

Effect of high relative air humidity on the cuticular water permeability, and its significance on the leaf water balance

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Introduction

- High relative air humidity (RH > 85%) during cultivation → excessive water loss during the postharvest phase → reduced vase life (cultivar dependent).
- Mostly related to stomatal malfunctioning but little is known about the participation of cuticula on the total water loss under such conditions.

Aims

Quantify the relative contribution of the cuticular permeability on the total leaf water loss in high RH grown plants, using both unstressed leaves (i.e. leaves in water) and leaves under maximum stomatal closure (i.e. desiccated or ABA-fed leaves).

Material and methods

PLANT MATERIAL AND CULTIVATION:

- Four treatments, combination of:
 - Contrasting cut rose cultivars: 'Frisco' (tolerant) and 'Prophyta' (sensitive);
 - Moderate (60%) and high (90%) RH level.

CUTICULAR WATER PERMEABILITY:

- Abaxial leaf surface was double sealed (grease, covered with polyethylene sheet);
- Leaves were desiccated from the adaxial stomatous leaf surface (n=12).

STOMATAL RESPONSES TO DESICCATION:

- Re-hydrated leaves were allowed to dry for 4h;
- Transpiration rate was measured gravimetrically (n=14).

STOMATAL RESPONSES TO ABSCISIC ACID (ABA) FEEDING:

- Transpiration rate was stabilized in water;
- Leaves were transferred to 100µM ABA solution;
- Transpiration rate was measured gravimetrically (n=14).



Results

Cuticular permeability

- Water vapor moved slowly across the cuticle despite a complete absence of stomata (0.007-0.018 mmol m⁻² s⁻¹);
- High RH increased the cuticular water loss (34 and 45% for 'Frisco' and 'Prophyta' respectively);
- Leaf dehydration affected the cuticular properties, i.e. cuticular permeability reduced by 30% after 32h of desiccation (Fig. 1).

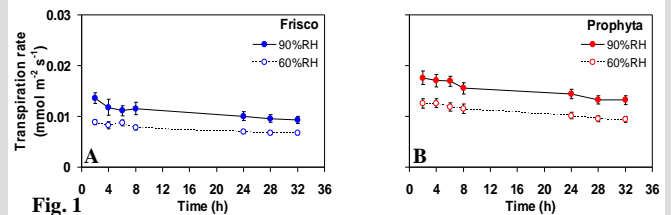


Fig. 1

Stomatal responses

- High RH decreased the degree and speed of stomatal response to both desiccation (Fig. 2A & B) and ABA feeding (Fig. 2C & D). These effects were stronger in 'Prophyta'.

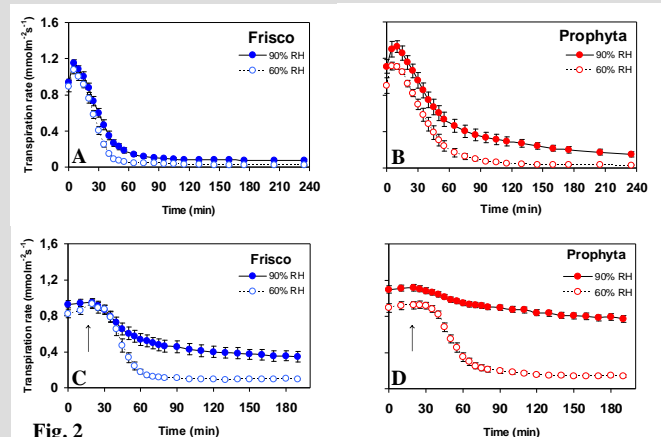


Fig. 2

Water vapor exchange is shared between the stomata and cuticle

- After 4h of desiccation:
 - 1-3% fresh weight loss via cuticle;
 - 21-66% fresh weight loss via cuticle & stomata.
- The cuticular fraction of total water loss (cuticle & stomata):
 - 3% in leaves in water (open stomata);
 - 19% (moderate RH) versus 5-9% (high RH) after 2h40min of ABA feeding (max stomatal closure).

Conclusions

- 1) The cuticle forms a dynamic barrier to water vapor, adjusting to the leaf hydration level;
- 2) Cuticular permeability contributed significantly to the total water loss under conditions of max stomatal closure when leaf development took place at moderate RH;
- 3) Cuticular permeability was increased at high RH, but its contribution to total water loss is minimal, and cannot be associated with the rapid wilting trait during the postharvest phase.

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