Development of marker-assisted breeding strategies for strawberry

The example of the everbearing trait (or perpetual flowering trait)

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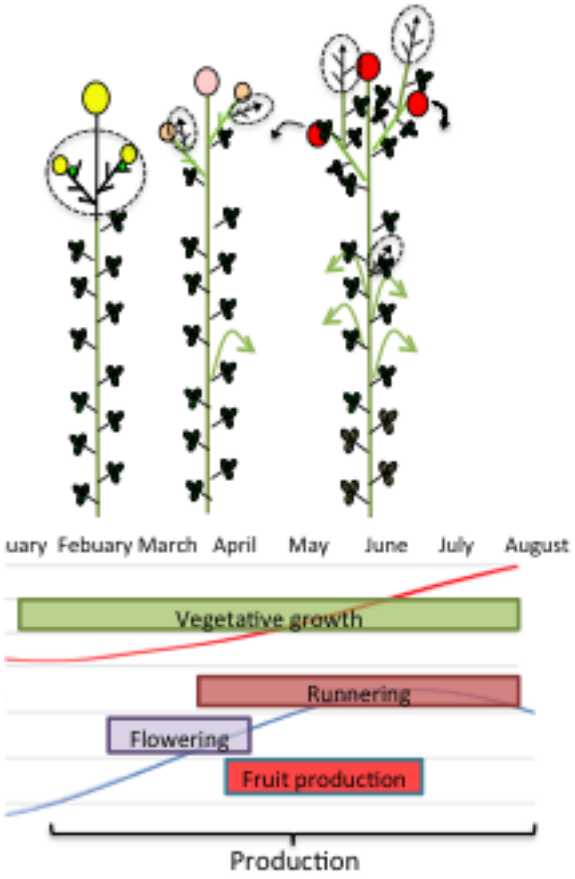
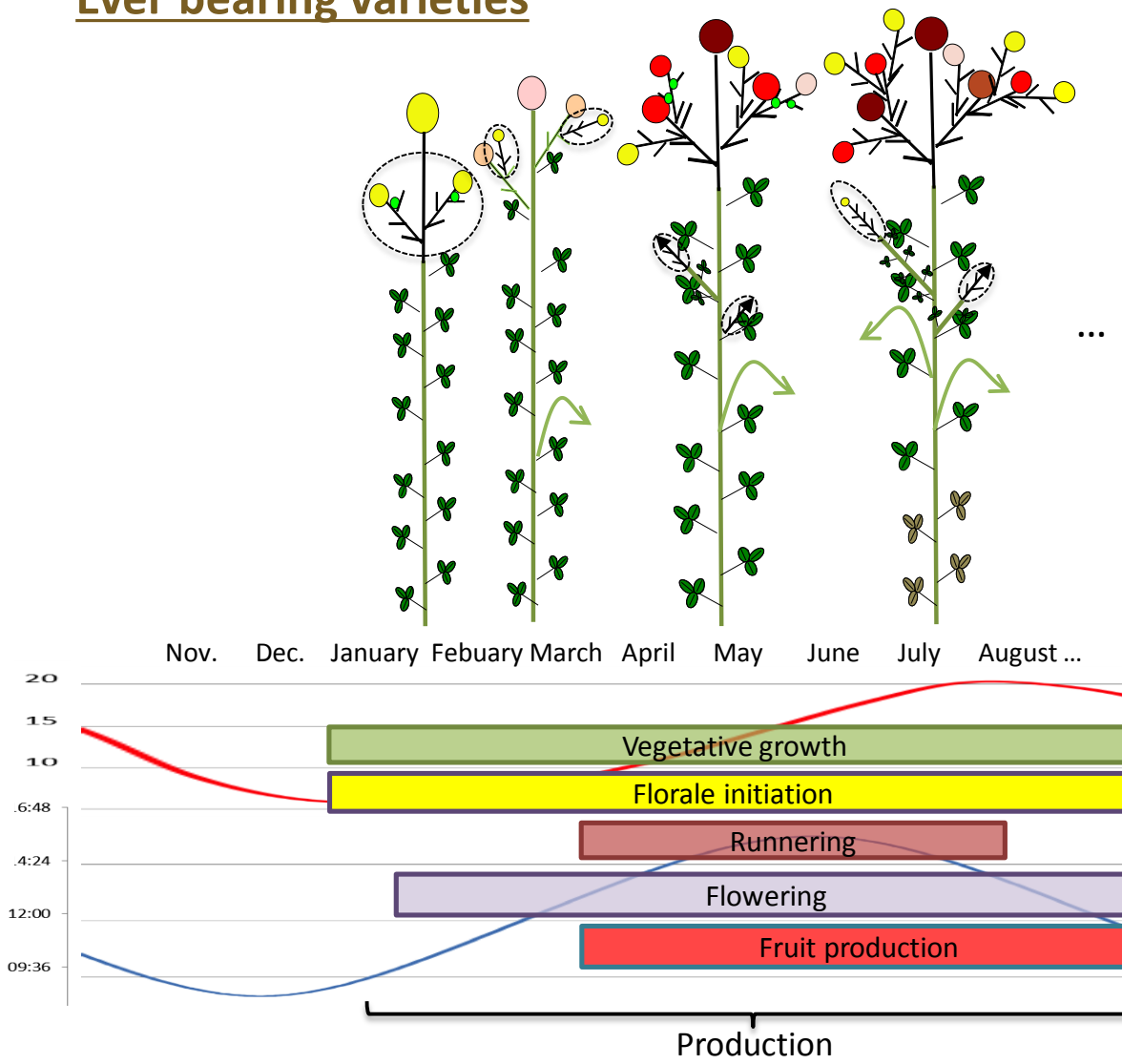
Strawberry development cycle in France

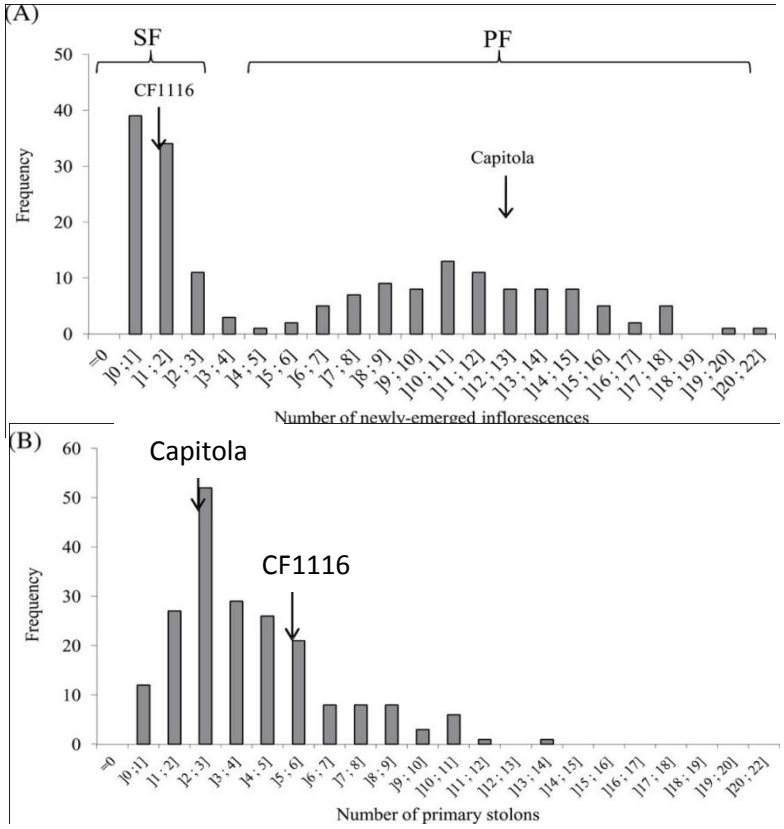
June bearing varieties

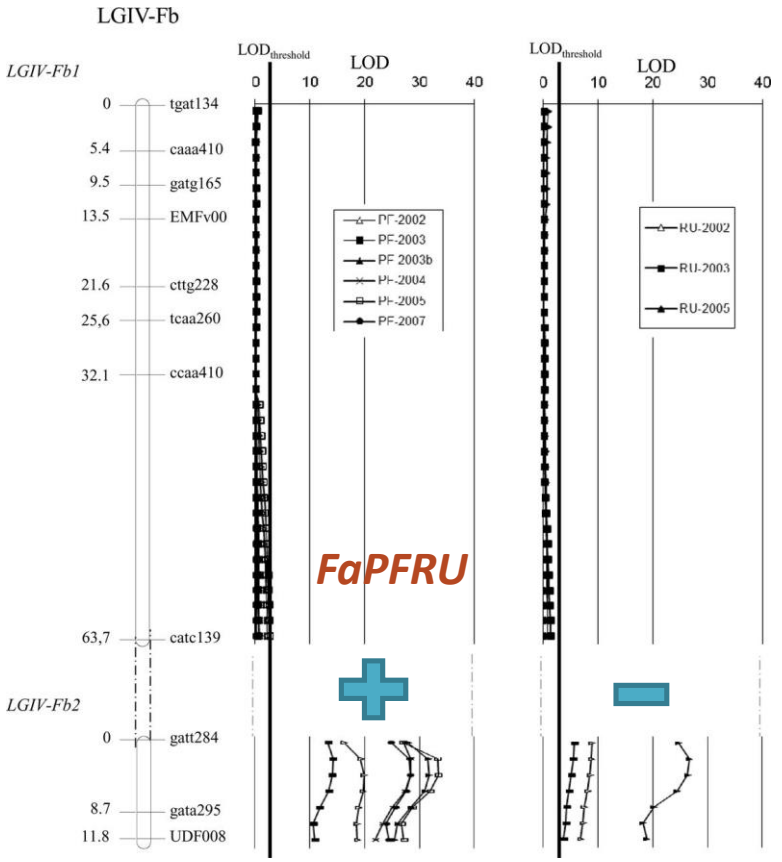


Ever bearing varieties



Perpetual flowering : a major QTL, *FaPFRU*





Quantitative notations for PF and RU

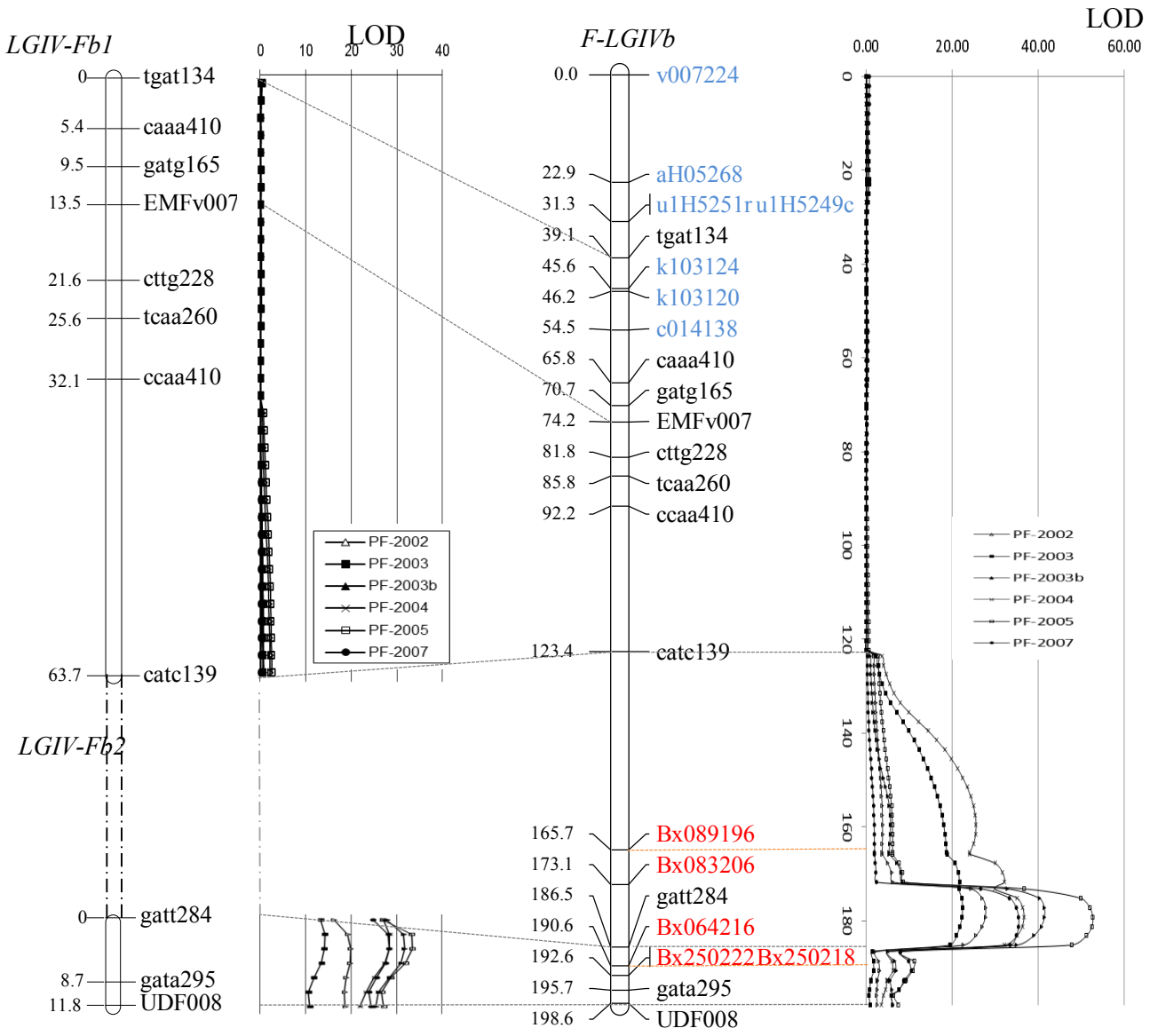
- 2 groups of genotypes for flowering : PF and SF
- continuous distribution for runnering

1 major QTL fot both traits, RU and PF
Antagonism between the two traits in the population.

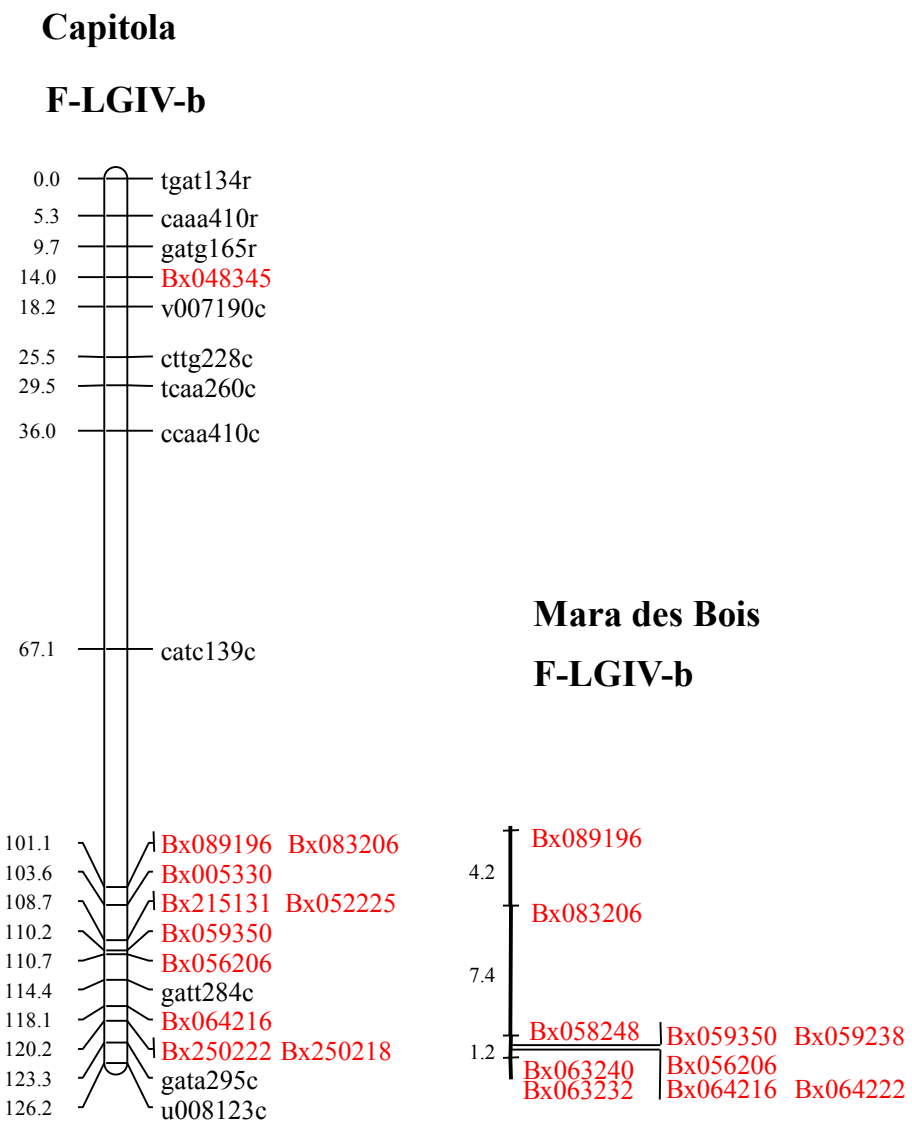
Quantitative perpetual flowering suggesting other genetic controls

Gaston et al., JXB, 2013

Adding markers in the genomic region of interest for improving the use of markers of MAS



Same introgression in different cultivars



The use of developed markers in different segregating populations

Genotypes of the parents

Presence of markers in PF

Different situations for OF genotypes: Presence or absence of markers

	Polyacrylamide gel									
Génotypes	Bx089	Bx083	Bx005	Phenotype (PF or OF)	Bx215	Bx052	Bx059	Bx056	Bx064	Bx250
Perpetual flowering										
Capitola	1	1	1	PF	1	1	1	1	1	1
Mara des Bois	1	1	1	PF	1	DD[(c)]	1	1	1	DD
Parent_PF1	1	1	1	PF	NA	0	1	1	1	1
Parent_PF2	1	1	1	PF	NA	0	1	1	1	1
Once flowering										
CF1116	0	0	0	OF	0	0	0	0	0	0
Pajaro	0	0	0	OF	0	0	0	0	0	0
Parent_OF1	1	1	1	OF	NA	0	1	1	1	1
Parent_OF2	0	0	0	OF	NA	0	0	0	0	0
Parent_OF3	0	0	0	OF	NA	0	0	0	0	0
Parent_OF4	1	1	1	OF	NA	0	0	0	0	1

DD, double dose.

The use of developed markers in different segregating populations

Results in samples of segregating populations

Population	Parent 1	Parent 2	N° ind.	**Bx064**	**Bx089**	Both Markers present & Rem.	Both markers absent and NOT Rem.
Population1	Parent_OF1	Parent_PF1	10	6	6	5/7	0/3
Population2	Parent_OF1	Parent_PF2	10	5	5	4/4	0/6
Population3	Parent_PF1	Parent_OF2	10	9	7	**3/4**	**4/6**
Population4	Parent_PF2	Parent_OF2	10	9	9	**7/7**	**2/3**
Population5	Parent_OF3	Parent_PF1	10	9	8	**1/1**	**7/9**
Population6	Parent_OF4	Parent_PF1	10	8	6	3/3	2/7
Population7	Parent_OF4	Parent_PF2	9	6	6	0/2	6/7
Population8	Capitola	CF1116	218	110	100	95/97	90/90

The markers can be used only when they are present in the PF parents and absent in the OF parent (Populations 3, 4 and 5)

Summary of results obtained in genetic resources

RECOMBINANTS	Distribution of phenotypes			
Markers Bx056-Bx005	total	N°PF	N°OF	N° uncertain
Nb of genotypes 1-1	35	17	10	8
Nb of genotypes 0-0	23	0	18	5
Nb of genotypes 1-0	7	0	6	1
Nb of genotypes 0-1	9	3	3	3
Nb of genotypes ?	7			
Total	81			
PF: Perpetual Flowering or everbearing / OF: Once flowering or June bearing				

The presence of markers in OF genotypes can be explained by pedigree. Old genotypes have had a double recombination around the trait

Name	Bx005	PF or OF	Bx056
Ciflorette (Mamie x Earlyglow)	1	OF	1
Earlyglow	1	OF	1
Mamie	1	OF	1

In conclusion: The presence of markers in OF genotypes is not rare.
Therefore, parents have to be genotyped before the use of markers in MAS for the everbearing trait.

What we can gain by using MAS for the everbearing trait?

Screening on S0: MAS can enable to produce more seedlings and evaluate just the right combination.
Exemple: introduction of a qualitative traits present in a everbearer variety (taste) for a june bearer project: Make more crosses (1000 seedlings) and keep just the 0-0 types: 2 weeks lab work to increase of 50% the probability of getting the right phenotype

Screening for S1: to avoid false positive for everbearers on second year: flowering observations alone on seedlings S0 indicating a possible everbearer phenotype is sometime not confirmed on the next year on the propagated plant leading to a wrong cultivation system:
-> wrong use of limited number of plots (cost effective).
50 plots available: 100 candidates S1 to analyse.
Cost of 2 analysis < cost of 1 plot

MAS: *The gain of the probability increase of success is difficult to evaluate*
The loss due to a junebearer cultivar taking the room space of a everbearer cultivar in a everbearer cultivation system trial is in the 100's €

MAS will be more efficient on several traits:
everbearing + fruit quality + disease tolerance


THANK YOU
FOR YOUR
ATTENTION