Breeding cut roses for better keeping quality: 

first steps

D. Fanourakis\(^1\), D.R.A Carvalho\(^2\), V. Gitonga\(^3\), A.W. van Heusden\(^3\), D.P.F. Almeida\(^2\), E. Heuvelink\(^1\), Susana M.P. Carvalho\(^{1,2}\)

\(^1\) Wageningen University – Plant Sciences Department, Horticultural Supply Chains group (The Netherlands)
\(^2\) Portuguese Catholic University – College of Biotechnology (Portugal)
\(^3\) Wageningen University – Plant Sciences Department, Laboratory of Plant Breeding (The Netherlands)
Introduction

- Production of high keeping quality plants is of utmost importance:
  - Increased competition in the ornamental horticultural sector
  - Key factor for consumers’ satisfaction

- Water stress is the major post-harvest quality problem
  \[\Rightarrow\] shorter vase life

- End of vase (at flower auction):
  - 52% water stress
    - Bent-neck
    - Leaf and flower wilting
    - Leaf drying
  - 33% Botrytis
  - 15% natural senescence
(sources: Van Meeteren, pers. comm)
How can we influence vase life of cut roses?

Problem is already there

- Genotype
- Environment during cultivation

Potential Vase Life
- e.g. 12 days

Actual Vase Life
- e.g. 7 days

Post-harvest handling

- Most research has been focused on post-harvest conditions (e.g. preservative solutions)
- Potential vase life = maximum vase life
Objectives

Contribute to fasten the selection criteria and procedures for breeding for cultivars with longer vase life (better control of water loss)

- Screen a segregating tretraploid (K5) rose population for stomatal responses to leaf desiccation
- Analyse the variation existing in the gene pool for:
  - stomatal responses to leaf desiccation
  - cuticular transpiration
- Vase-life evaluation
M&M: Cut rose population screening (Expt. 1)

- 110 genotypes & 2 parents
  - Population created for studying resistance to powdery mildew
  - Shows segregation for many morphological traits
- Greenhouse cultivation

- Response to leaf desiccation
  - n = 12 terminal leaflets per genotype
  - Detached and re-hydrated during 1 hr in light
  - Desiccation in test room (RH: 50±3 %, T: 21°C, 50 µmol m⁻² s⁻¹)
  - RWC after 4 hours desiccation
M&M: Cut rose population screening – cont.

\[ RWC = \frac{\text{Fresh Weight} - \text{Dry Weight}}{\text{Saturated Fresh Weight} - \text{Dry Weight}} \times 100 \]
Expt. 1: Population screening

- Large genotypic variation in response to leaf desiccation
- RWC 4h desiccation ranged 7-62% (parents: 20, 51% RWC)
Expt. 2: Variation in the stomatal responsiveness (SR)

- Representative genotypes from each group (12 & 2 parents)
- Leaf desiccation (n = 12 per genotype)
- Transpiration rate during 4 hours (gravimetrically)
Variation in the stomatal responsiveness (SR) – cont.

- **Initial transpiration rate** (10min) is only slightly related to stomatal responsiveness.
- **Final transpiration rate** (4h) is an irrelevant trait, since it corresponds to very different leaf hydration levels (RWC).
Variation in the stomatal responsiveness (SR) – cont.

- **Speed of stomatal closure** is strongly related to stomatal responsiveness (RWC stabilization high > moderate > low)
- **Degree of stomatal closure** at certain leaf hydration level (RWC) is strongly related to stomatal responsiveness (high > moderate > low)
Expt. 3 – Variation in the cuticular transpiration

- 8 genotypes (4+4) & 2 parents
- n = 12 per genotype

- Sealing lower leaf surface with wax and polyethylene sheet
- Desiccation in test room (RH: 50±3 %, T: 21°C, 2.5 μmol m⁻² s⁻¹)

Hypostomatous leaves
Cuticular permeability (G): no screening value

- Similar range of G in contrasting genotypes
- Cuticular contribution to total water loss is minimal
Expt. 3 – Vase-life evaluation

- 6 genotypes (3+3)
- \( n = 8 \) stems/genotype (normalized length & leaf area)
- Harvest at stage 2 (VBN, 2001)

- Standard solution
  \((0.7\text{mM CaCl}_2, 1.5\text{mM NaHCO}_3, 5\mu\text{M CuSO}_4)\)
- RH: 50 %, T: 20°C, 10-12 \(\mu\text{mol m}^{-2}\text{s}^{-1}\) (12h/d)
- End of vase life according to VBN criteria (2001)
Importance of stomatal responsiveness on vase life

- Low stomatal responsiveness (SR)
  - Shorter vase-life (8 days ± 0.5 / 15 days ± 3.1)
  - Limited by the high water loss rates
Stomatal responsiveness & Flower opening

- Low stomatal responsiveness \(\rightarrow\) hampered flower opening (end vase life without reaching stage 5)
Conclusions

- Large variation present in the gene pool for stomatal responsiveness → many possibilities for breeding for better control of water loss

- Key traits: speed & degree of stomatal closure (i.e. stomatal physiology)
- Cuticular permeability is not a relevant trait
Conclusions

- RWC after 4h of leaf desiccation proved to be a quick and reliable screening method suitable for large-scale screening of rose genotypes for stomatal responses to water stress

- Genotypes with lower RWC at 4h desiccation (i.e. lower stomatal responsiveness):
  - Shorter vase life
  - Flower opening is hampered
Muito obrigada!!!

Thank you for your attention!
Why relative water content (RWC) after 4h desiccation?

- Previous work has shown that RWC is a good indicator of the control of water loss

\[
RWC = \frac{\text{Fresh Weigh ht} - \text{Dry Weight}}{\text{Saturated Fresh Weigh ht} - \text{Dry Weight}} \times 100
\]