Characterisation of the QTL associated with chill requirement during endodormancy in *Malus x domestica* Borkh.

S Cornelissen, JT Burger and DJG Rees
South African Apple Production

- 22 700 Ha
- 817 000 tons produced
- 16th largest producer in the world
- 7th largest exporter
- 388 000 tons exported
- R7 billion industry
Pome producing regions of South Africa
Chilling units for the Elgin region over the last 7 years

Average of Chilling units required by most apple varieties grown in South Africa (650 CU’s)
Prolonged dormancy symptoms in apple trees

- Delayed foliation
- Reduced branching
- Erratic flowering and fruiting
- Reduced fruit quality
Lady Williams x Anna Population

- F1 Outbred cross
- 98 Individuals
- Difference in Initial Budbreak from lowest to highest: 75 days
Genetic Mapping: Methodology

DNA Isolation from leaves

8K Apple Infinium SNP chip

Scan on HiScanSQ

QTL analysis with MapQTL™ 6.0

Draw genetic maps with JoinMap™ 4.1

Analyse and cluster with Genomestudio™
Lady Williams x Anna Genomic Map

Linkage Group 1-17; Total length: 1984 cM; Total nr of SNPs: 3112
QTL analysis: Major QTL on Linkage

Group 9

60.9% Phenotype Explanation
RNA-Seq Analysis

Cuttings from Anna and Lady Williams → Incubate at 4°C → Dissecting buds for meristem at ≈ 100 hour time intervals → RNA extraction from meristem → TruSeq library preparation → HiSeq 2500 → Cuffdiff ← Cufflinks ← Tophat ← Trimmomatic
Genes of interest within QTL on Linkage Group 9

Membrane Component

ATP Binding

Glycerophosphodiester phosphodiesterase

Transcription factor
Transcriptomic expression of genes in QTL on Linkage Group 9

**Glycerophosphodiester phosphodiesterase**

- **Anna**
- **Lady Williams**

**Transcription factor**

- **Anna**
- **Lady Williams**

![Graphs showing expression values over hours spent at 4°C for different genes in Anna and Lady Williams.](image-url)
Heatmaps of selected differentially expressed genes

Differential expression of Anna

Increase in time interval

0 Hours 300 Hours

Differential expression of LW

Increase in time interval

0 Hours 600 Hours
Current and future work

• Characterization of minor QTLs
• Verification of QTLs in Royal Gala x Anna Population
• Finding possible variations of these genes in different germplasm
• A global gene expression analysis for the parents
• Validating gene expression of putative candidate genes
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