HAL
archives-ouvertes.fr

Genetic determinants of response to water deficit in cultivated tomato fruits – QTL x E analysis

Elise Albert, Claire Duffes, Julien Bonnefoi, Justine Gricourt, Yolande Carretero, Esther Pelpoir, Mathilde Causse

▶ **To cite this version:**

Elise Albert, Claire Duffes, Julien Bonnefoi, Justine Gricourt, Yolande Carretero, et al.. Genetic determinants of response to water deficit in cultivated tomato fruits – QTL x E analysis. The Genome Analysis Centre, Jan 2015, Norwich, United Kingdom. 2015. hal-02799805

HAL Id: hal-02799805
https://hal.inrae.fr/hal-02799805

Submitted on 5 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Genetic determinants of response to water deficit in cultivated tomato fruits – QTL x E analysis

Albert E., Duffes C., Bonnefoi J., Gricourt J., Carretero Y., Pelpoir E., Causse M.

INRA, UR1052 Génétique et Amélioration des Fruits et Légumes F-84143 Montfavet, France

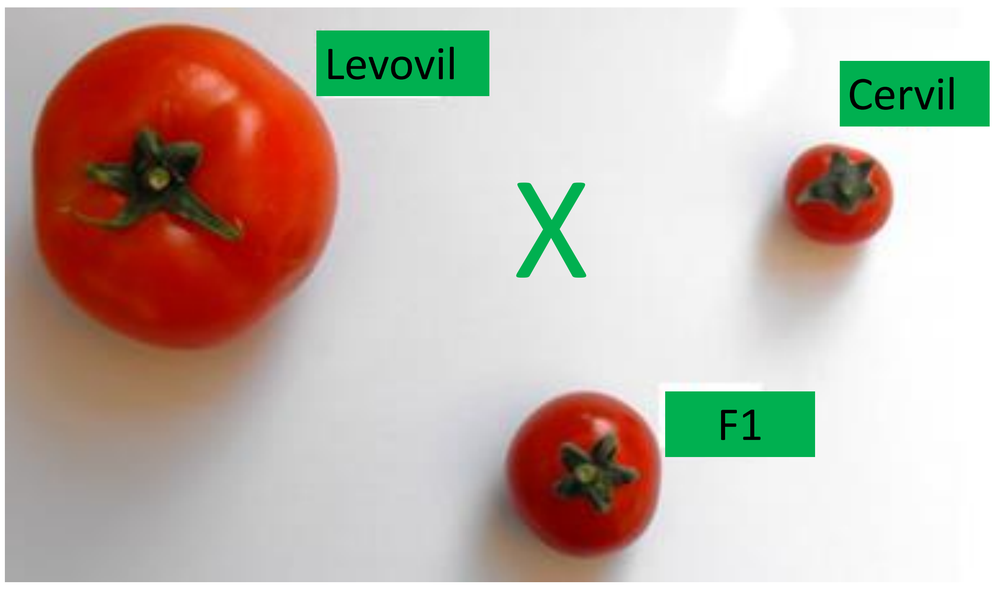
Context

- Tomato, grown in drought areas, **requires a large amount of water** for its production.
- A slight limitation of water input can have a positive impact on tomato **fruit quality** by increasing the concentration in **taste and nutritional compounds.** But the right balance must be found **to limit yield loss**.
- Only a small part of the genomic regions involved in tomato behavior under water deficit (WD) have been identified.

➢ This study aims to i) **describe the pattern of genotype (G) by water regime (WR) interaction** at the phenotypic levels and ii) **reveal the genetic architecture of** response to WD in tomato fruits.

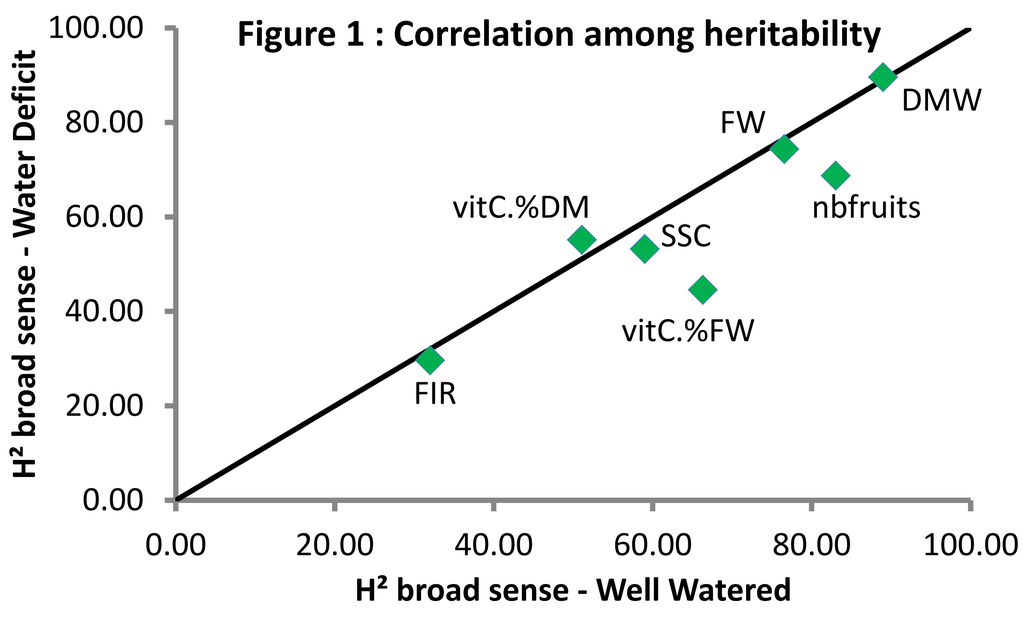
Materials & Methods

- **119 RILs** from a cross between Levovil (sensitive to WD) and Cervil were grown in greenhouse under **two WR** : well watered (WW) and water deficit (WD = 50% WW).
- Fruits were phenotyped for **their number per plant** (nbfruits), **fresh weight** (FW), **firmness** (FIR), **dry matter** (DMW), **soluble sugar** (SSC) and **total vitamin C** (vitC) contents. **Yield** (fruit fresh weight per plant) was estimated as the product FW x nbfruits.
- RILs were genotyped for 501 SNPs covering **98% of the tomato genome**. A QTL analysis was performed using **QTLNetwork-2.0** software, with a **multi-environment analysis approach** ($p < 0.05$ and threshold with 1,000 permutations).



Impact of WR & heritability

- **Strongly significant interactions G x DH** were observed ($p < 10^{-5}$), representing between 6 and 21% of the total SCE and resulting from **rank (~ 90%) and scale changes (~ 10%).**
- High negative correlation between the ratio $(FW_{WD} – FW_{WW})/FW_{WD}$ and FW_{WW} (pearson = -0.49) **indicate higher losses of FW under WD for large fruit genotypes**, mainly due to **important water loss**.
- **Broad sense heritability** per trait and watering regime ranged **from 30%** (FIR) **to 90%** (DMW).
- Heritability among the watering regimes were strongly correlated (0.89), as well as the genetic variance (0.99), suggesting **a conserved genetic variability in the two treatments** [Figure 1].



QTL detection & QTL x WR

- **30 QTL were detected**. They **explained between 2 (FW_{WD} & $yield_{WW}$) and 35 % (FW_{WW})** of the phenotypic variability (PVE).
- **5 QTL showed a significant interaction QTL x WR**, two with **opposite effect** according to the watering regime (for DMW & SSC) and three with **reduced effect** according treatment (Yield and FW) [Figure 2].
- Two different QTL for vitamin C were detected on linkage groups 4 and 8, according the expression of the content in percentage of dry mater weight or fresh mater weight. It suggests that **dilution effect is important in tomato fruit under WD.**

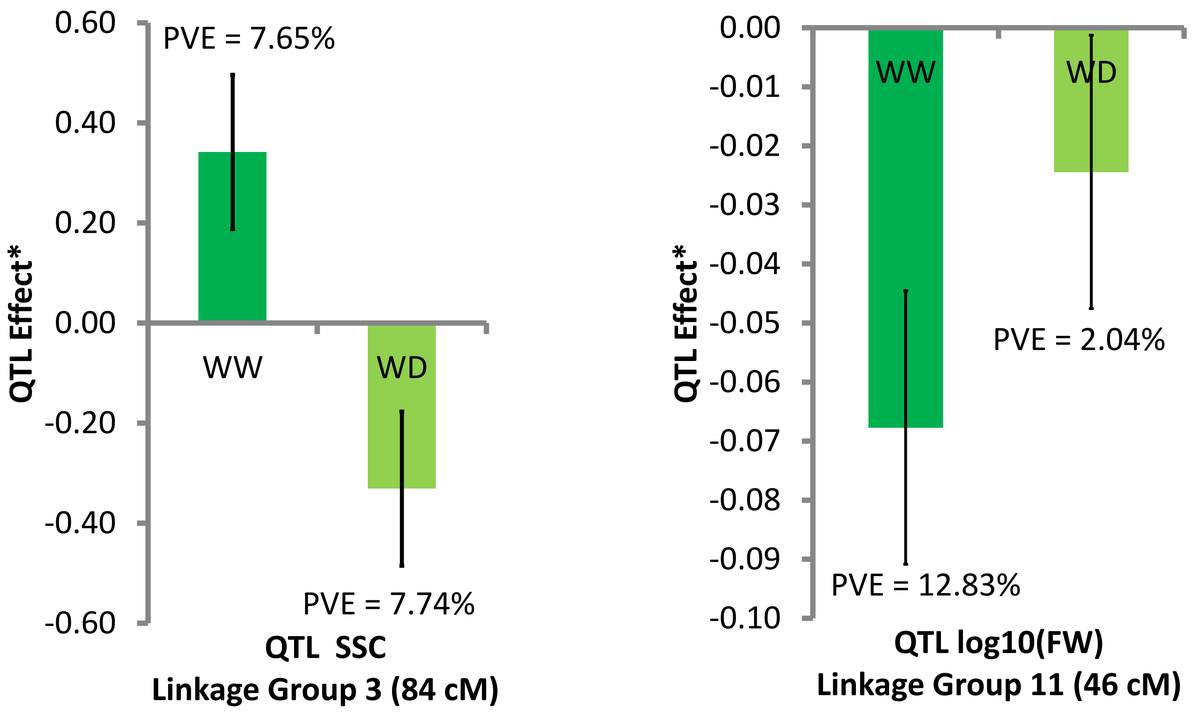


Figure 2 : Two examples of QTL x WR

** QTL effect = (mean allele Cervil – mean allele Levovil)/2*

Conclusion & prospects

- High **genetic variability** for response to WD in tomato
- Important **dilution effect** in tomato fruits under WD
- **20% QTLs** showed significant **interaction with water regime**

➢ Parallel GWAS analysis in the same conditions with a more genetically diversified population

➢ Screen for the underlying genes (RNAseq and gene expression…)

Funding : INRA SCIENCE & IMPACT · CTPS · Agence Nationale de la Recherche ANR