

Identification of a new pear (*Pyrus Communis*) QTL associated with spring vegetative budbreak

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RG8



Introduction

- Climate change threatens production of deciduous fruit trees
 - Vegetative and floral budbreak disorders
 - Insufficient fruit quality
 - Yield reduction
- Pear is among the three most important fruit crops in temperate zones



Low chill cultivars are needed

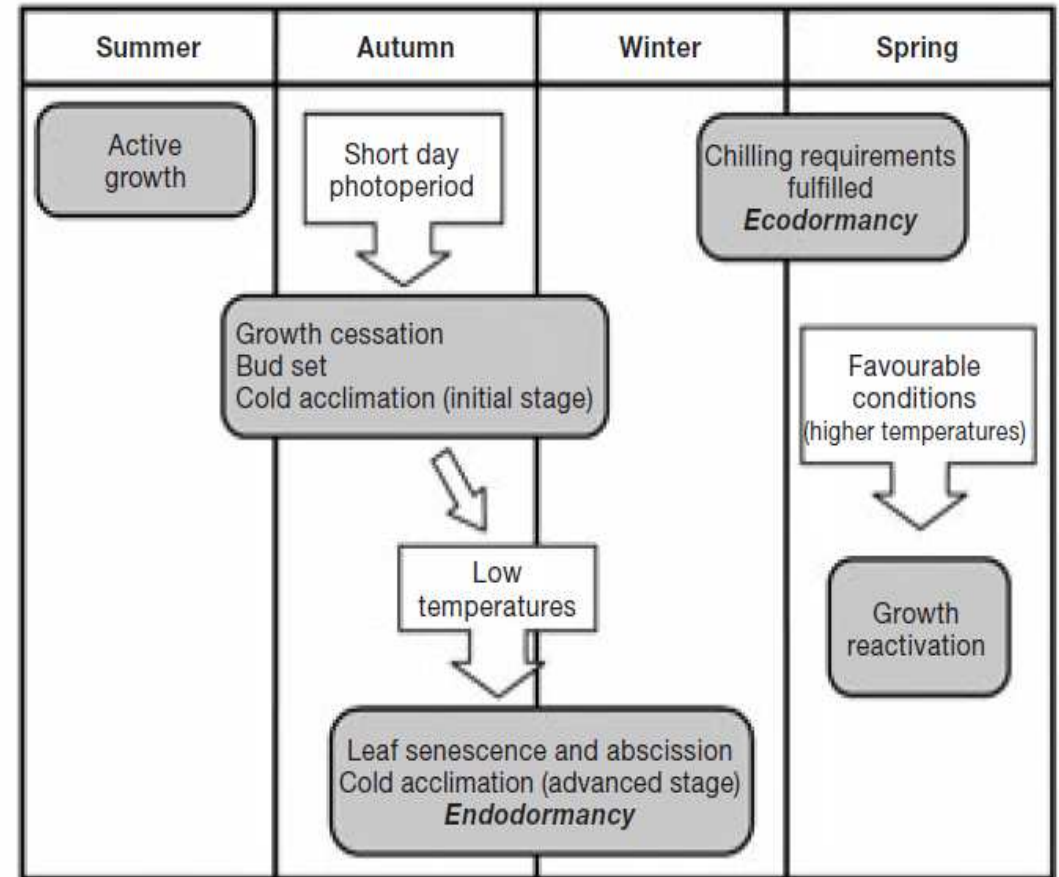
(Sugiura et al., 2012; Saito et al., 2013; Wu et al., 2013)



Pyrus Communis

Introduction

- Chilling requirement amount is *genetically* determined
- Ecodormancy bud release is provoked by *environmental* factors (Saito et al., 2013)
- Previously published QTL's mapping in apple (van Dyk et al., 2010; Celton et al., 2011; Allard et al., 2016)



Dormancy stages of woody plants
(Aragoncillo et al., 2008)

Introduction

Fruit breeding for warm climate in Israel

- Mediterranean-type climate, hot spring and summer temperature
- Fruit tree cultivation suitable under warm conditions
- Center for warm climate horticulture

The ARO Volcani center pear breeding program

Objectives: **Low chill cultivars**, disease resistance

↓

‘Spadona’(SPD) X ‘Harrow Sweet’(HS)
Low chill High chill and fire blight resistant
2010



Introduction

The aim of this study

Analyzing the genetic, environmental and interactions (GXE) factors of vegetative budbreak in pear (VB) by:

Phenotyping:

Vegetative budbreak(VB) timing

- Full-sib family - low and high chilling requirements(CR) (**G**)
- Locations with different chilling hours (**E**)

Genotyping and analysis

- Molecular markers ‘tail analysis’ (genotyping the extremes individuals)
- QTL’s and markers analysis associated to vegetative budbreak



Materials and Methods

“On-wheel” Orchard

Parents

SPD X HS

F1

180 genotypes X 4 clones

2 clones planted in ‘Bet Dagan’

2 clones planted in portable pots

Chilling requirements

*'Spadona' 300 chilling hours

'Harrow Sweet' 800 chilling hours

*'Spadona' is the main cultivar in Israel



‘Bet Dagan’ (50m a.s.l) Orchard

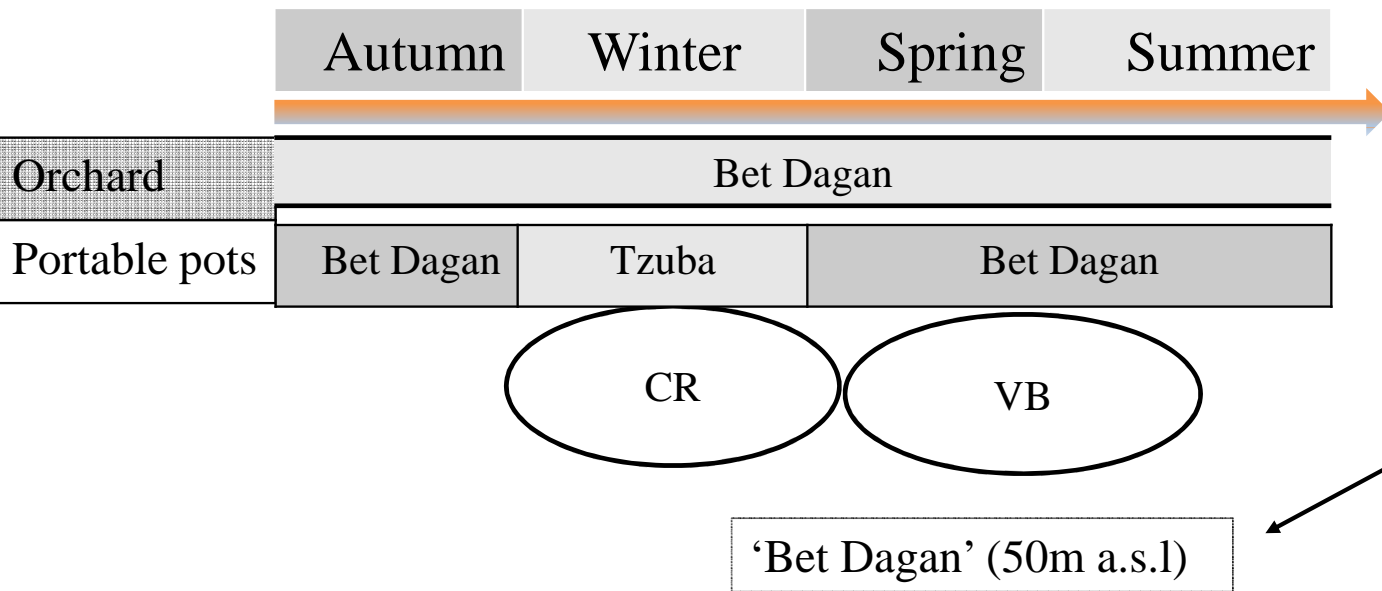


‘Tzuba’ (720m a.s.l) - Winter

‘Bet Dagan’

Materials and Methods

Locations and chilling hours



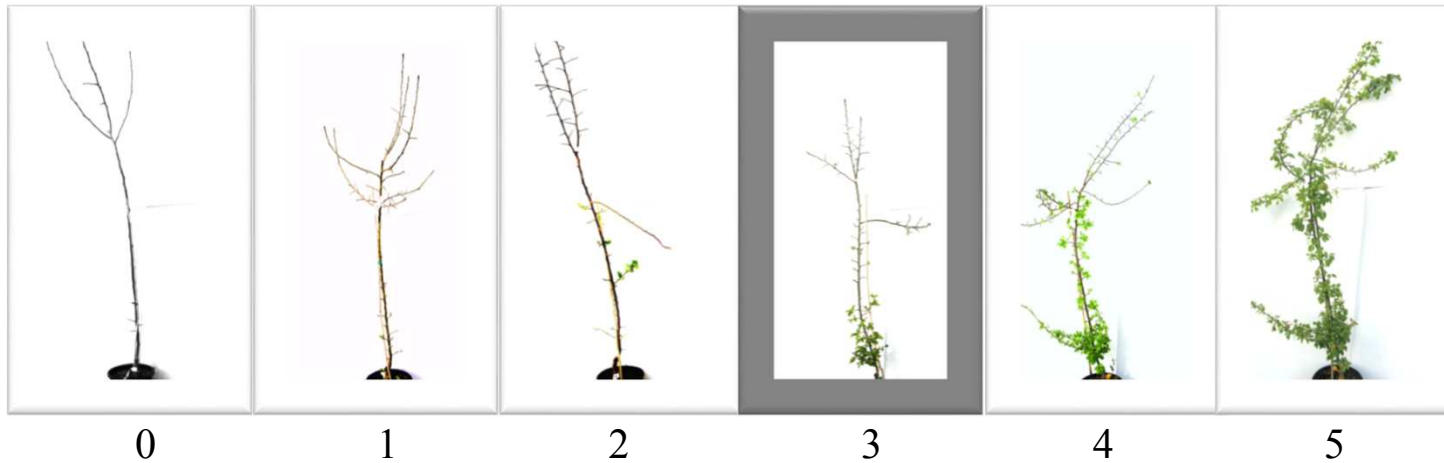
'Tzuba' (720m a.s.l)

- The average chilling hours are significantly different between the sites
- Same heat conditions inducing VB ('Bet Dagan' 10-25°C During March)

Materials and Methods

Phenotyping

- Evolutions were done under the same conditions ('Bet Dagan')
- 2-3 Days Intervals
- 2 years (2014-2015)



Vegetative Budbreak stages

Materials and Methods

Genotyping and marker selection

Previously published QTL's in **apple**
(LG8 and LG9)

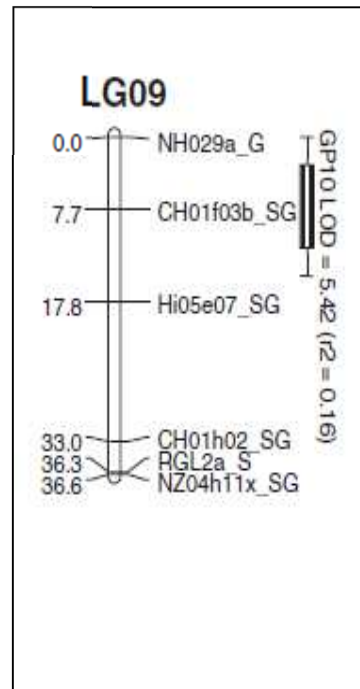
Published **Pear** Genetic SSR data

40 SSR markers were examined for
potential QTL's mapping in **Pear**

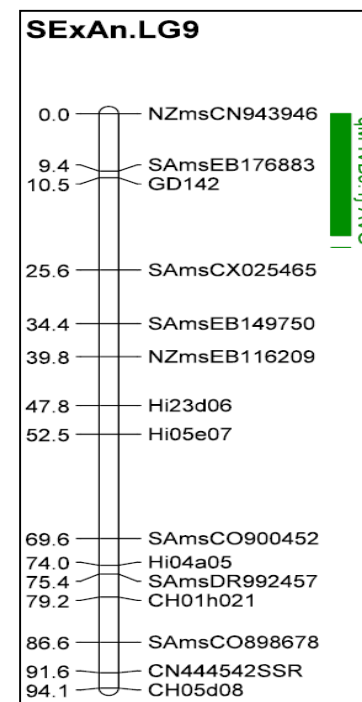
Selection of SSR markers (Parents
Polymorphism)

Tail analysis of SPDxHS F1

Previously published QTL's

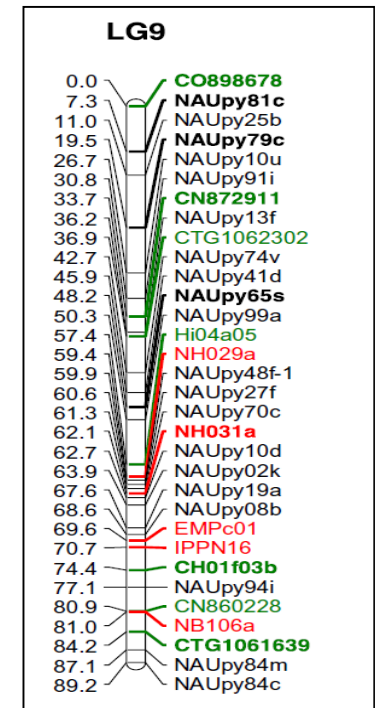


(Celton et al., 2011)



(van Dyk et al., 2010)

SSR Map



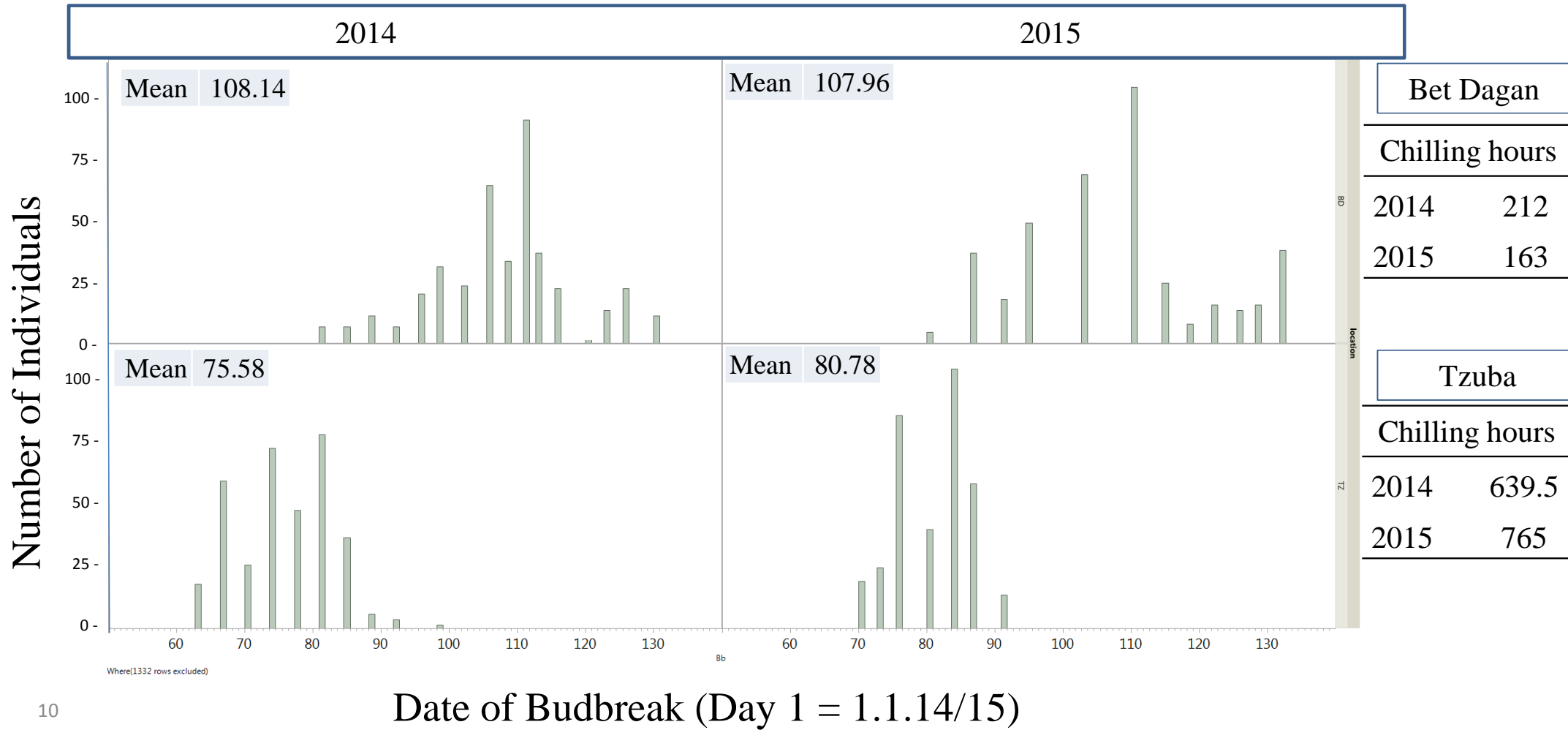
(Chen et al., 2014)

Apple

Pear

Results

Vegetative budbraek date of SPD X HS F1 population



Results

Phenotype data statistics

REML analysis

Normalization was performed due to the variance gaps between the sites

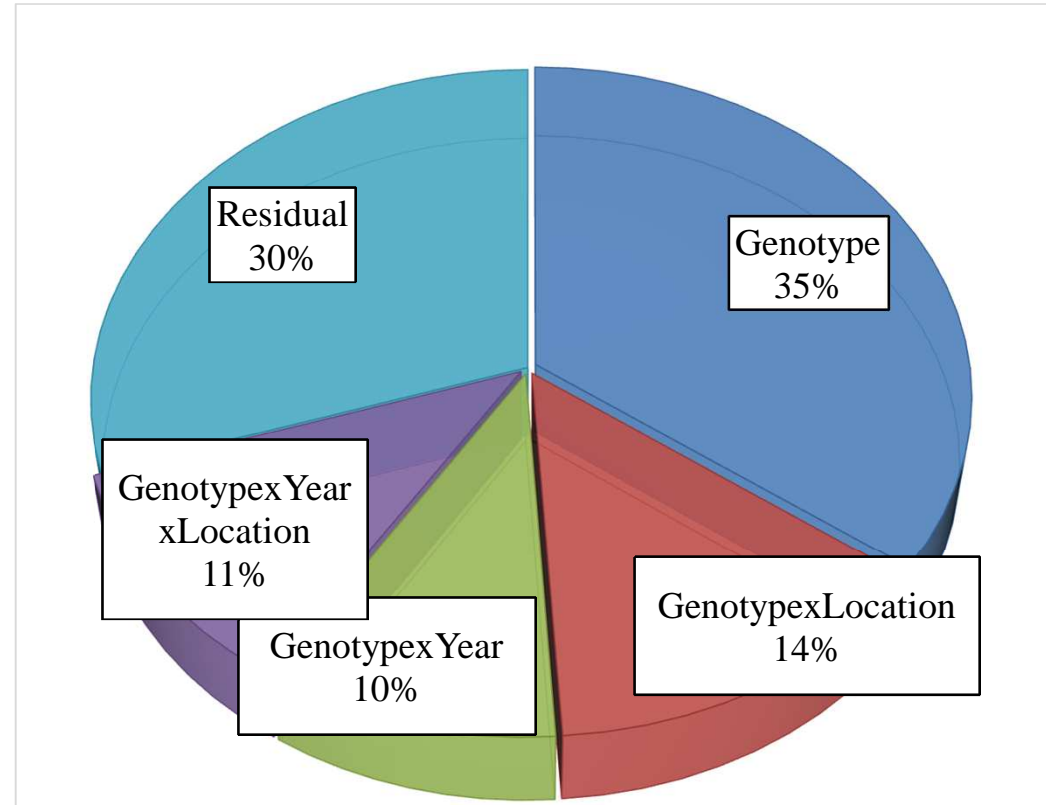
Random effect: Genotype, Year and all interactions

Fixed effect: Location



70% of the variance in VB date is explained by the genotype and its interactions

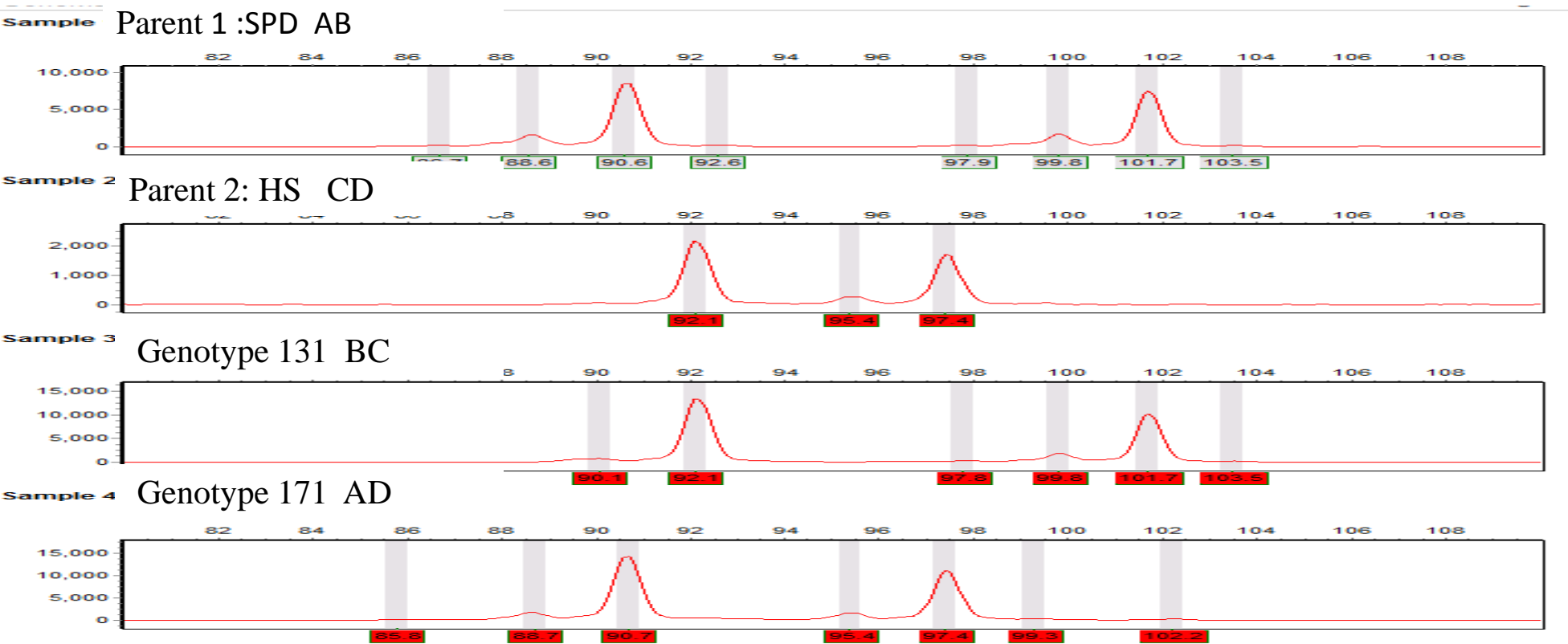
Budbreak time variance component %



Results

Genotyping

14 markers were selected based on allelic polymorphism



SSR fragments detected and sized by the ABI PRISM™ 3730xl DNA Analyzer

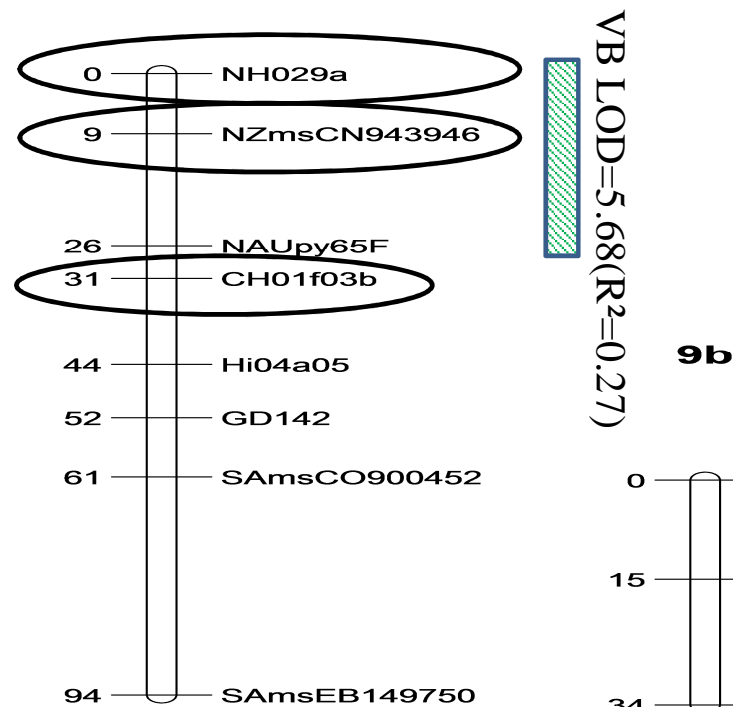
Results

QTL analysis

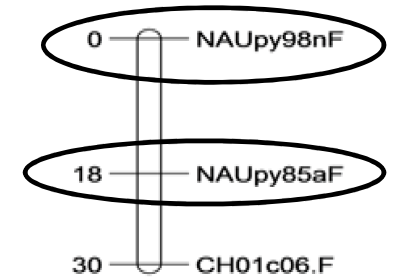
Group	Locus	LOD
8	CH01c06.F	0.03
8	NAUpy85aF	3.85
8	NAUpy98nF	3.5
9	CH01f03b	3.86
9	GD142	2.64
9	Hi04a05	1.9
9	NAUpy65F	2.32
9	NH029a	4.36
9	NZmsCN943946	5.68
9	SAmSCO900452	0.25
9	SAmSEB149750	0.93
9b	SSR-C	2.79
9b	NAUpy13f	0.28
9b	NHo31a	0.06

NZmsCN943946 Expl. 31.2 %

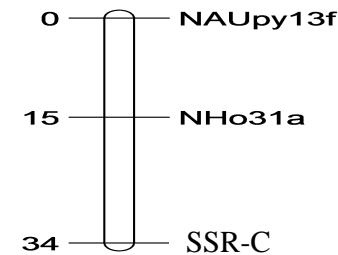
Linkage group 9 SPD X HS



Linkage group 8 SPD X HS



9b



Grouping LOD threshold = 4

Conclusions

- Chilling requirements are majorly influenced by genetics factors (70%)
- VB time QTL was detected on LG9
- Two SSR markers on Lg8 showed association to VB time
- Our results suggest synteny between apple and pear in chilling requirements and confirmation of the previously published QTL's in apple (LG8 and LG9)

Thank you very much!!

To my supervisors:

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Mrs. Yardena Dahan

Mr. Yacov Izhaki

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Dr. Tal Isaacson

ARO, Newe Yaa'r

Dr. Assaf Distelfeld

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