Interactive effects of crop and process management determine the quality of tomato products

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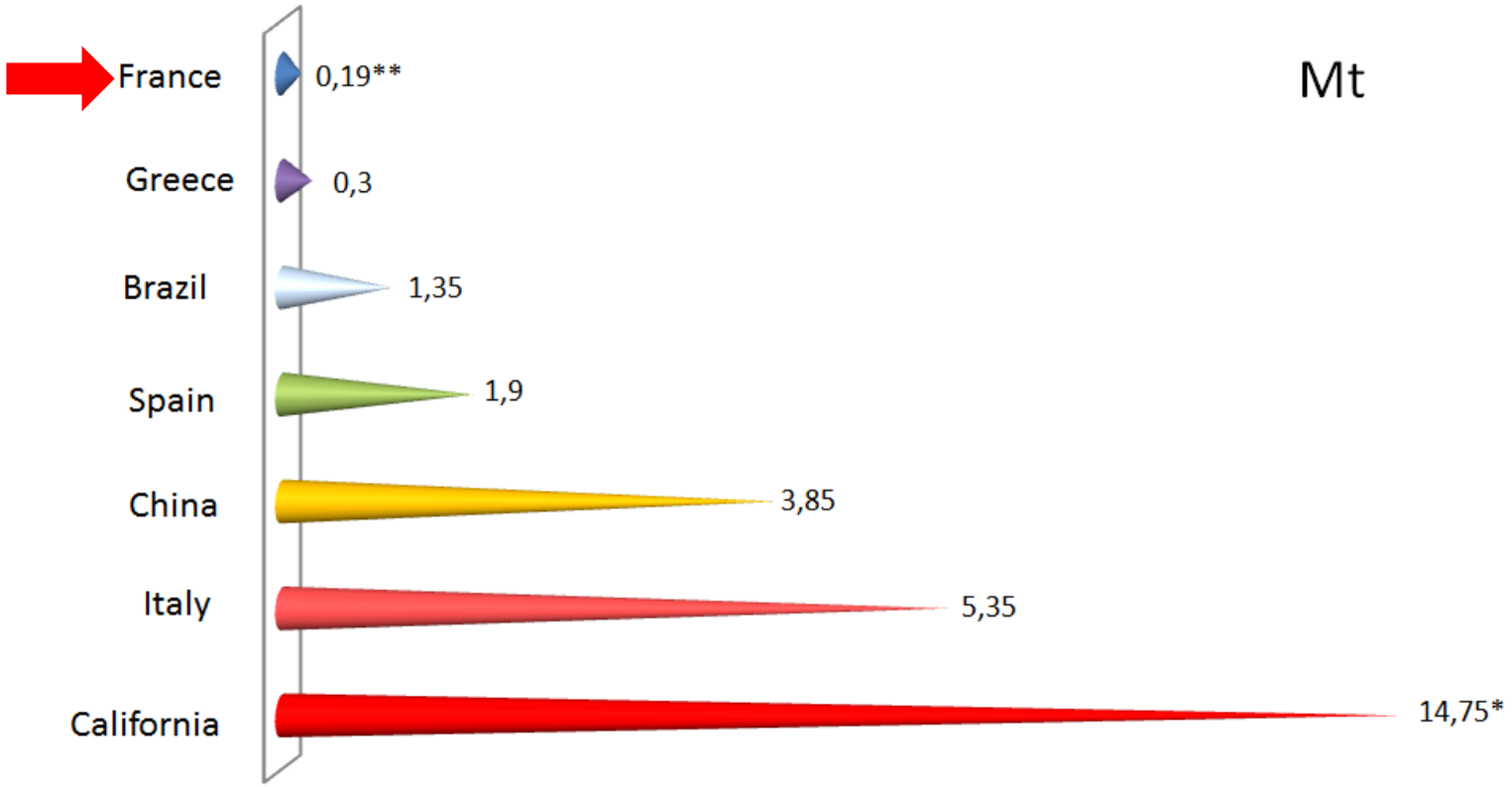
The industry tomato in France



* USDA, 2015
** France Agrimer, 2014

Industry Tomato, an intensive production in terms of water use

- A major environmental concern in agriculture is the use of fresh water for irrigation.
- Water resources are under threat due to the increase in water demand for agriculture, and the gap between water availability and demand is exacerbated by global climate changes.

Afzal, M., et al. (2016). Agric. Water Manage. 176, 40-54.

- Tomato crop is highly concerned with this issue. In Italy, the blue water footprint (ratio of the volume of irrigation to the crop yield) of this production has been estimated at 60 m3 per ton.

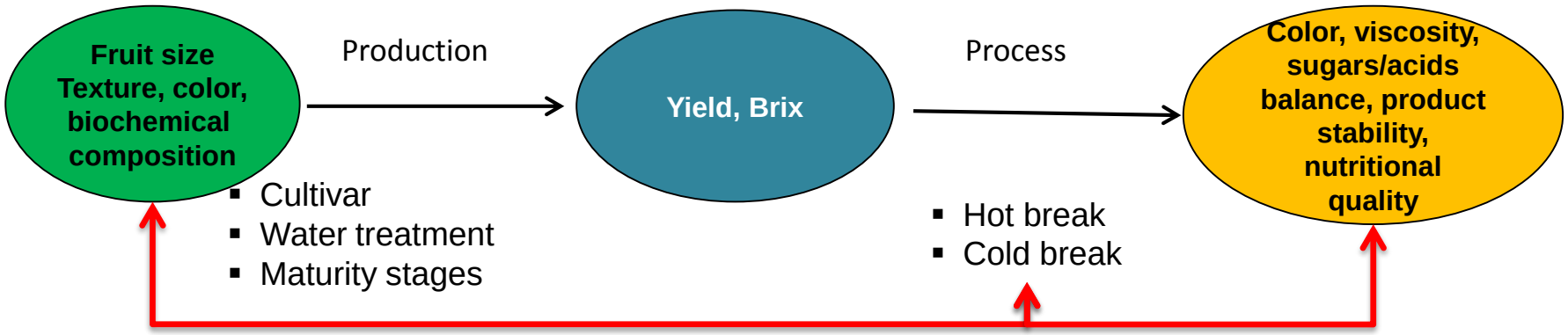
Aldaya, M.M., and Hoekstra, A.Y. (2010). Agric. Syst. 103(6), 351-360.

Quality is build throughout the food chain









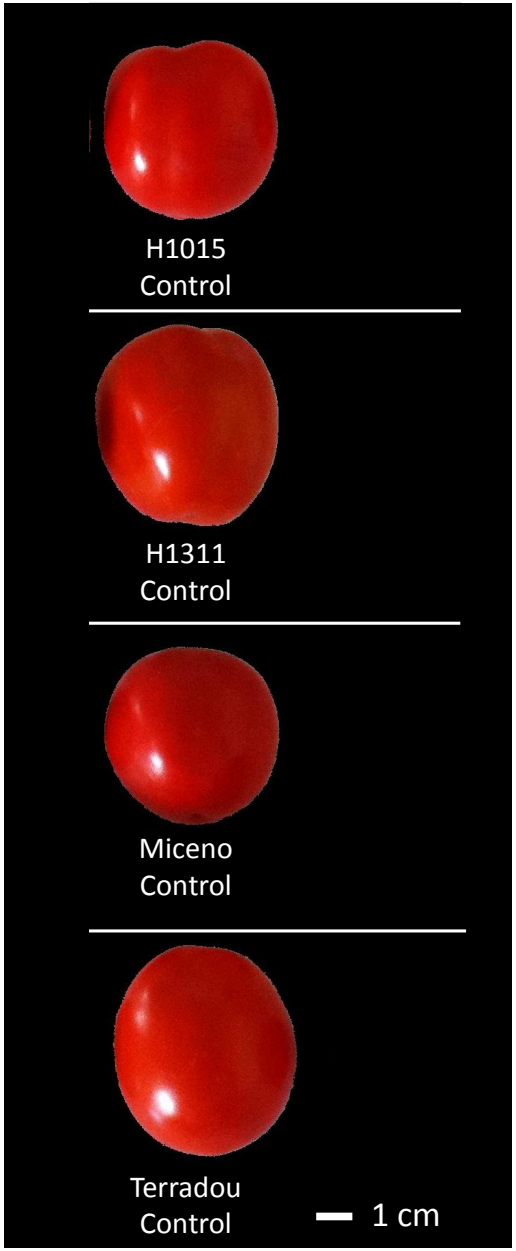
What are main factors impacting quality ?

Pre- and post-harvest relationships? Can we find early indicators of the final quality ?

Towards the management of quality throughout the food chain

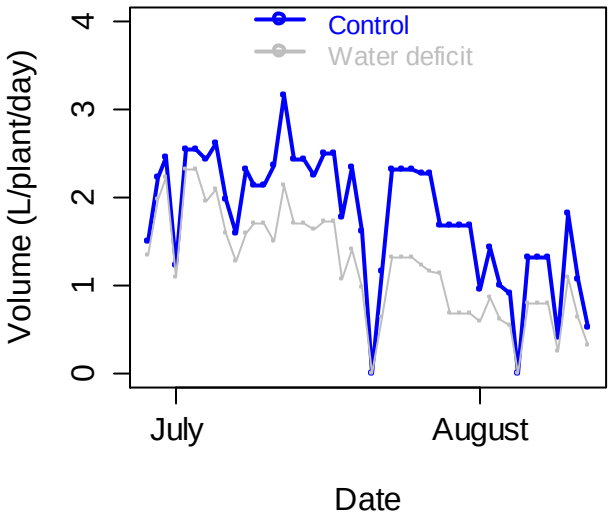
Strategy: Analysis of 4 cultivars, 2 water regimes, 3 maturity stages, and 2 processes

- Four cultivars selected on the basis of a previous study and for giving contrasted purees



- Medium lycopene content and medium viscosity
- High lycopene content and high viscosity
- Medium lycopene content and medium viscosity
- low lycopene content and low viscosity

Representation of the two irrigation regimes

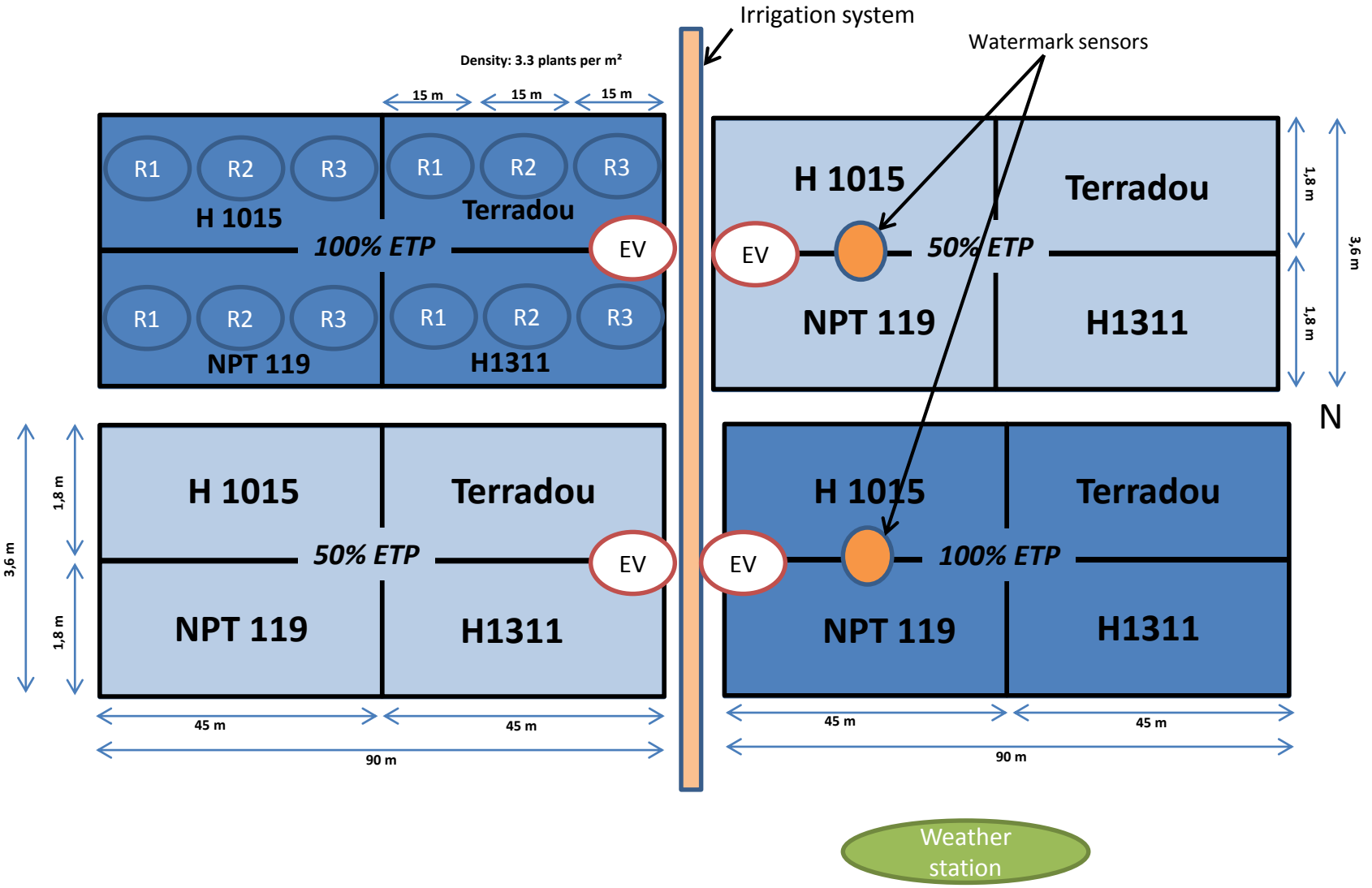


- Irrigation was scheduled daily to compensate the evapotranspiration loss from tomato crop (ETP).
- Water was first supplied every day in order to fully fit 100% of ETP.
- Forty-five days after planting, two levels of irrigation were applied: (1) water deficit (60% replacement of ETP) and (2) well-watered to match 100% replacement of ETP.

- Fruits were harvested at 40 (light orange), 47 (orange red) and 55 (red ripe) days after anthesis (DAA) for quality analyses and processing.

Representation of the two process

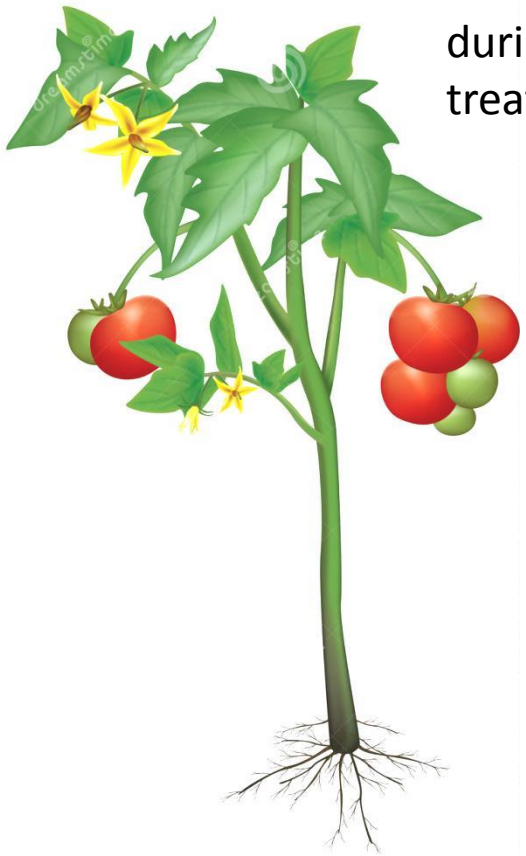
Transplanting: May, 17th 2016
Water treatment: June, 20th 2016



Traits monitored during the season and at the harvest

- Climatic data recorded daily (temperature, rainfall, solar radiation)

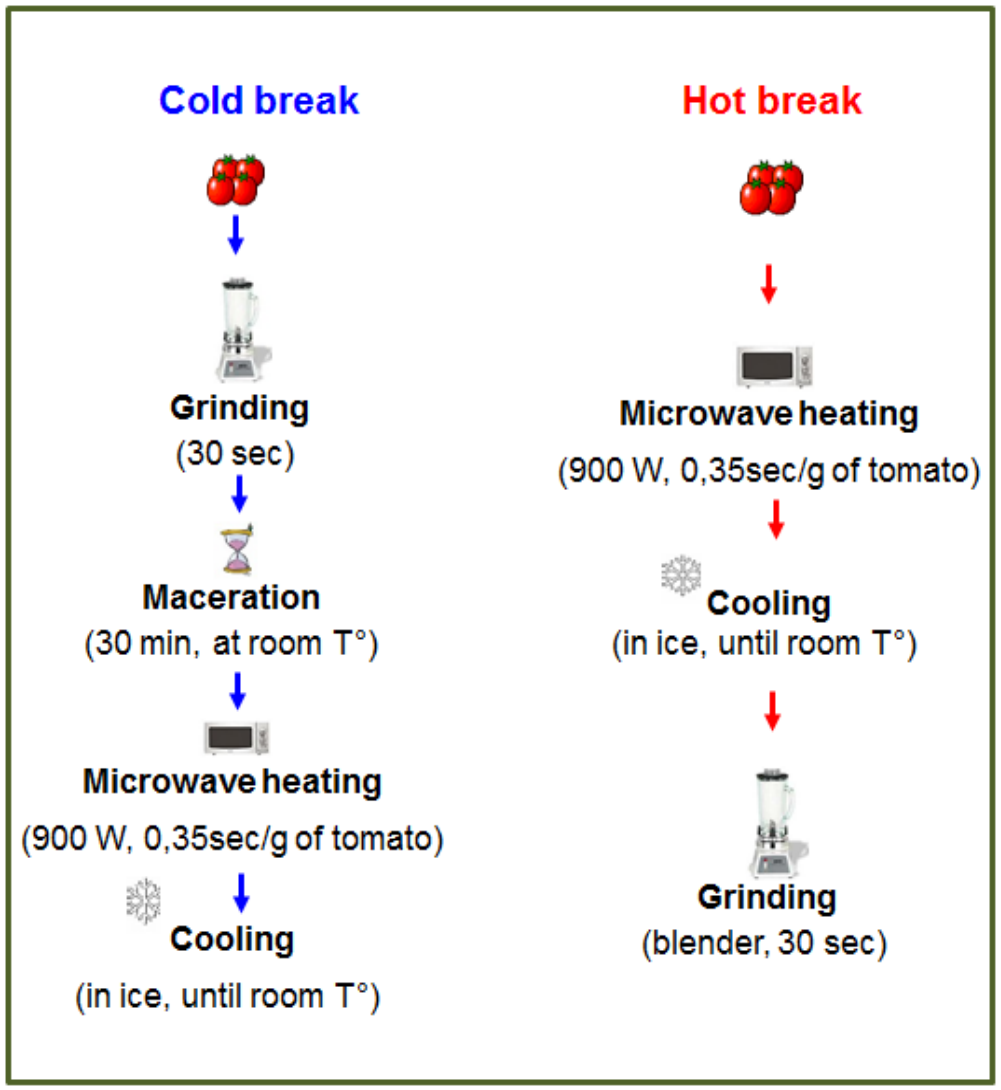
- Soil humidity monitored daily



- Stomatal conductance, water potentials, and Specific Leaf Area determined 3 times during the water treatment

- At harvest: determination of fresh and dry yields, the number of fruits per plant, plant and fruit dry matter contents

Representation of the two processes



Hot Break

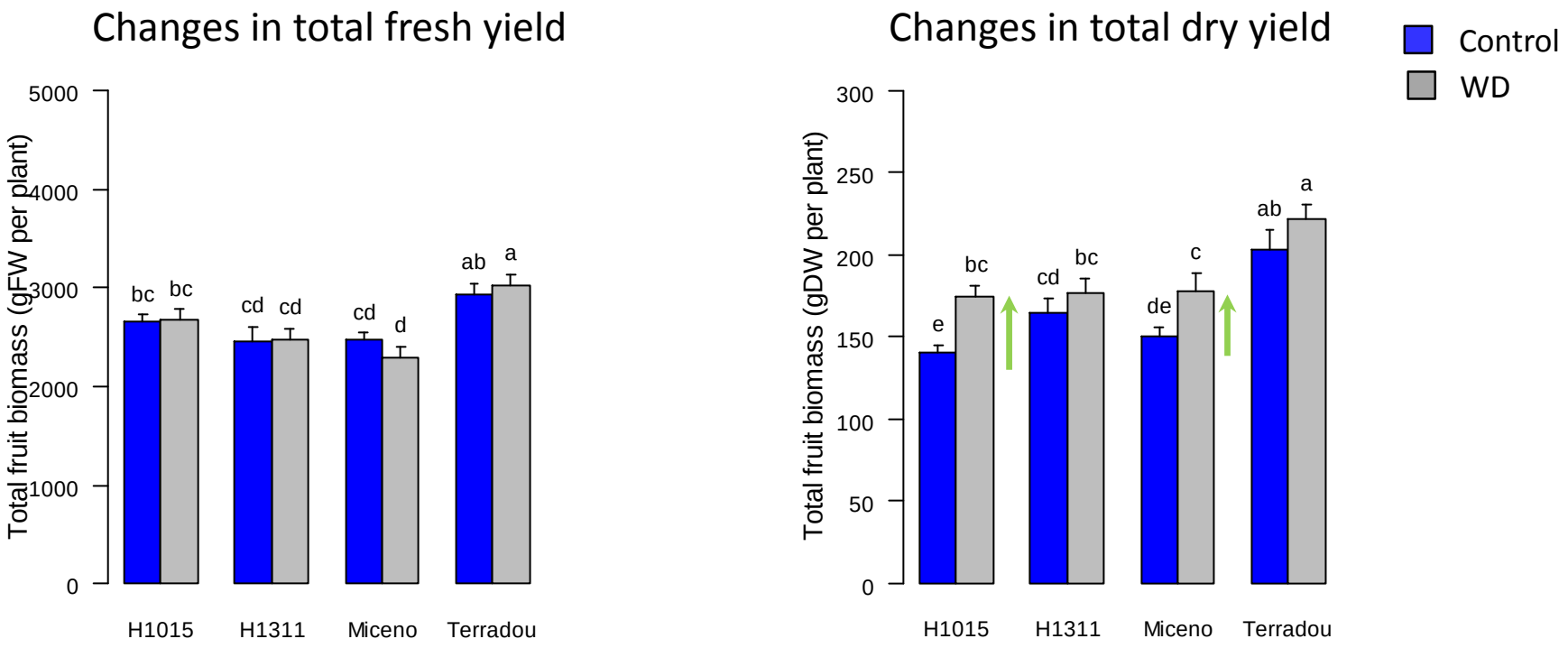
Cold Break

Quality traits determined on fruits and purees

- Fruit color, Brix, dry matter, starch, soluble sugar, organic acid and carotenoid contents

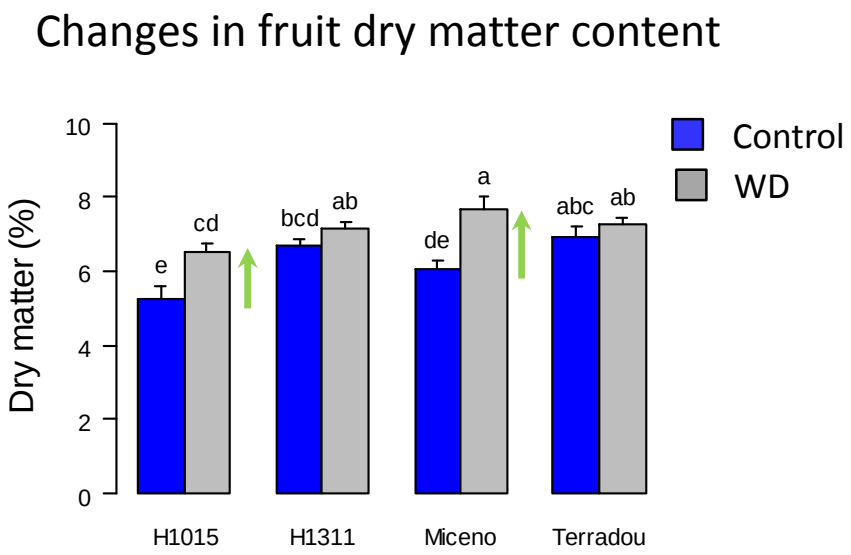
- Color, dry matter content and viscosity

Moderate WD did not reduced yield in field



- WD did not impact the fresh yield despite significant plant responses (reduction in stomatal conductance and in individual leaf area)
- WD slightly increased the dry yield (up to + 27% for H1015)
- The water use efficiency (total fresh yield / total water used for irrigation [$kg.m^{-3}$]) increased on average by 20% comparing WD to control

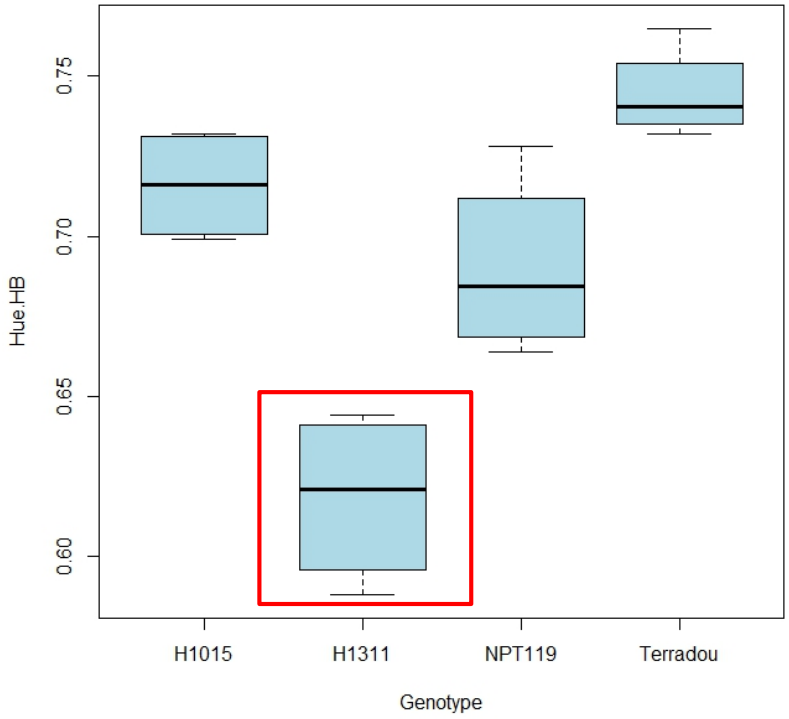
WD increased fruit dry matter content



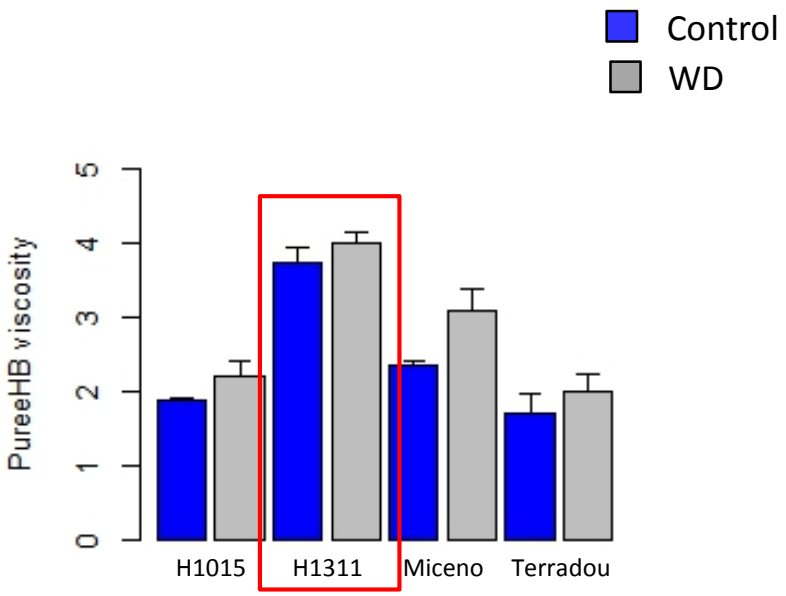
- Fruit dry matter content increased by 27% for H1015 and 26% for Miceno

The puree color and viscosity strongly depended on the genotype and on the maturity stage

Variations in Hue angle color parameter

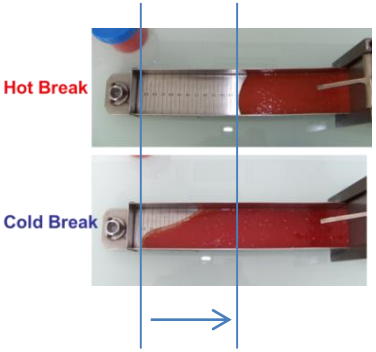


Variations in Viscosity

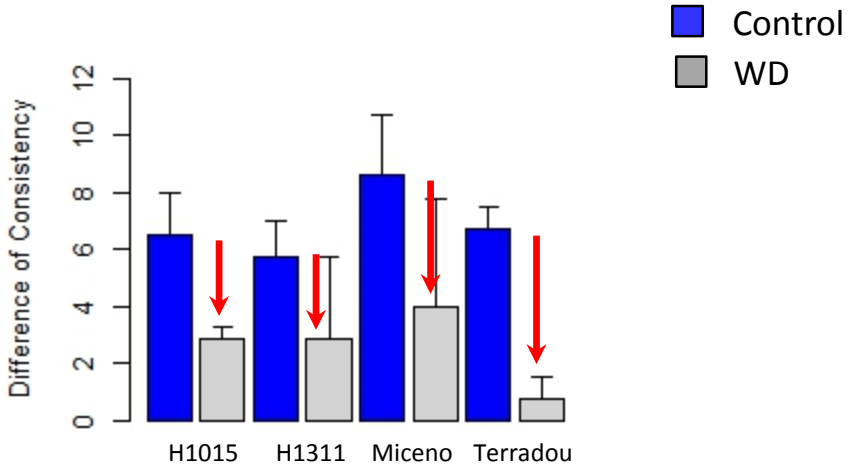


- The hot break purees from H1311 ripe fruits presented the lowest Hue values (highest red color)
- Cultivar H1311 produced the most viscous purees in all conditions
- WD led to significant higher puree viscosity

The water treatment impacted the fruit reactivity to process



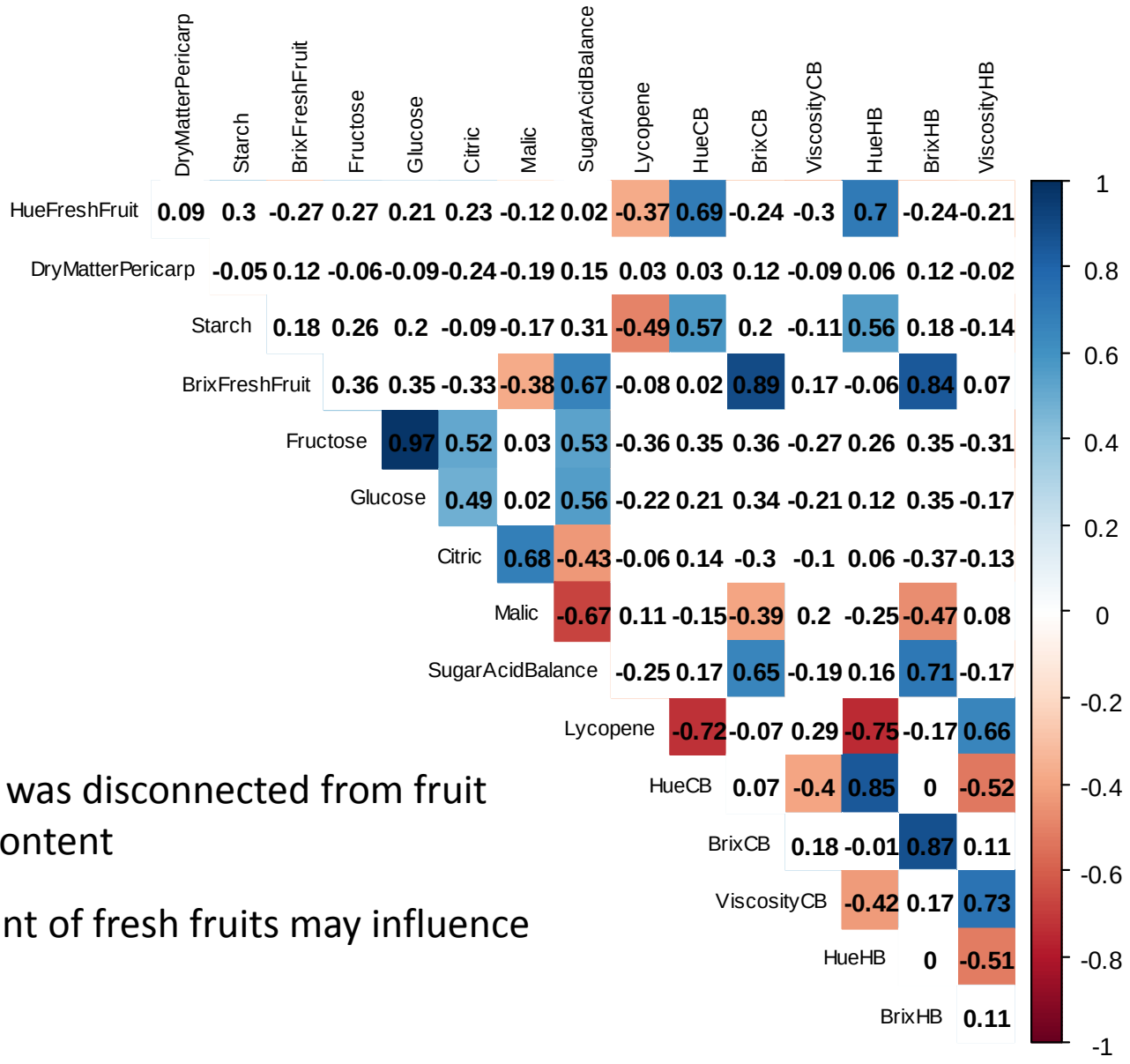
Difference of consistency
= enzymatic acivity for loosing viscosity



- WD significantly influenced the loss of consistency evaluated through the difference in consistency between HB and CB purees

- For all genotypes, fruit reactivity to process was remarkably lower for purees produced from WD tomatoes than for purees from control tomatoes

Relationships between pre- and post-harvest quality traits



- The puree viscosity was disconnected from fruit Brix or dry matter content
- The lycopene content of fresh fruits may influence puree viscosity

Conclusions and Perspectives

- A reduction of water supply from 100% to 60% of the ETP, increased the water use efficiency by 20% and may enhanced the dry yield depending on genotype.

- WD modified the reactivity of tomato fruits to process. The activity of pectin-degrading enzymes in response to WD should be analyzed in further details for a better understanding of the WD effect.

- Fruit Brix is not a good indicator of puree viscosity. Pectin composition and solid particle size and shape should be investigated in further details.

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