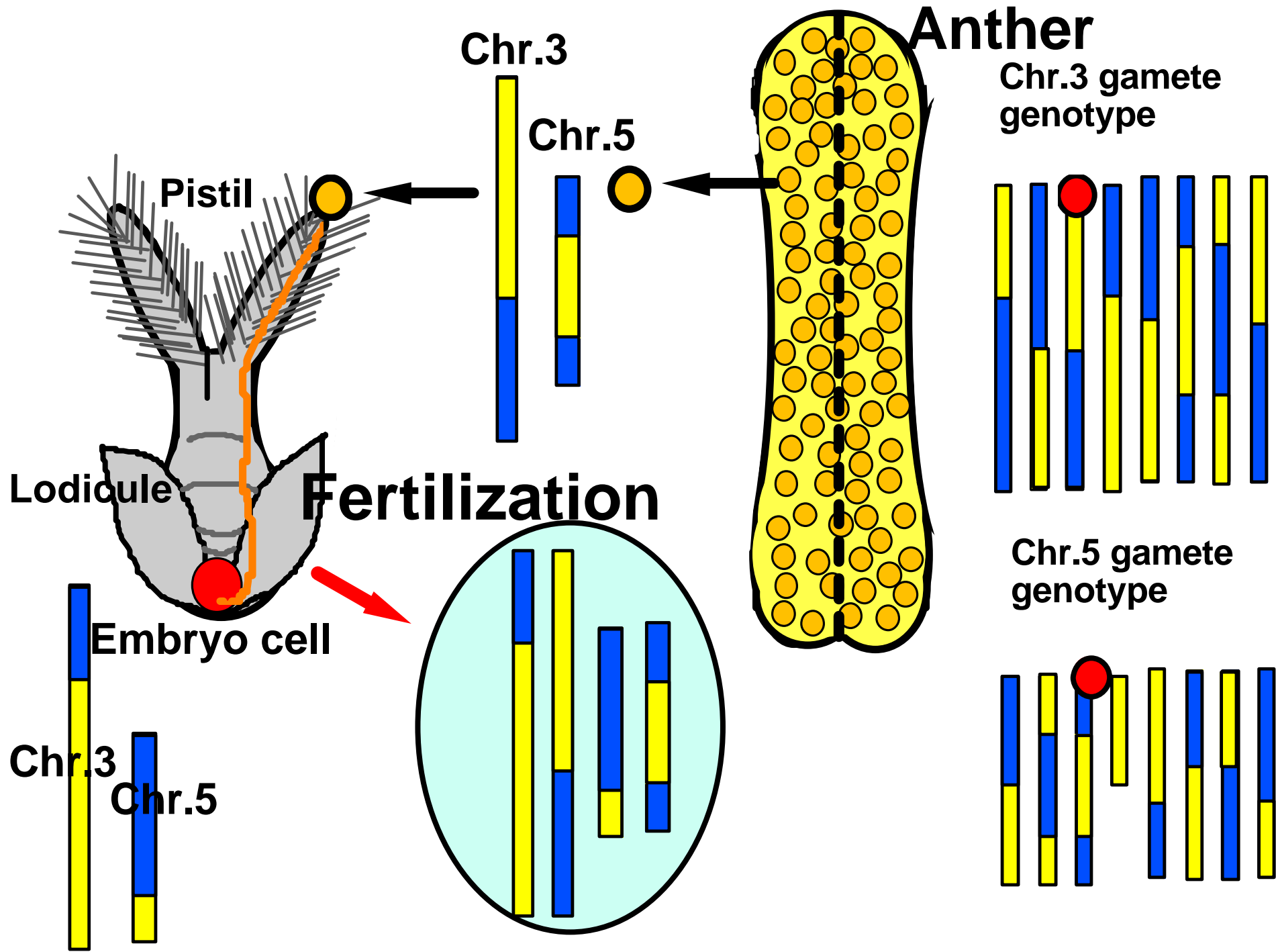


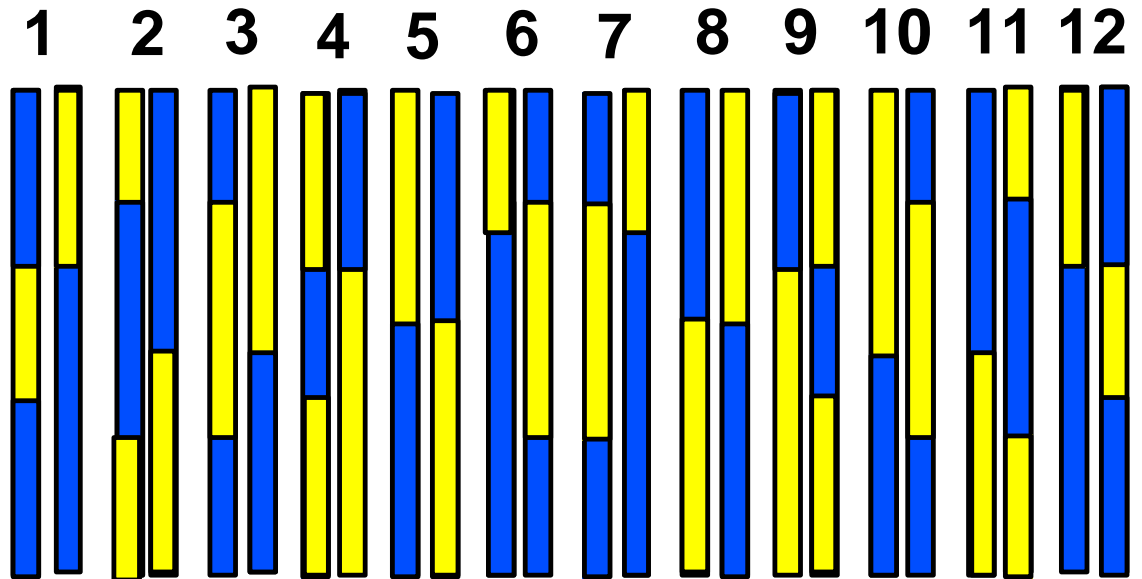
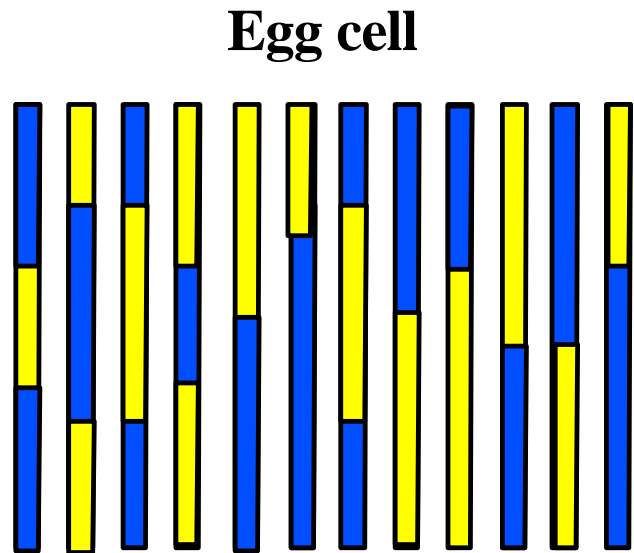
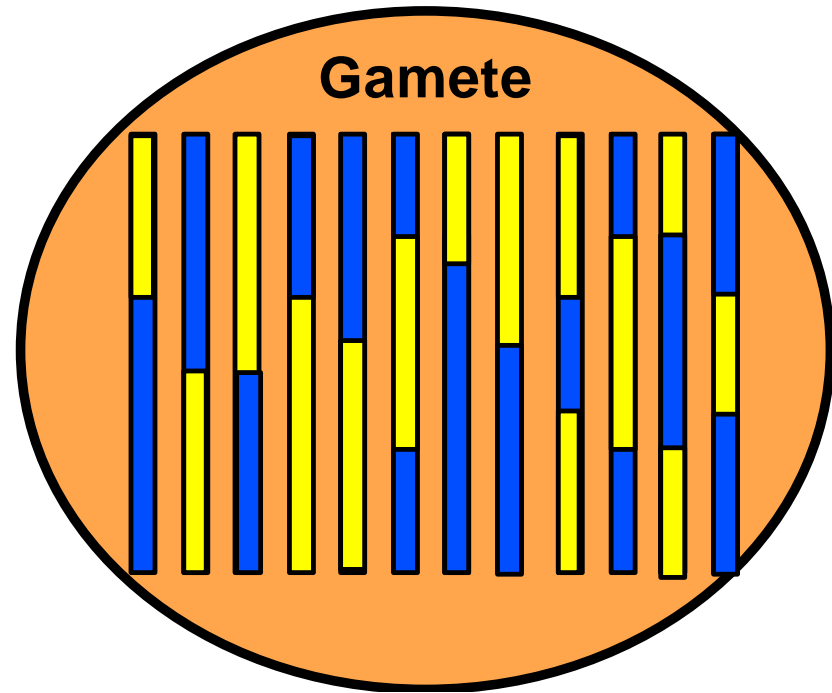
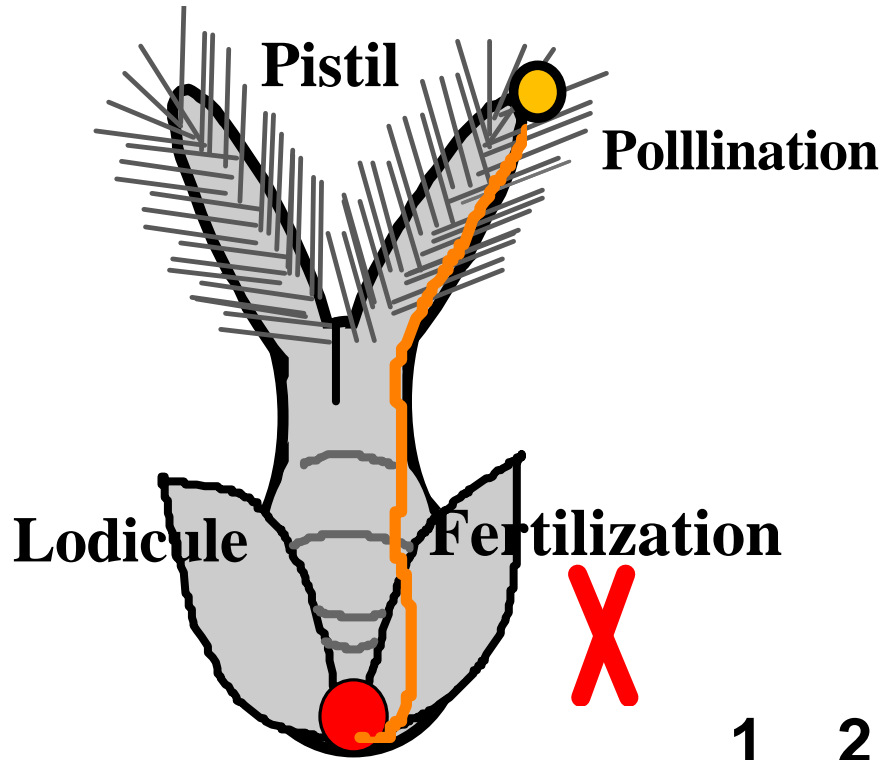
Scheme of chromosome recombination in meiosis



Cell division - **Recombination** in meiosis

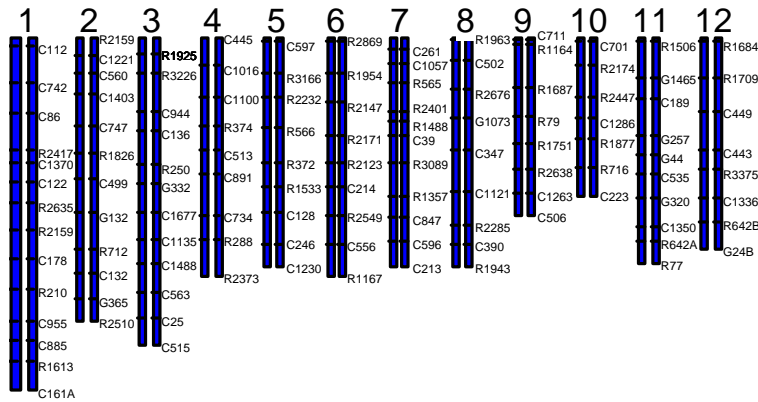
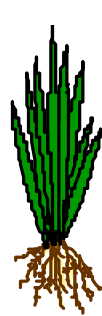




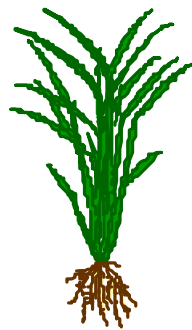
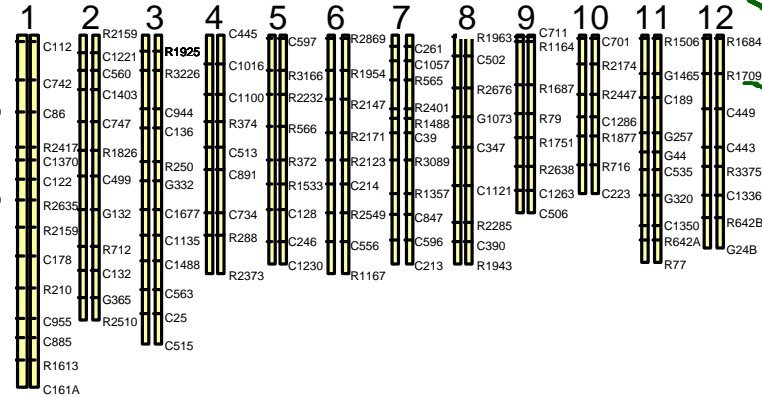
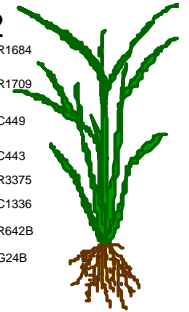


Crossing (graphical genotype)

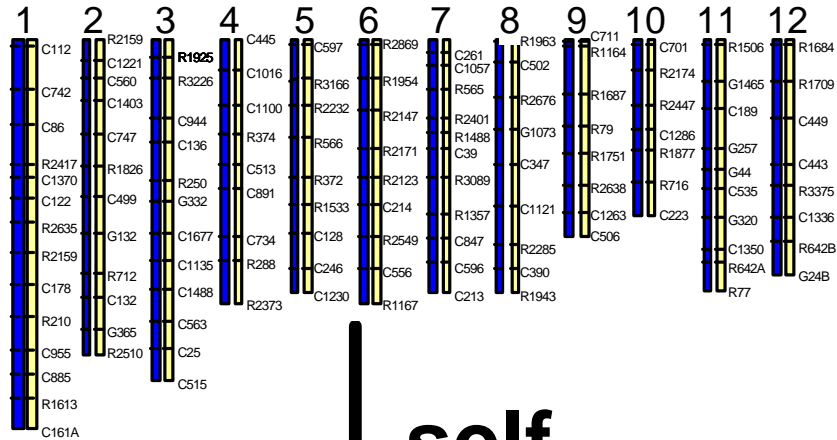
Japonica



Indica



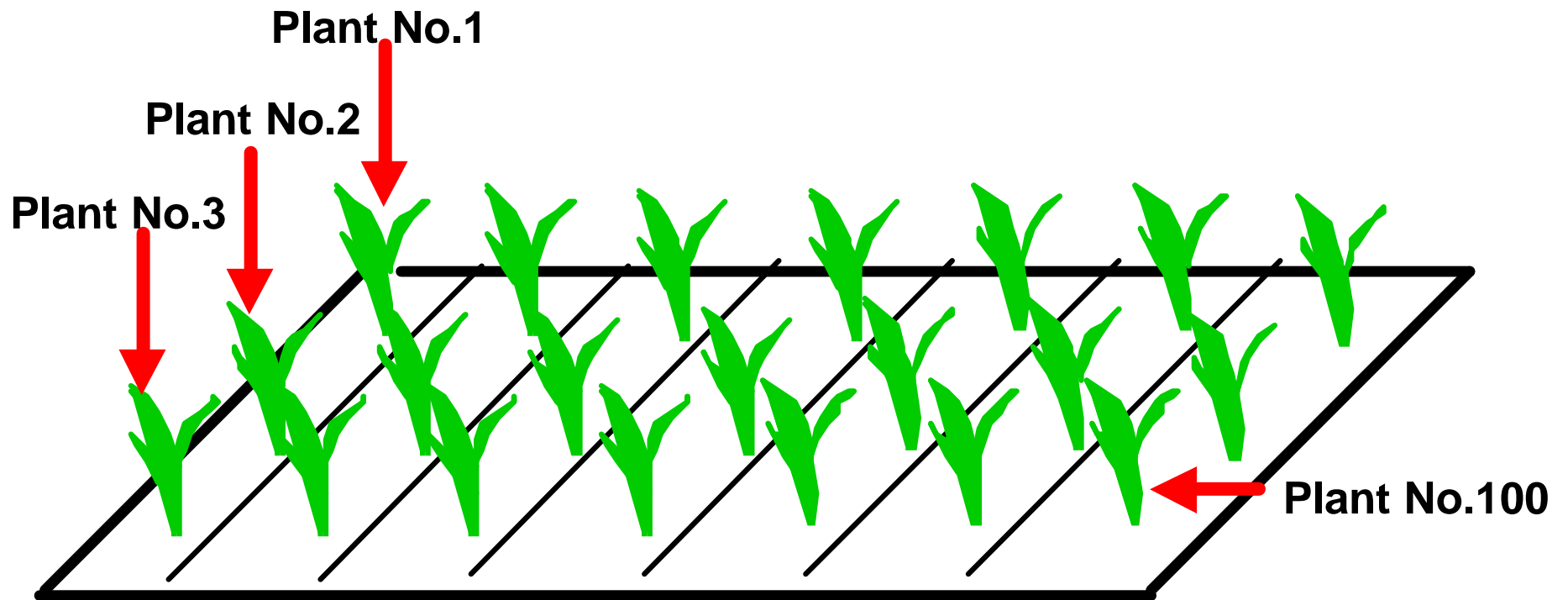
F1



self

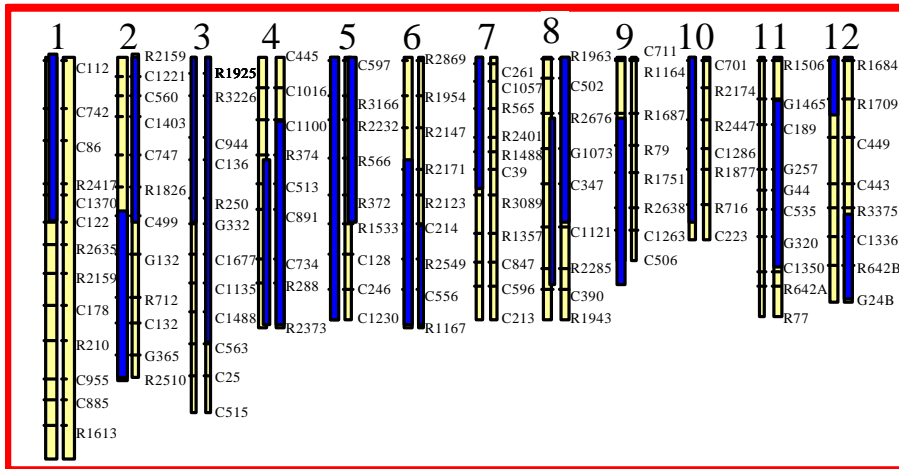


F₂ plants derived from the F₁ self fertilization

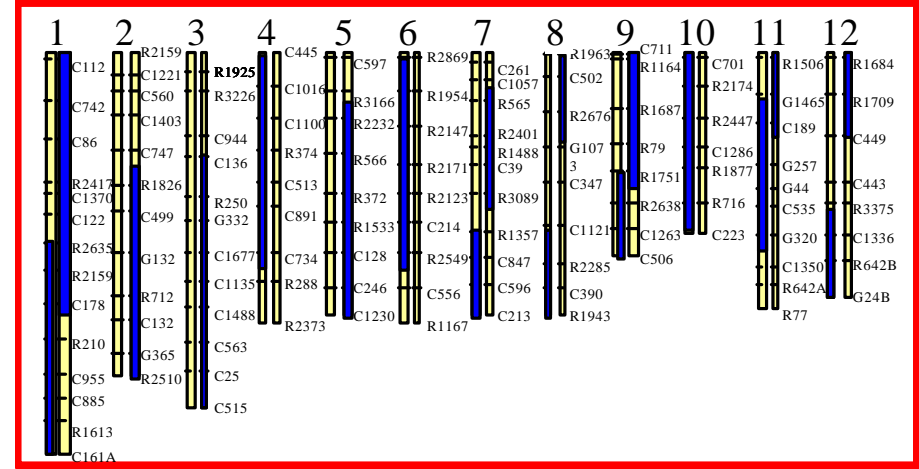


Graphical genotype in F2 plants

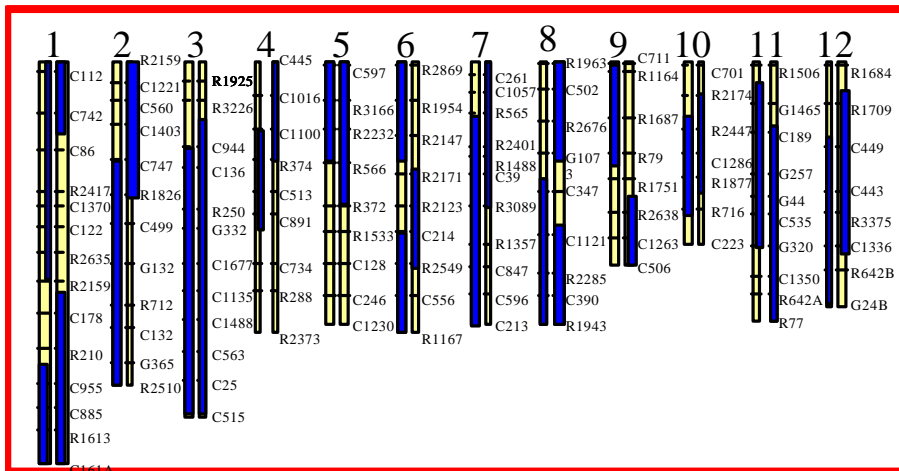
Plnat No.1



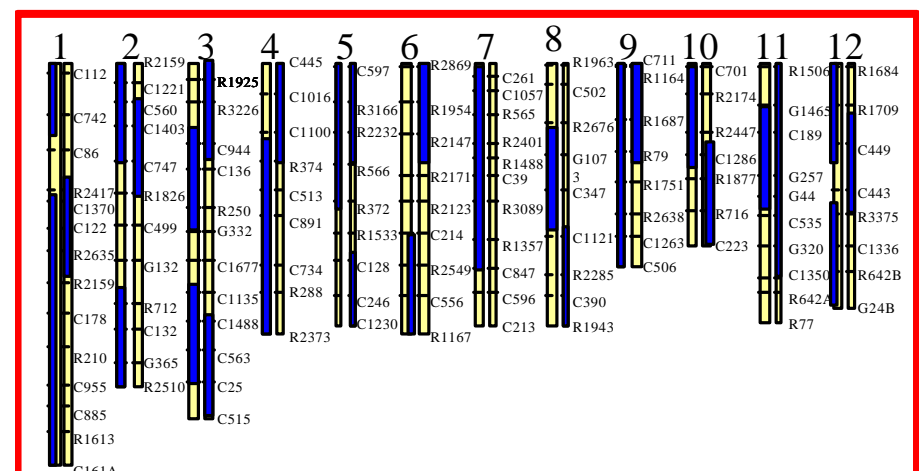
Plnat No.3



Plnat No.2



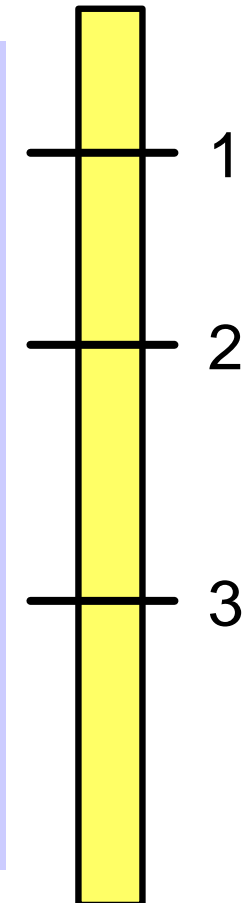
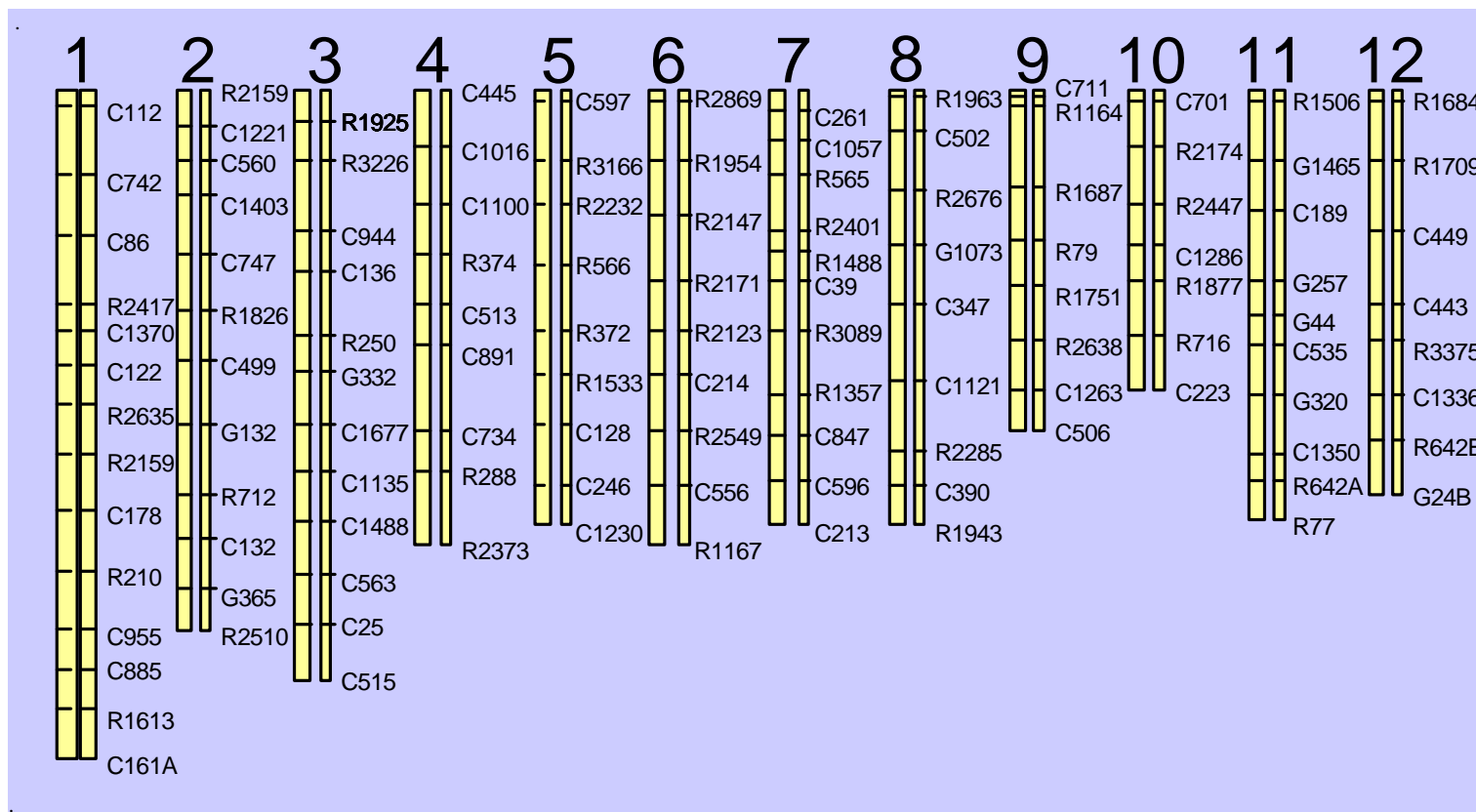
Plnat No.100



Here we study molecular markers

What is marker?

It is address which shows the chromosome location



Many types of molecular markers are available

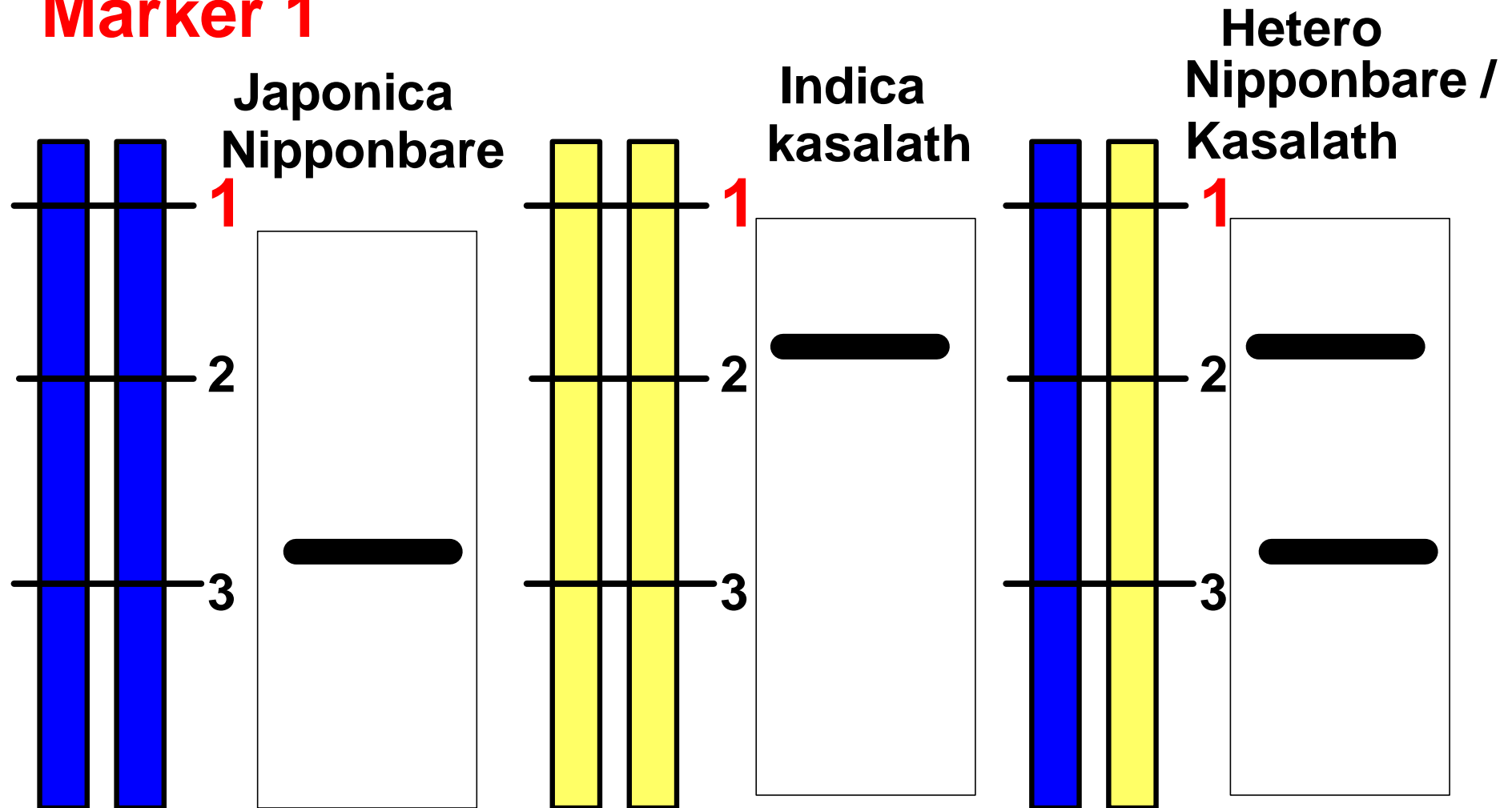
That is DNA fragment or base deference

- RFLP (Restriction Fragment Length polymorphism)
- SSCP (Simple Strand Conformation polymorphism)
- RAPD (Random Amplified Polymorphic DNA)
- AFLP (Amplified Fragment Length Polymorphism)
- CAPS (Cleaved Amplified Polymorphic Sequence)
- SSR (Simple Sequence Repeat)
- STS (Sequences Tag Site)
- SNPs (Single nucleotide polymorphism)

Polymorphism (DNA difference between 2 varieties) become molecular marker

That is DNA fragment difference

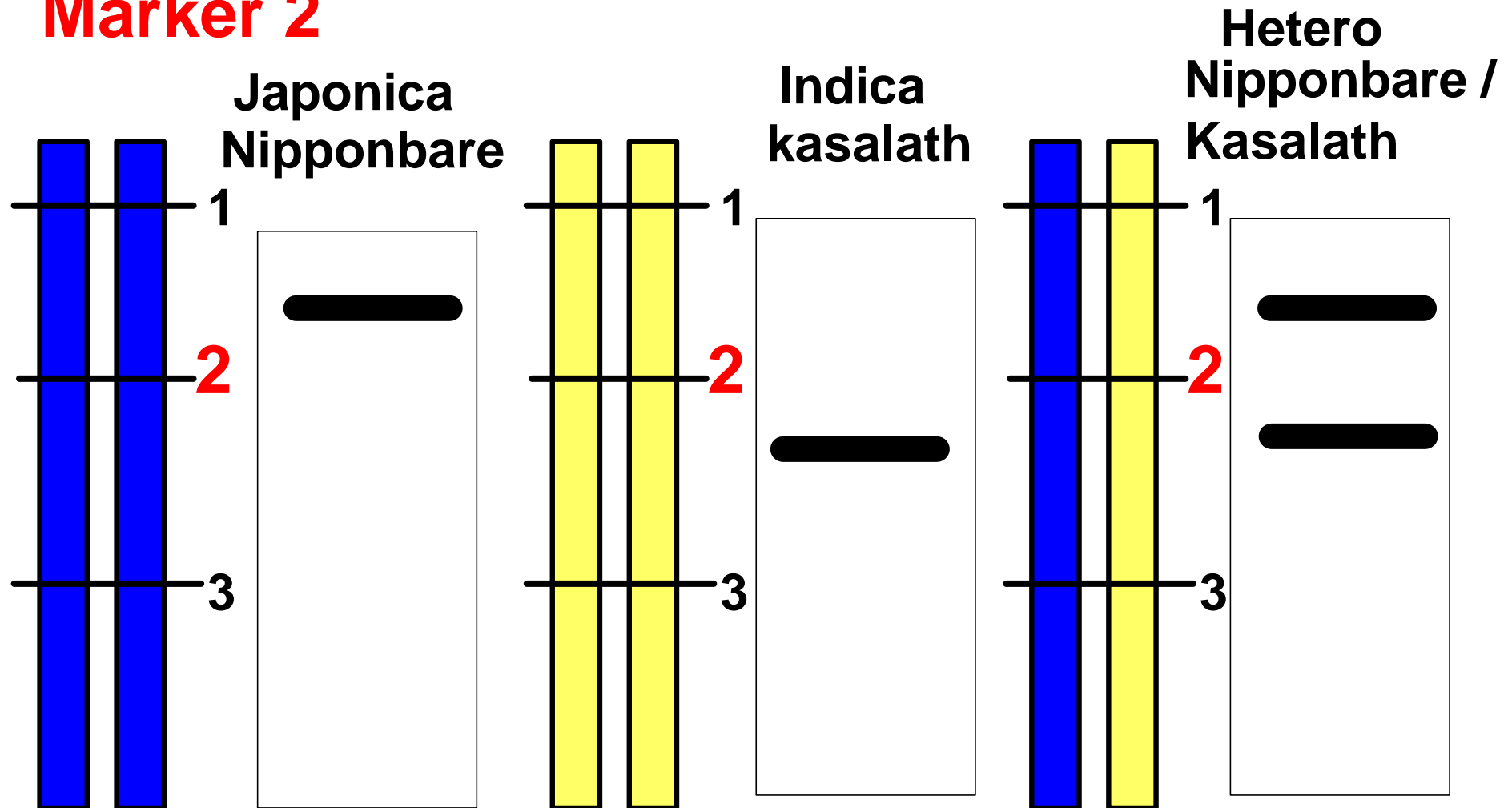
Marker 1



Polymorphism (DNA difference between 2 varieties) become molecular marker

That is DNA fragment difference

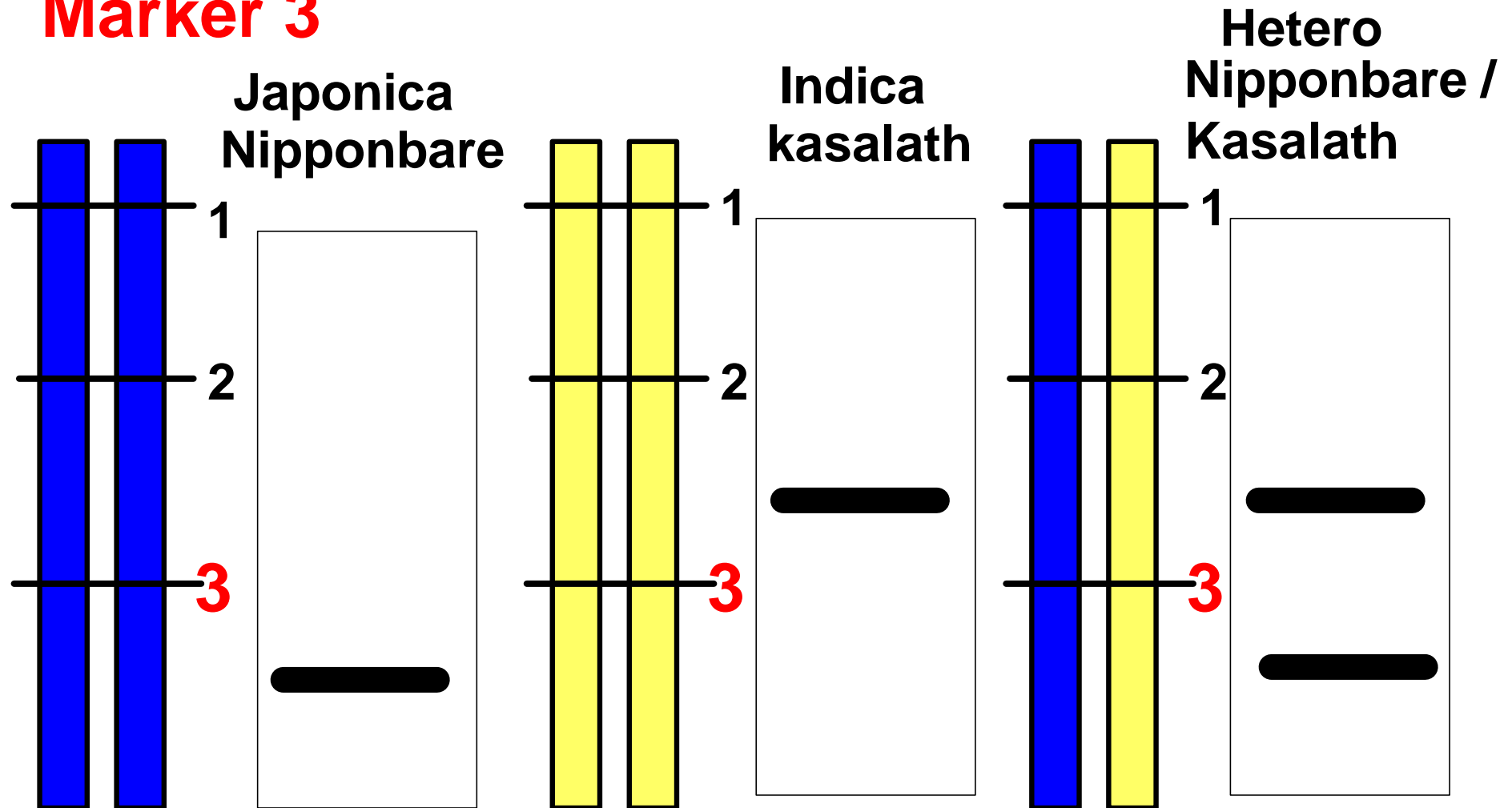
Marker 2



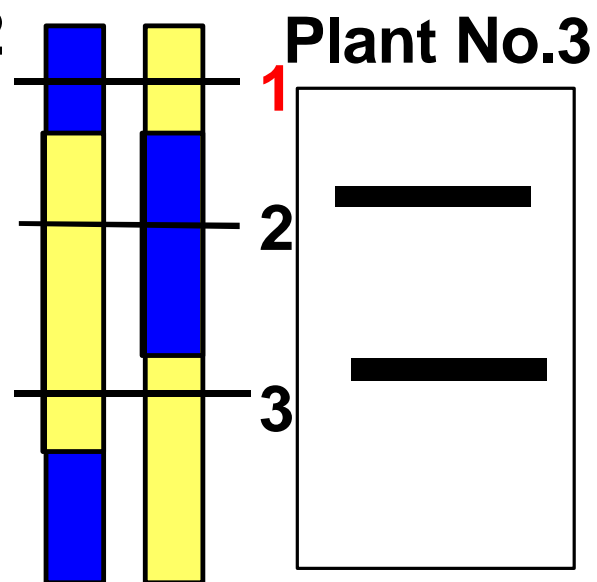
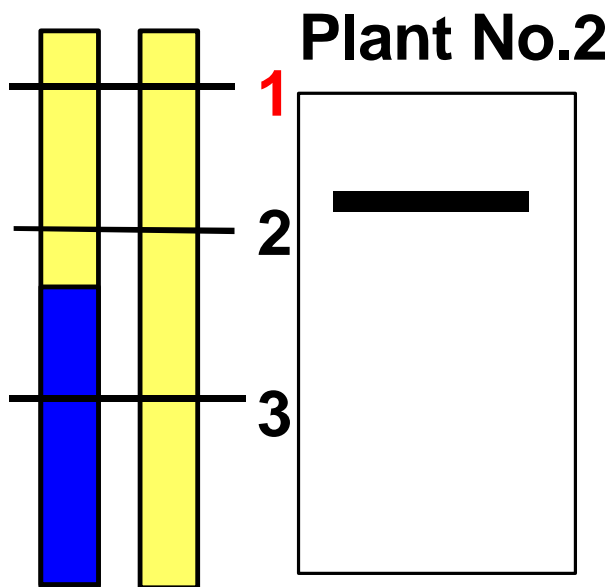
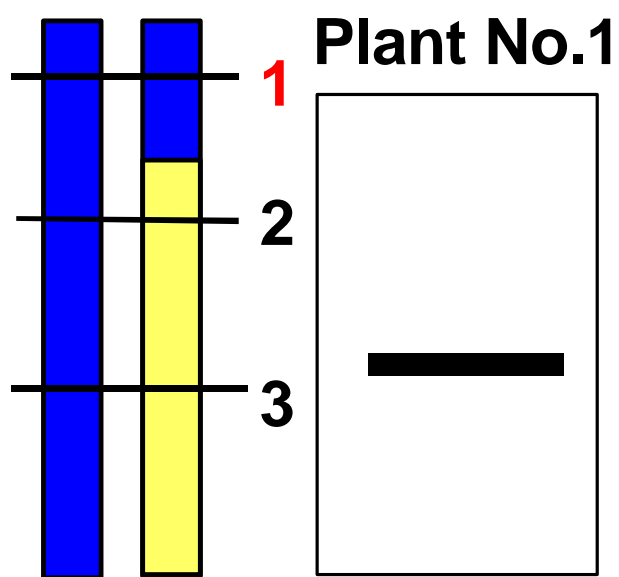
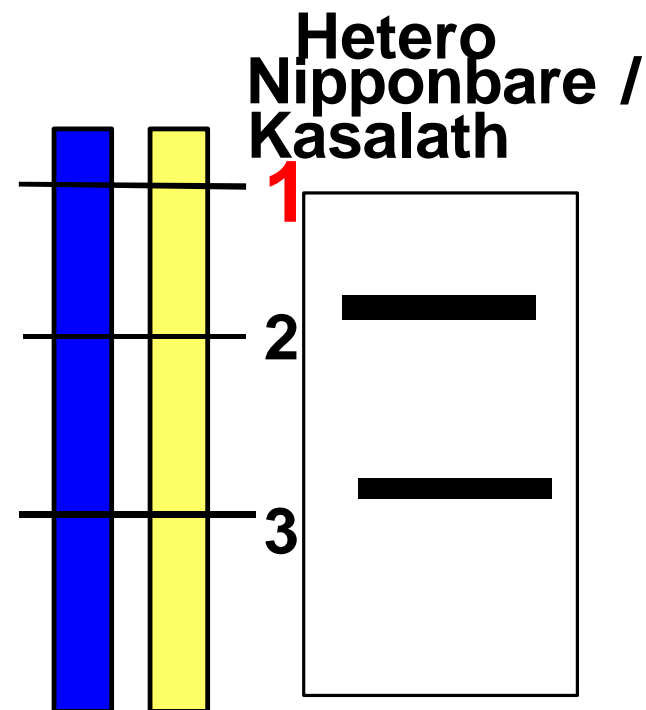
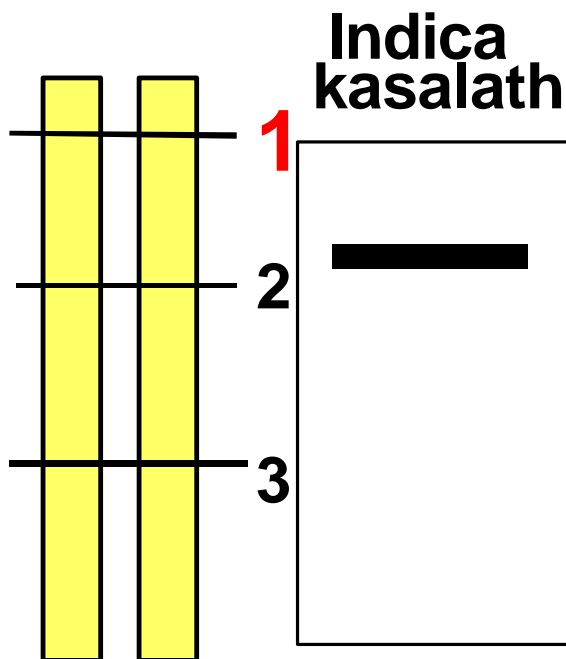
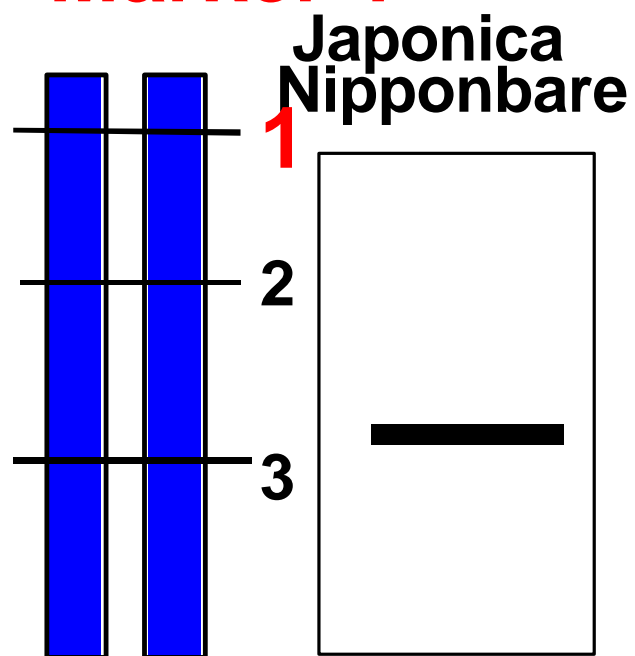
Polymorphism (DNA difference between 2 varieties) become molecular marker

That is DNA fragment difference

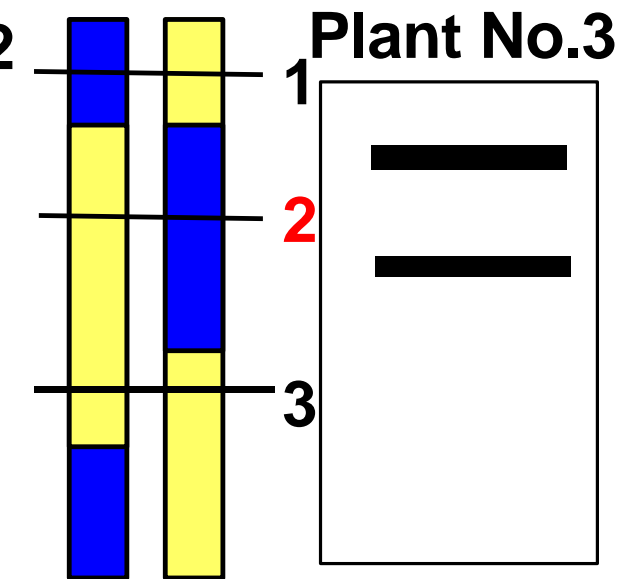
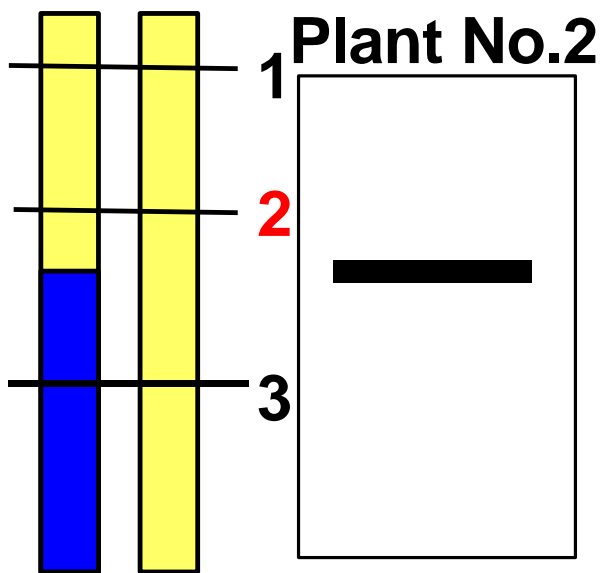
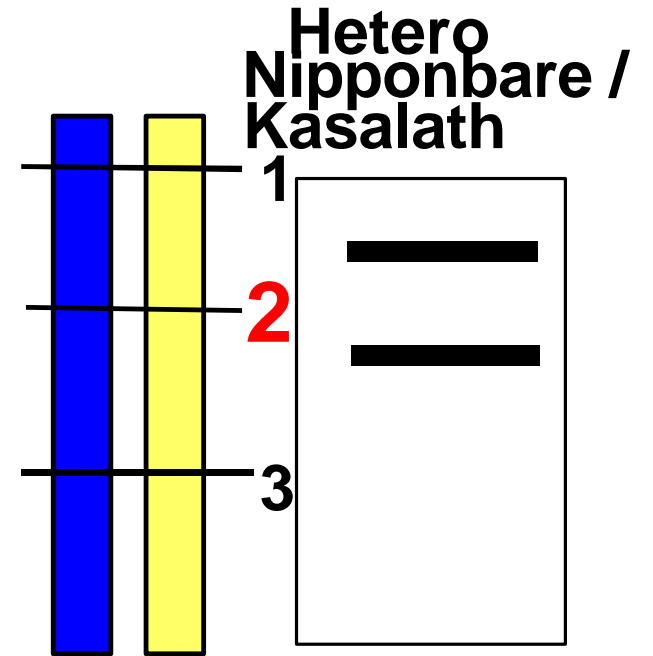
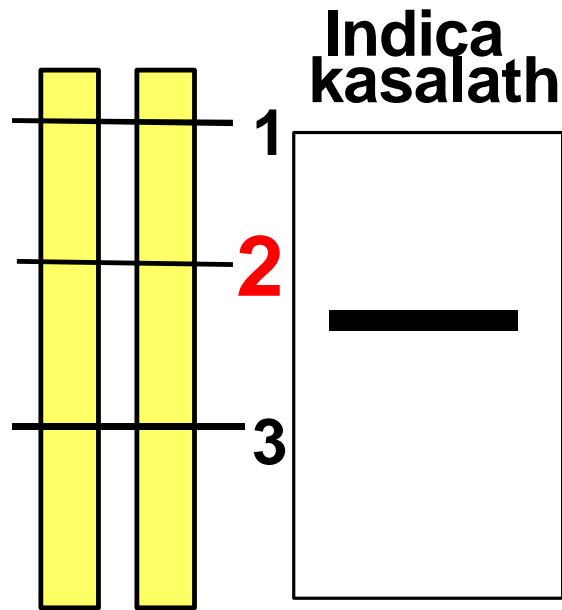
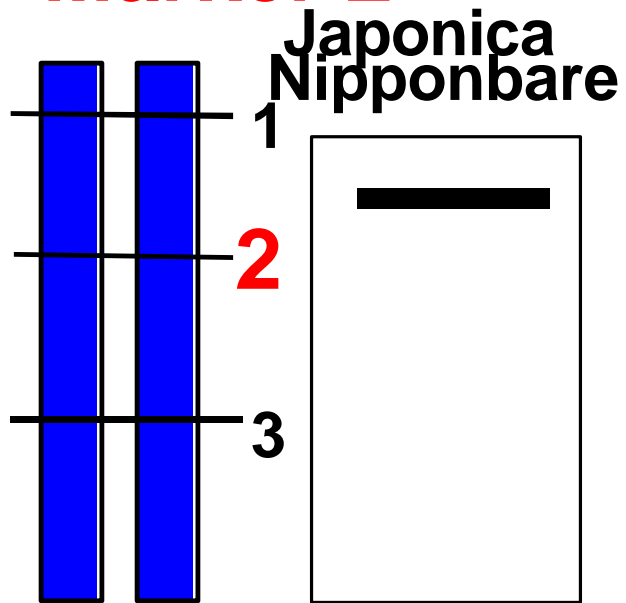
Marker 3



Marker 1



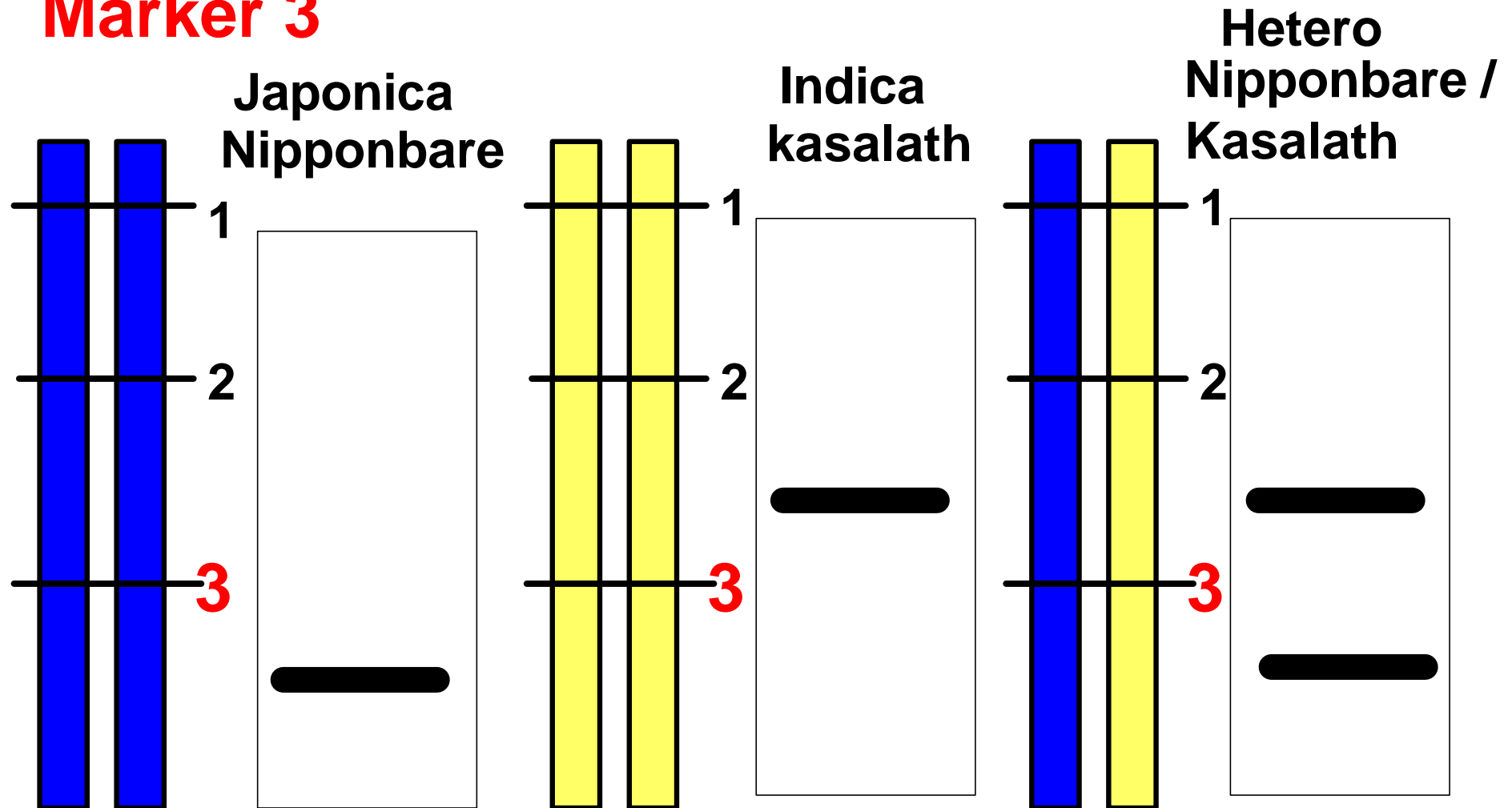
Marker 2



Polymorphism (DNA difference between 2 varieties) become molecular marker

That is DNA fragment difference

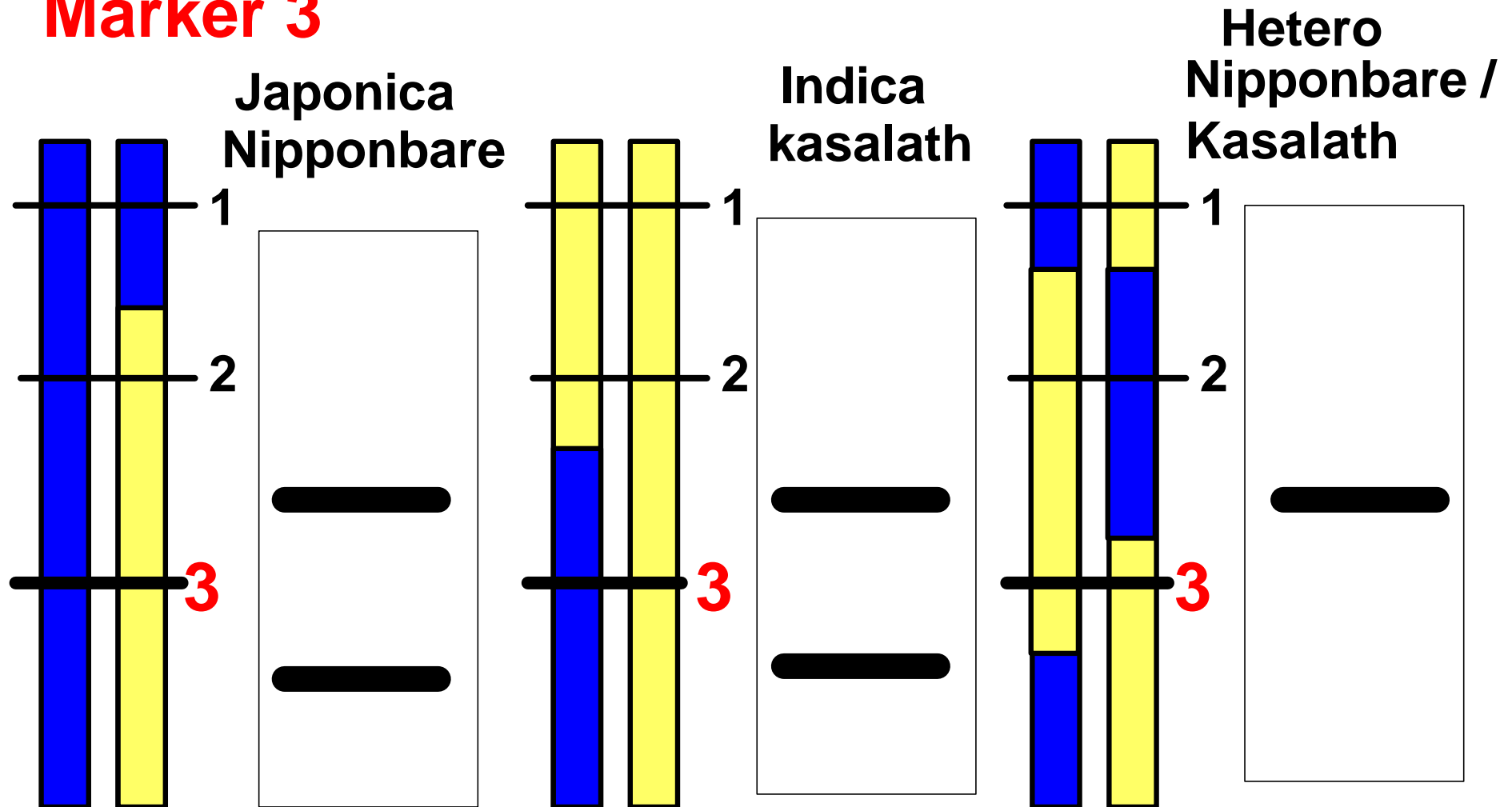
Marker 3

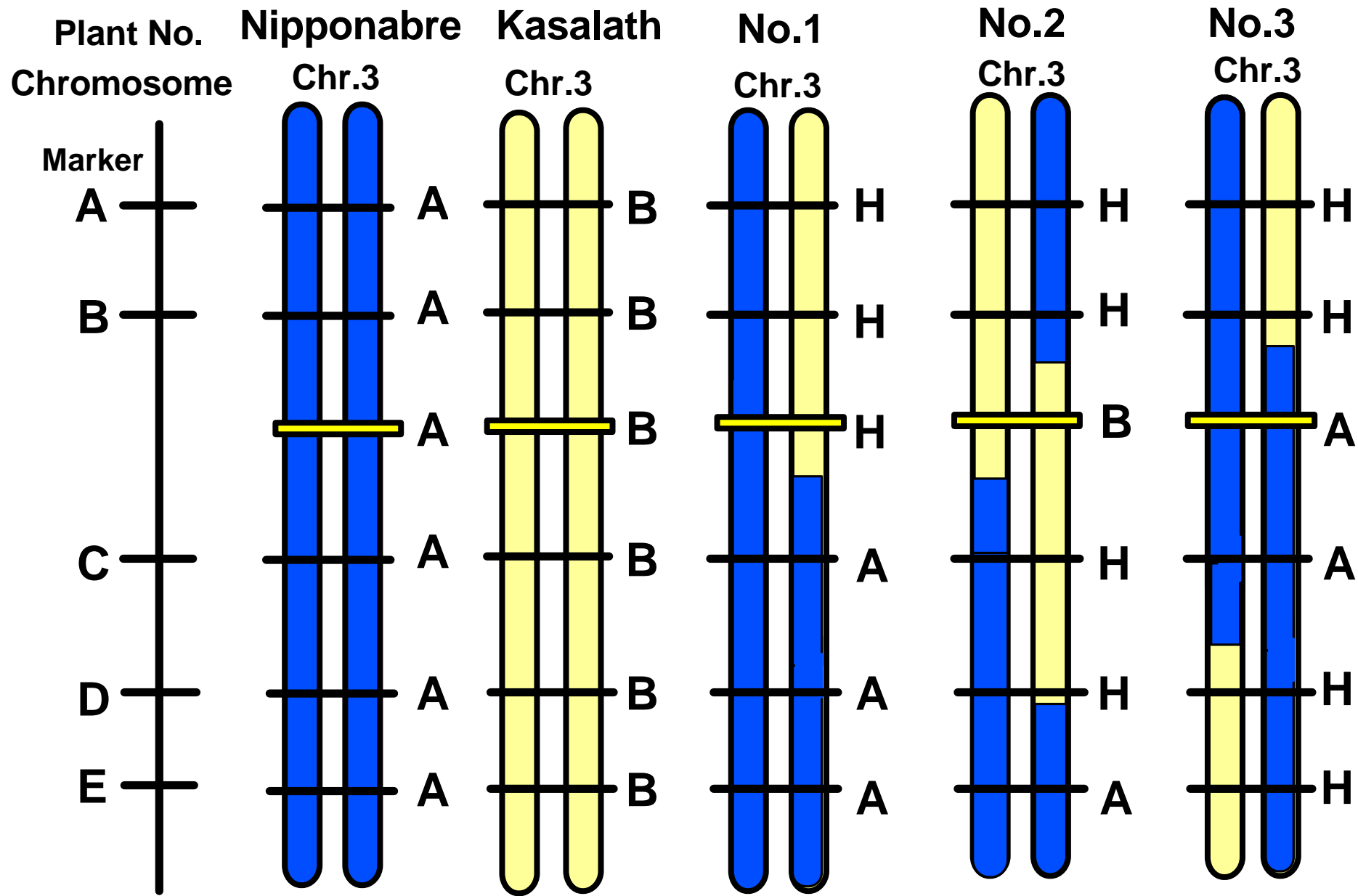


Polymorphism (DNA difference between 2 varieties) become molecular marker

That is DNA fragment difference

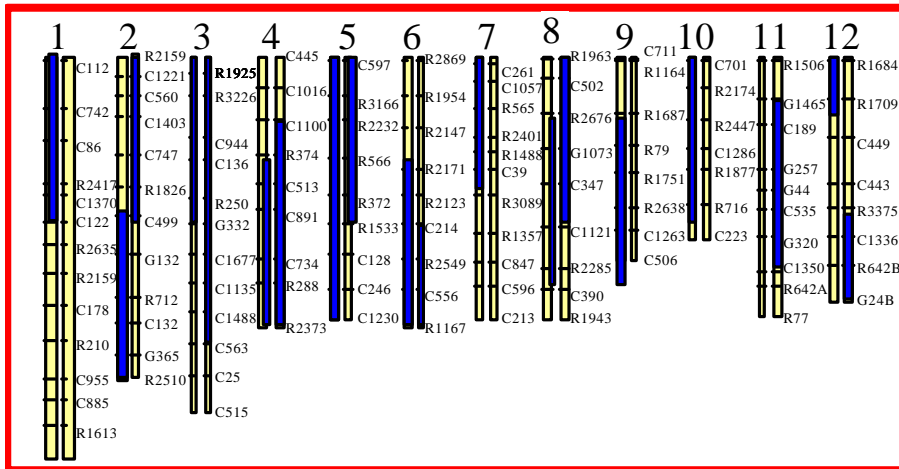
Marker 3



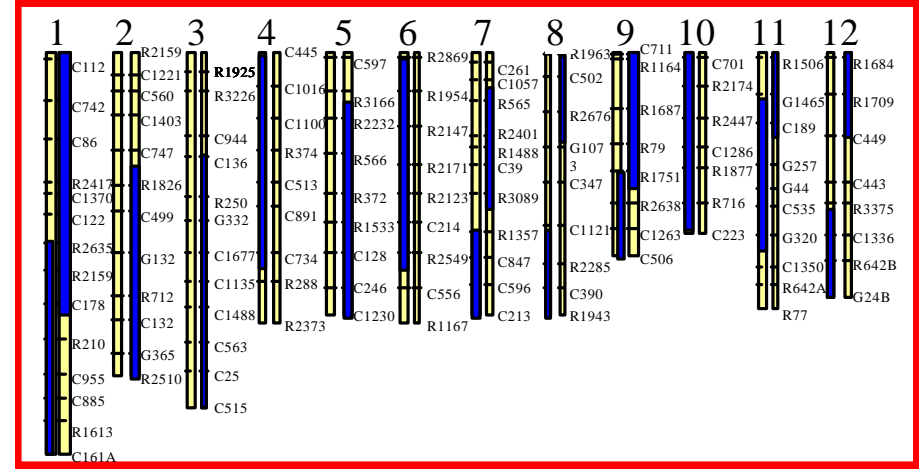


Graphical genotype in F2 plants

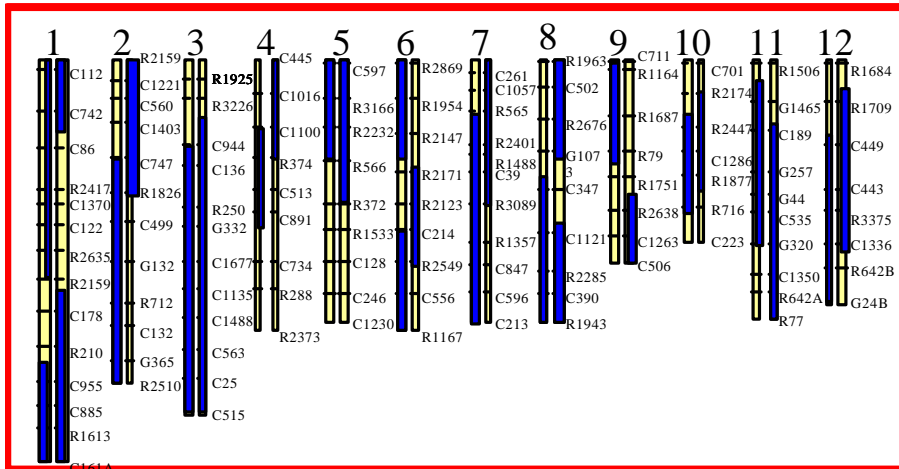
Plnat No.1



Plnat No.3



Plnat No.2



Plnat No.100

