

Selection with QTL

Identifying genes with significant traits for agriculture



QTL: Quantitative Trait Loci



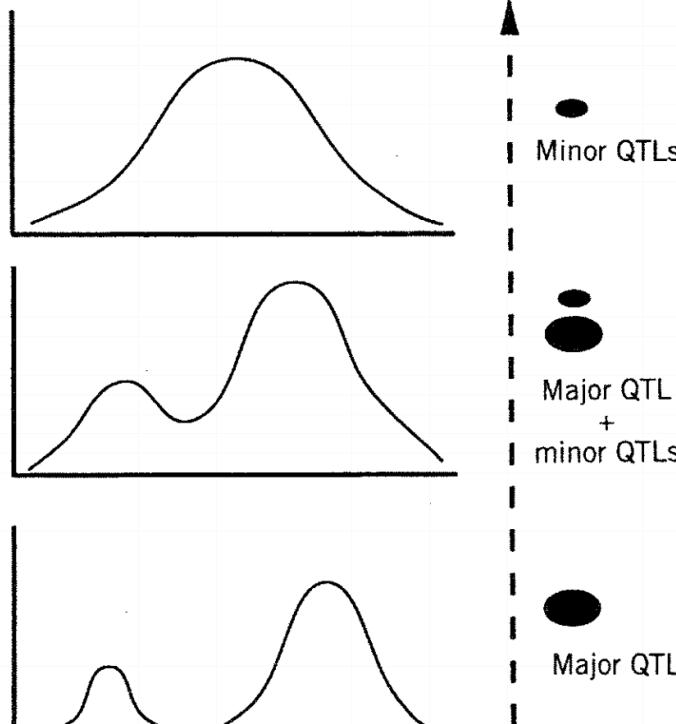
Genome-wide
Association Study:
GWAS

QTL analysis

GWAS analysis

KOBE UNIVERSITY

Increase of
gene number



Phenotype value

Xu 1997

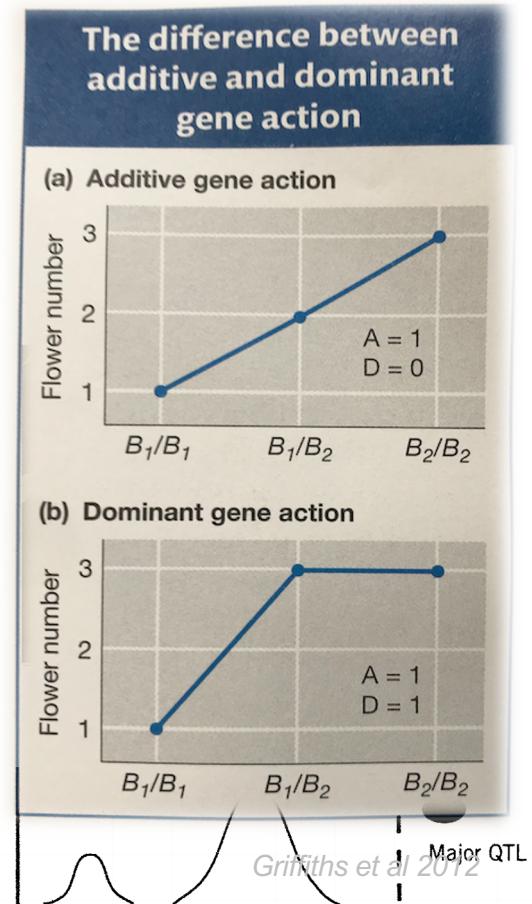
Selection with major QTL

Major QTL is defined as a QTL with a consistent and large effect to be meaningful in breeding program.

Table 1. The anthracnose resistance of the parents and $F_{2:3}$ families.

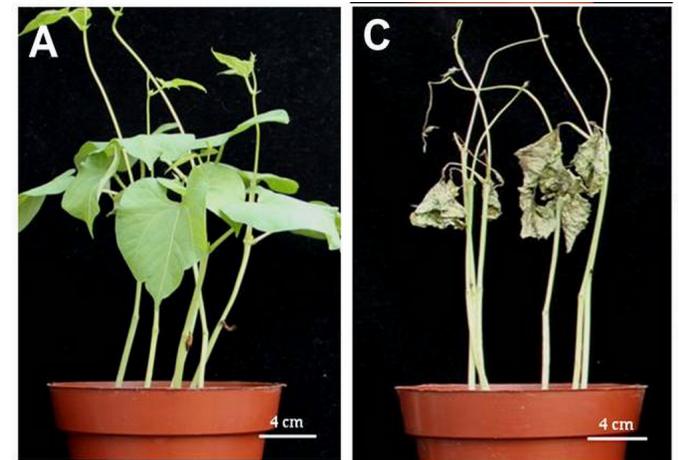
Parent or cross		No. of plants or lines			Expected ratio	χ^2	P -value
		Resistant	Segregating	Susceptible			
Hongyundou	P1	30					
Jingdou	P2			30			
Hongyundou × Jingdou	F_1	50					
Hongyundou × Jingdou	F_2	138		44	3:1	0.029	0.864

Chen *et al* 2017



Selection with major QTL

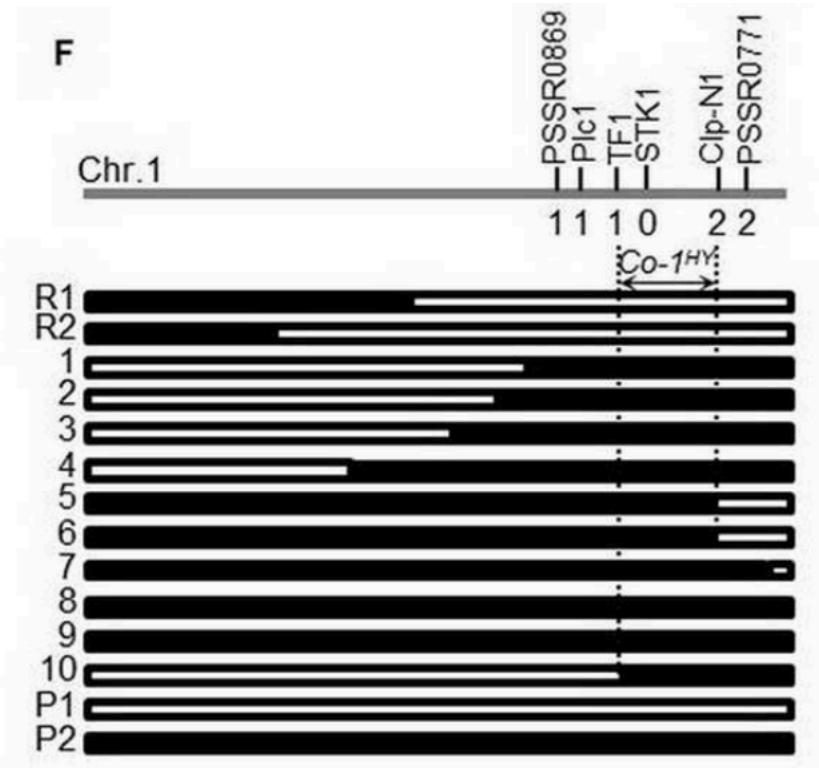
1. Identify sources of QTL alleles.



Chen et al 2017

Selection with major QTL

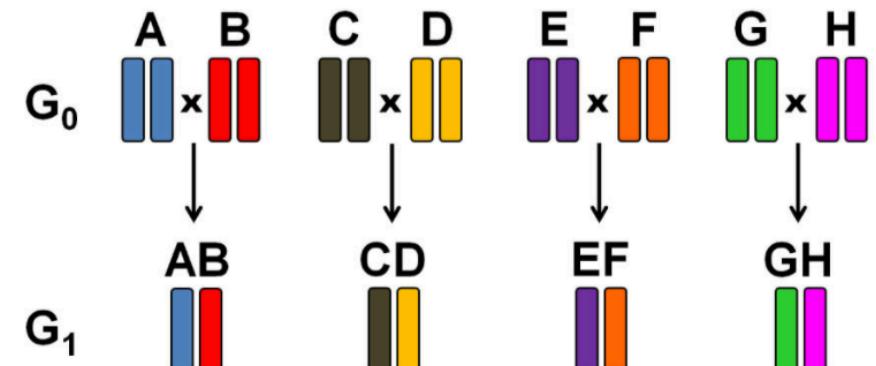
1. Identify sources of QTL alleles.
2. Find markers closely linked to a major QTL.



Chen et al 2017

Selection with major QTL

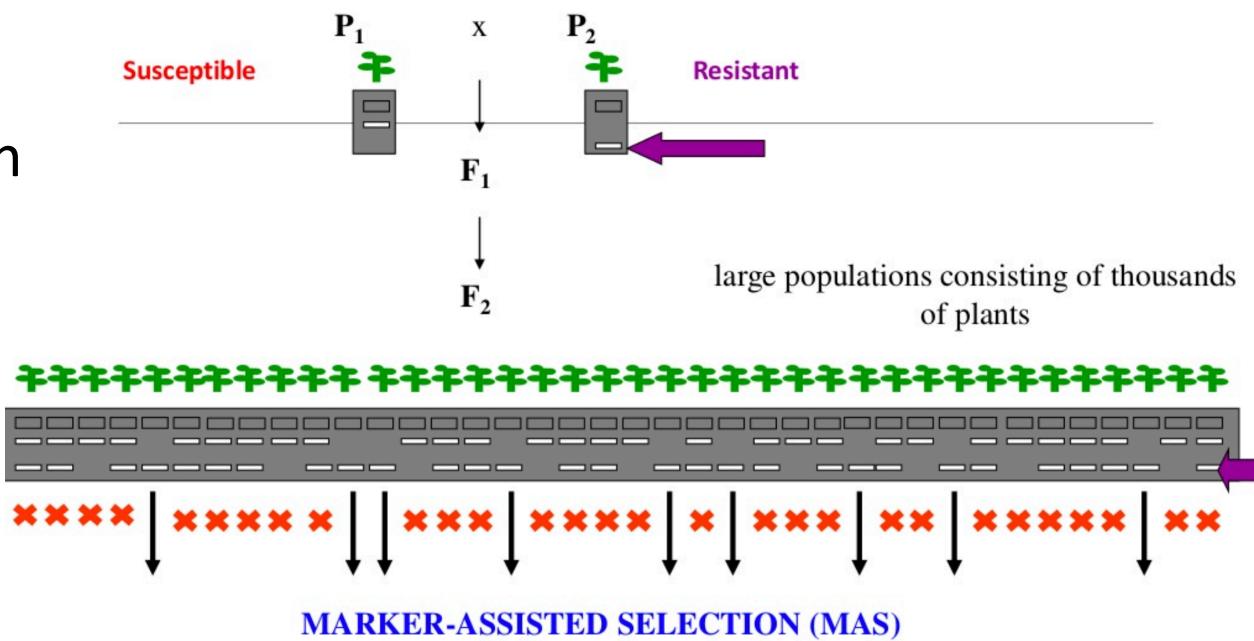
1. Identify sources of QTL alleles.
2. Find markers closely linked to a major QTL.
3. Confirm the effects of the major QTL in different genetic background.



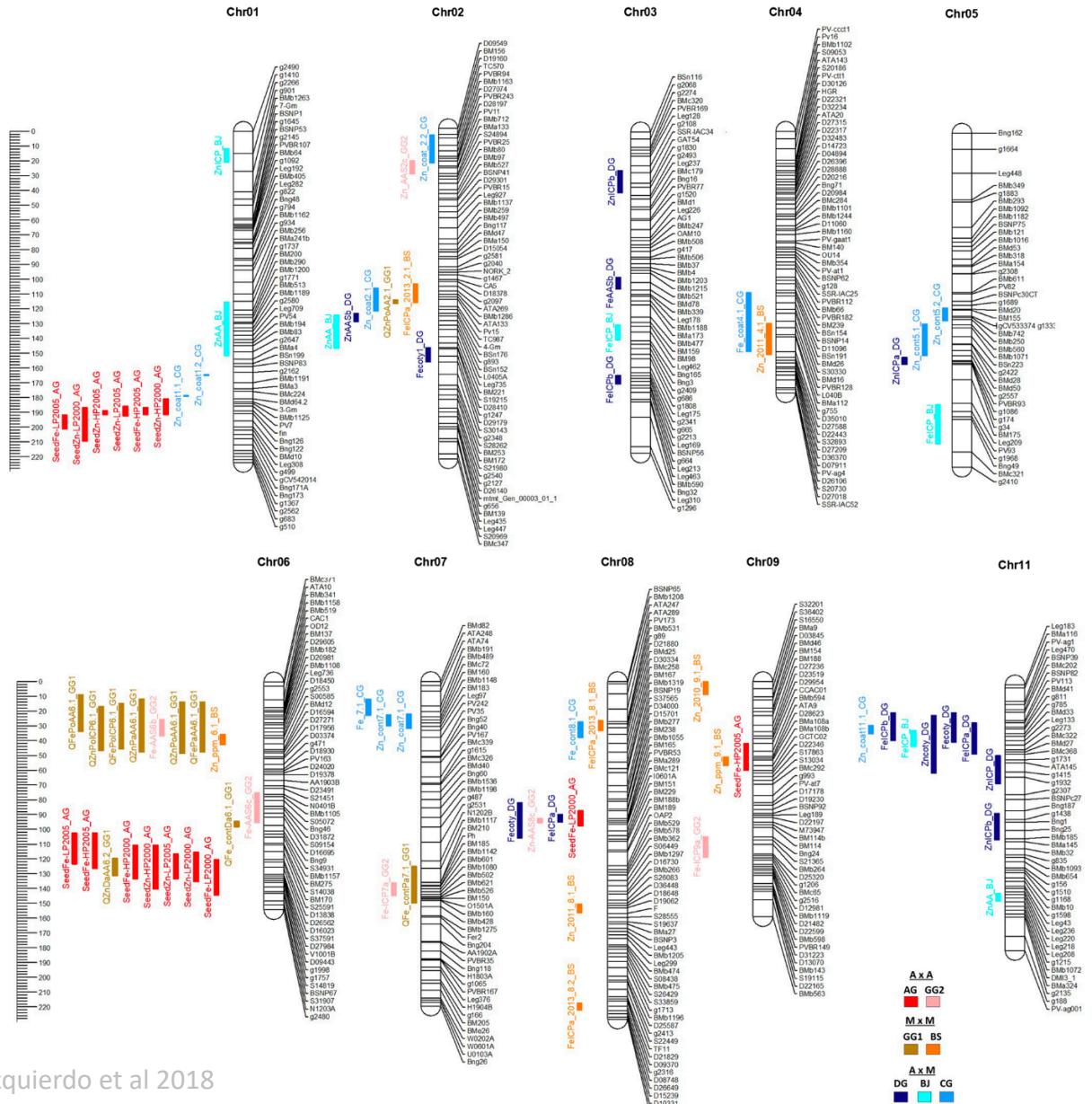
Stadlmeier et al 2018

Selection with major QTL

1. Identify sources of QTL alleles.
2. Find markers closely linked to a major QTL.
3. Confirm the effects of the major QTL in different genetic background.
4. Spread out the QTL in the breeding program.



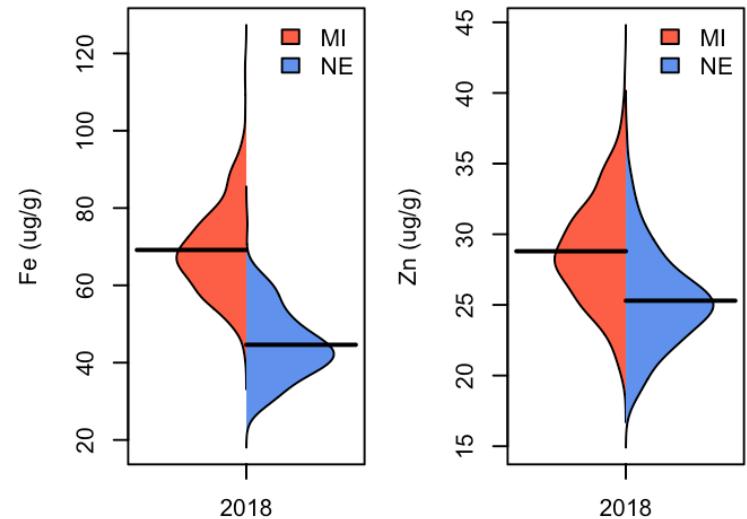
Selection with many QTLs



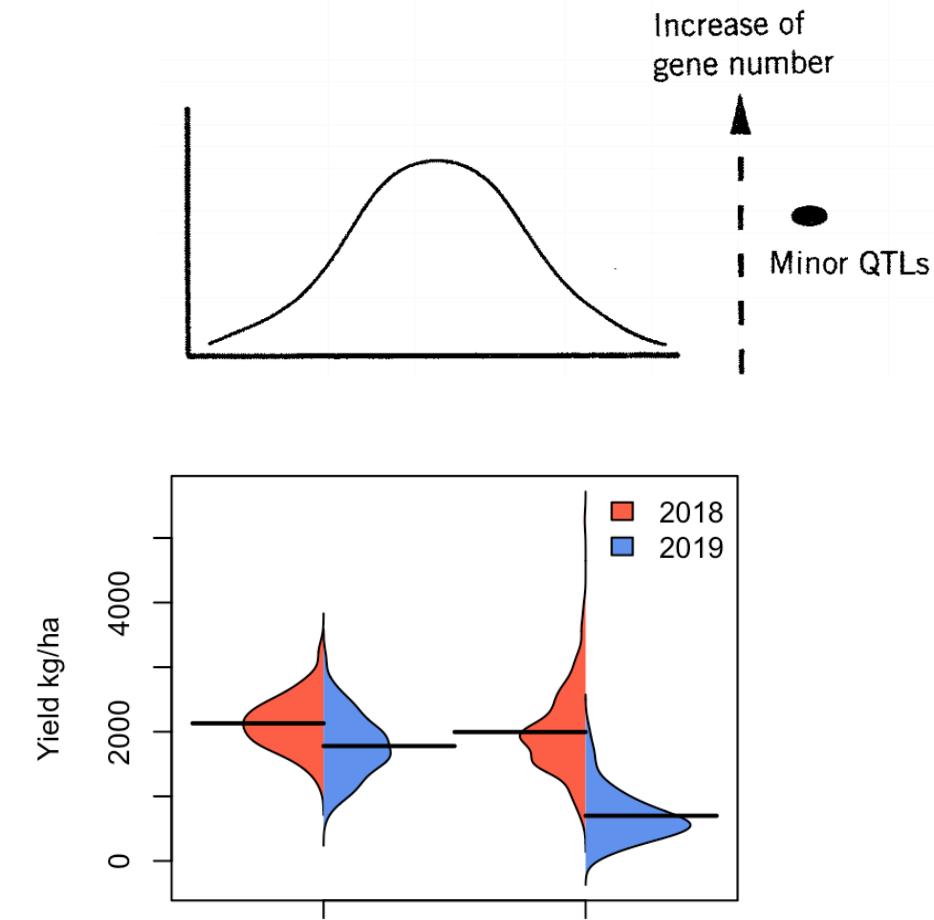
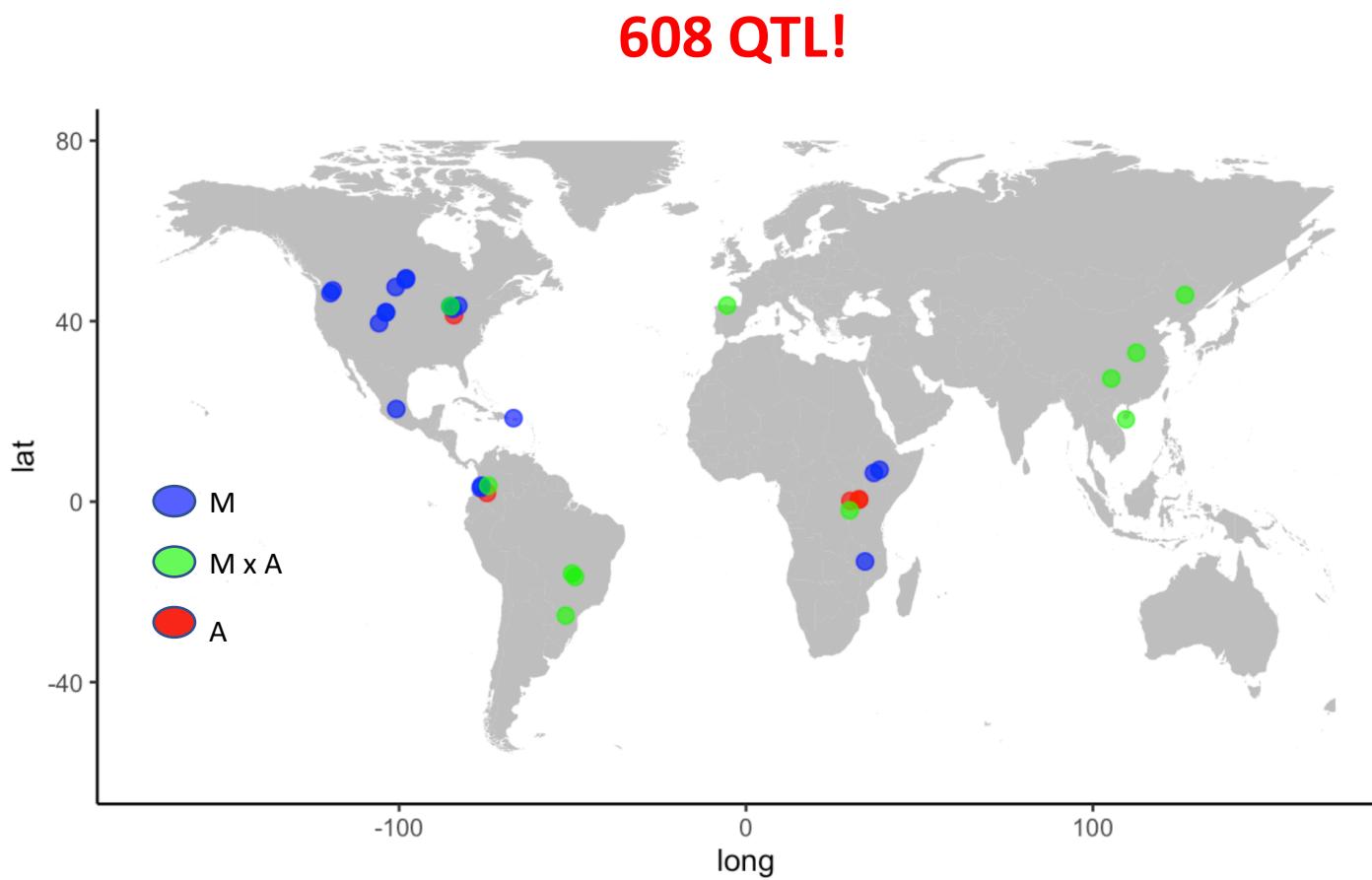
Increase of
gene number

Minor QTLs

Xu 1997

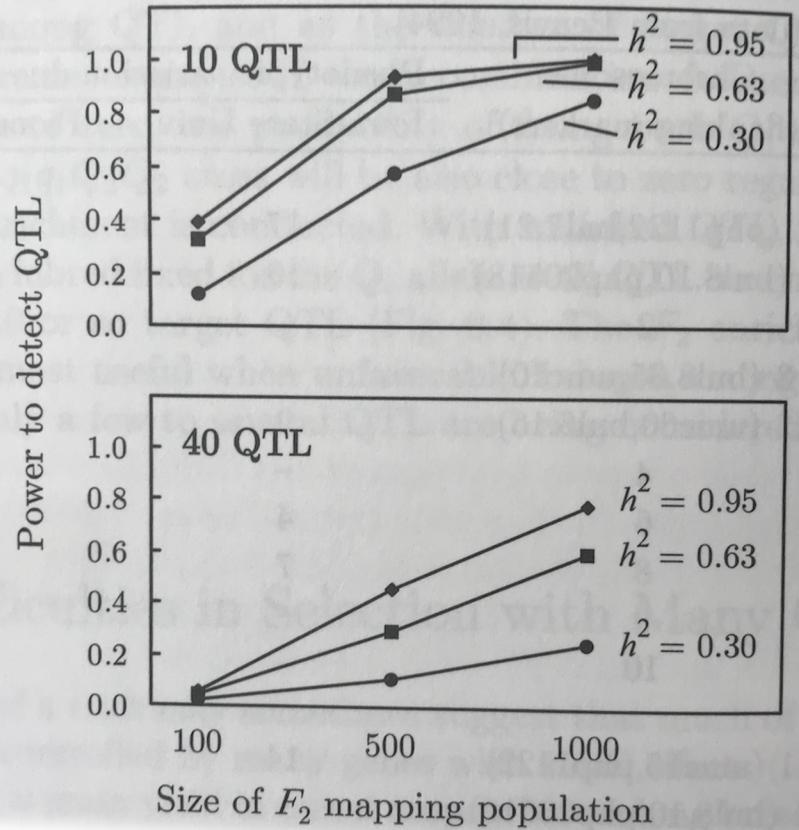


Selection with many QTL

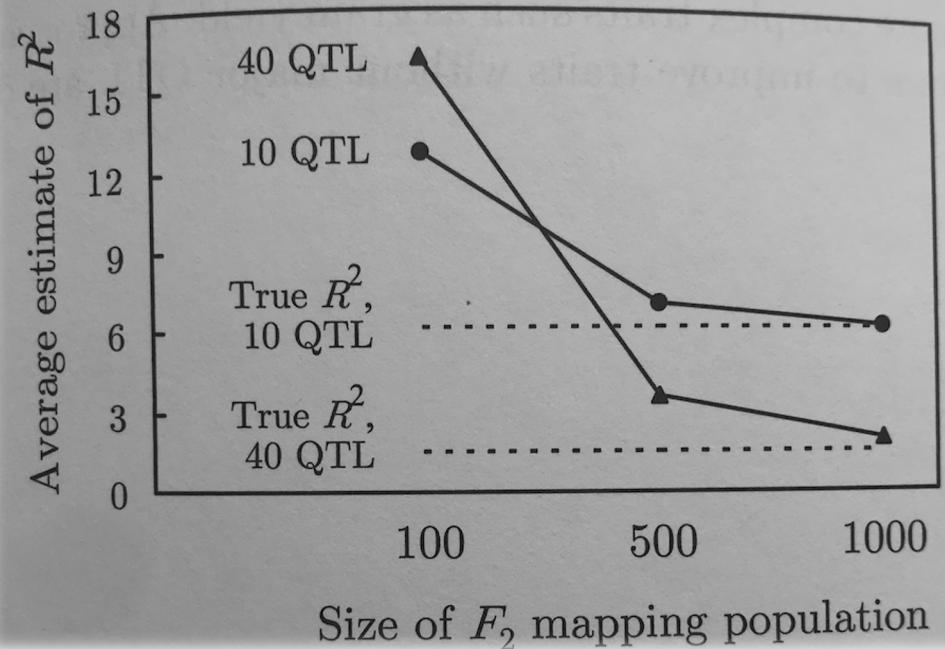


Selection with many QTL

Power to detect QTL



Upwards bias in R^2 values



$$Nh^2$$

Selection with many QTL

1. Identify sources of QTL alleles.
2. Find markers closely linked to a major QTL.
3. Confirm the effects of the major QTL in different genetic background.
4. Spread out the QTL in the breeding program.

Selection with many QTL

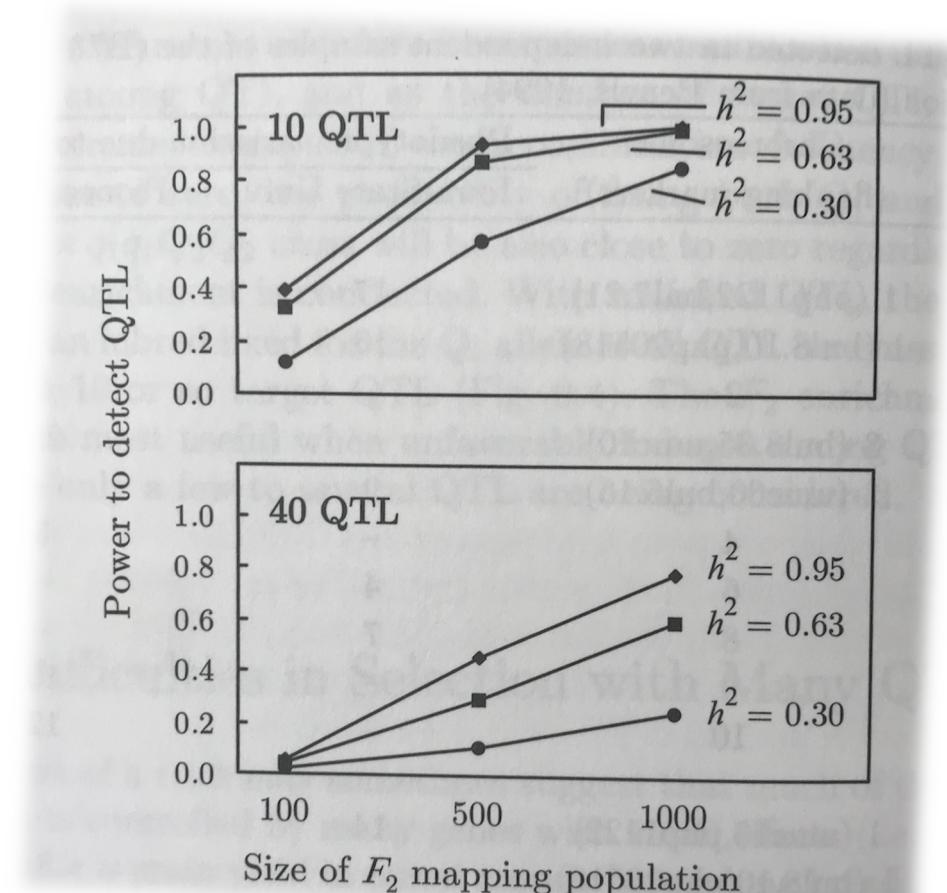
1. Identify sources of QTL alleles.

QTL alleles are likely to be found in many individuals



Selection with many QTL

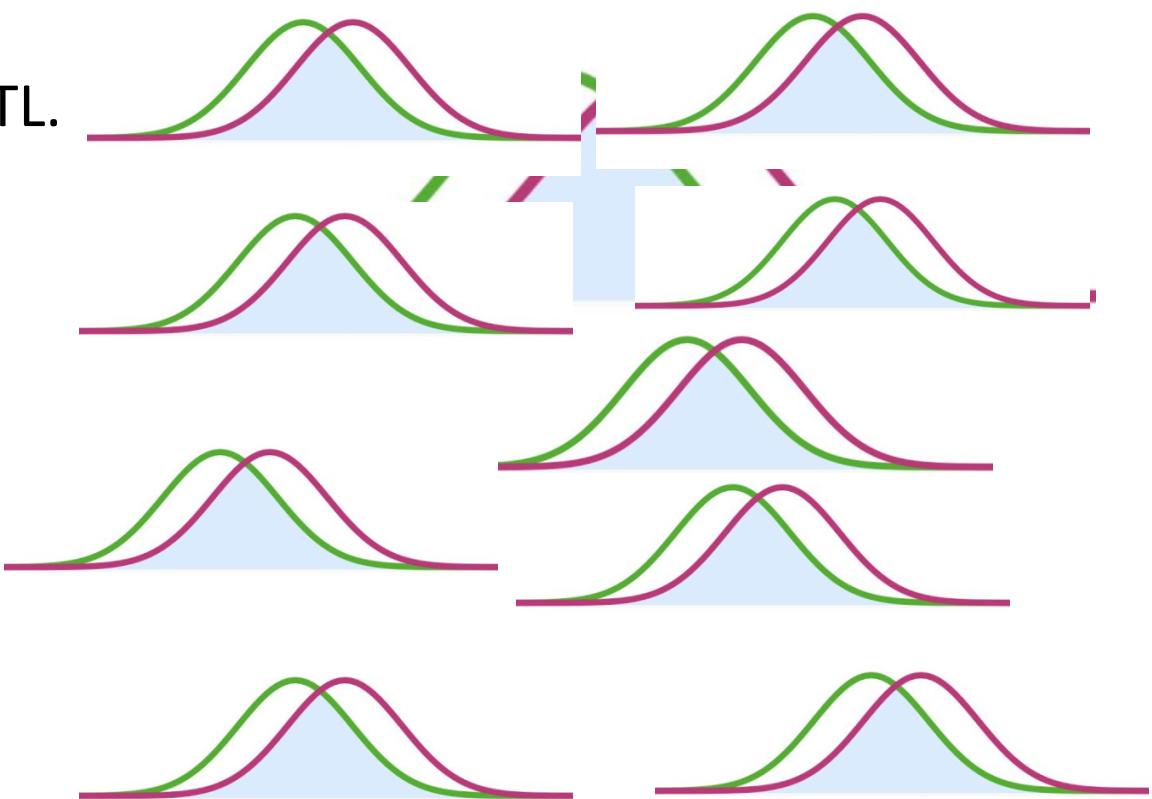
1. Identify sources of QTL alleles.
2. Find markers closely linked to a major QTL.



Selection with many QTL

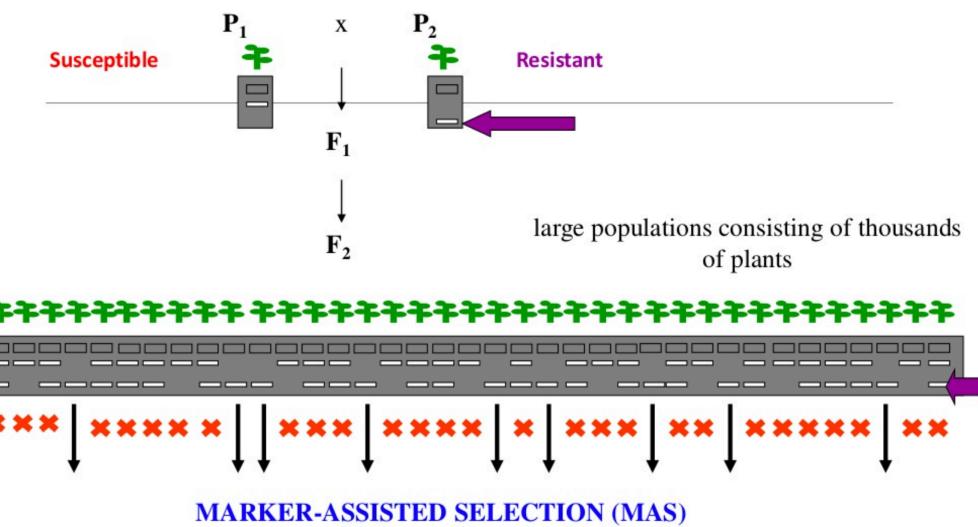
1. Identify sources of QTL alleles.
2. Find markers closely linked to a major QTL.
3. Confirm the effects of the major QTL in different genetic background.

Low power + G x E + QTL segregation

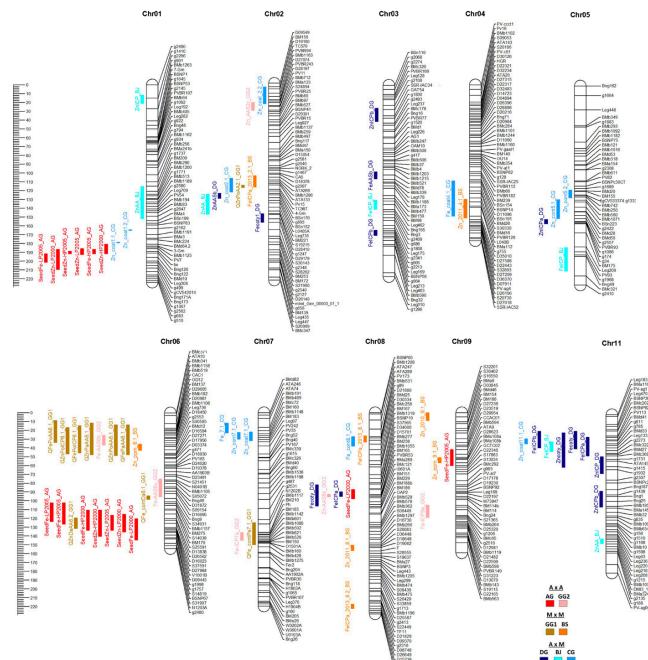


Selection with many QTL

1. Identify sources of QTL alleles.
2. Find markers closely linked to a major QTL.
3. Confirm the effects of the major QTL in different genetic background.
4. Spread out the QTL in the breeding program.



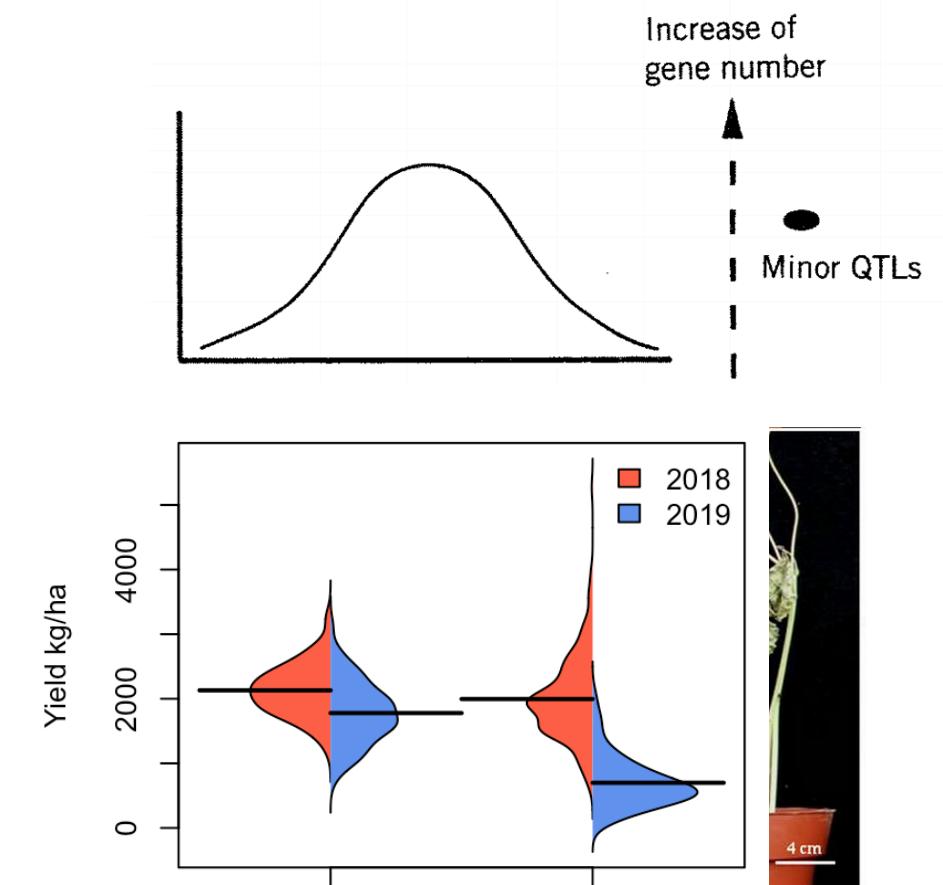
Pavan 2015



Izquierdo et al 2018

Selection with QTL

- Major QTL can be used in breeding programs!
- For quantitative traits, predictive methods are more useful.



Chen *et al* 2017