

Low Irradiance Combined with High Relative Humidity Induce Leaf Tipburn in *Eustoma grandiflorum*



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Abstract

Leaf tipburn (TB) of *Eustoma grandiflorum* (Raf.) Shinn. is a calcium-deficient disorder. Low irradiance combined with high relative humidity would reduce transpiration stream and thus may induce this disorder. Vegetative plants of *Eustoma* 'King of Orchid' with five fully expanded leaf pairs were placed in a growth room at 25/18°C and received two treatments: high irradiance (HI; 285 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ photosynthetic photon flux, PPF) combined with moderate relative humidity (MRH; mean 74% RH), and low irradiance (LI; 212 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PPF) combined with high relative humidity (HRH; mean 91% RH). Artificial lighting was provided by high-pressure sodium lamps for 12 h per day. Plants for both treatments had microscopically visible sepals with 13 leaf-pairs initiated 11 days after treatments (DAT). Leaf tipburn occurred at 18 DAT only in plants under LI and HRH conditions. Consistently lower transpiration was found in the first to third leaves under flower bud at LI and HRH, whereas no significant difference in stomata density and stomatal conductance between treatments. Plants under LI and HRH conditions produced expanding leaves with reduced vasculature density that may limit calcium transport to the leaf tip..

Introduction

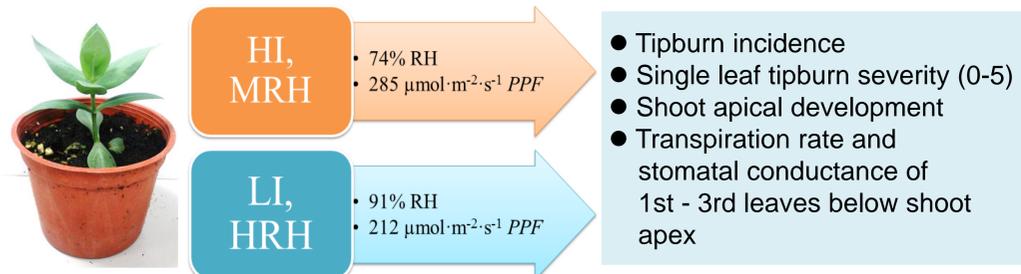
Eustoma is an important cut flower crop in Taiwan. However, tipburn, a necrotic symptom appears on leaf margin and shoot apex, has been a prevalent problem that may reduce quality of *Eustoma*. *Eustoma* tipburn has been reported to be a calcium deficiency symptom. High air humidity and low irradiance are commonly seen in greenhouse production and may lead to Ca deficiency. This study aimed to determine the effect of air humidity in combination with irradiance on tipburn development in *Eustoma*.

- In extreme cases, tipburn may cause shoot apical meristem died.



Materials and Methods

Vegetative plants of *Eustoma* 'King of Orchid' with five fully expanded leaf pairs were placed in a growth room at 25/18°C and received two treatments as follows



Results

- Tipburn occurred at 18 DAT only in plants with elongating sepals and petals under LI and HRH conditions, and whole plant tipburn severity increased dramatically during 18 to 35 DAT (Fig. 1, 2 and 3).

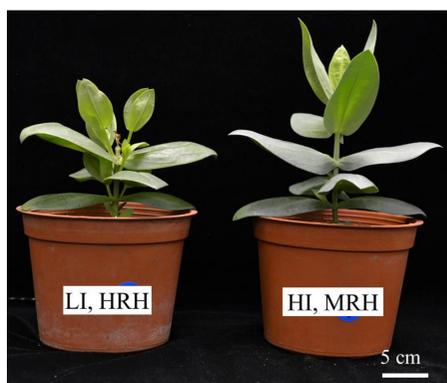


Fig. 1. Appearance of *Eustoma* 'King of Orchid' plants grown under HI, MRH (285 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PPF, 74% RH) and LI, HRH (212 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PPF, 91% RH) conditions.



Fig. 2. *Eustoma* 'King of Orchid' plants with elongating sepals and petals under LI, HRH (212 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PPF, 91% RH) conditions for 18 days. Scale bars = 200 μm .

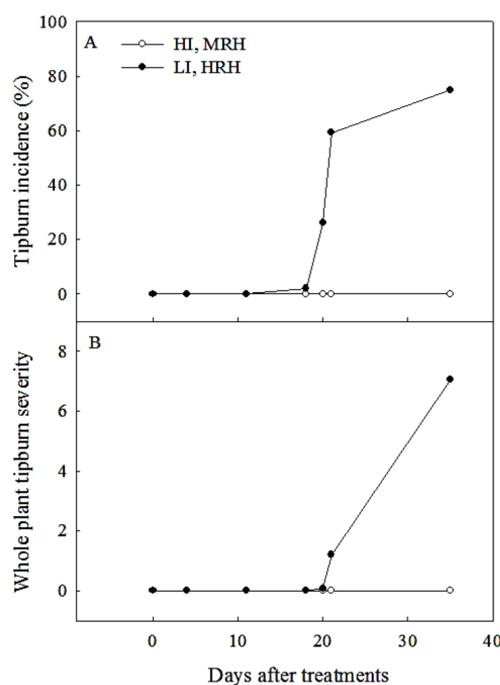


Fig. 3. Changes of tipburn incidence (A), and whole plant tipburn severity (B) of *Eustoma* 'King of Orchid' grown under HI, MRH (285 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PPF, 74% RH) and LI, HRH (212 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PPF, 91% RH) at 25/18°C.

- Reduced vasculature density and lower transpiration was found in the first to third leaves below shoot apex at LI, HRH (Fig. 4 and 5), whereas no significant difference in stomatal conductance and stomata density between treatments.

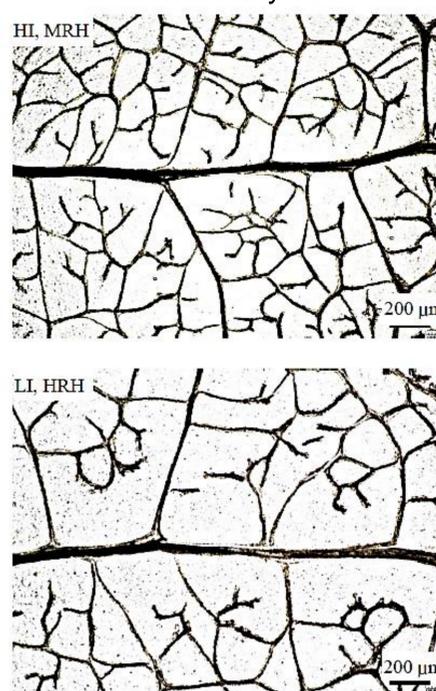


Fig. 4. Leaf vein development in *Eustoma* 'King of Orchid' grown under HI, MRH (285 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PPF, 74% RH) and LI, HRH (212 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PPF, 91% RH) for 18 d at 25/18°C. Scale bars = 200 μm .

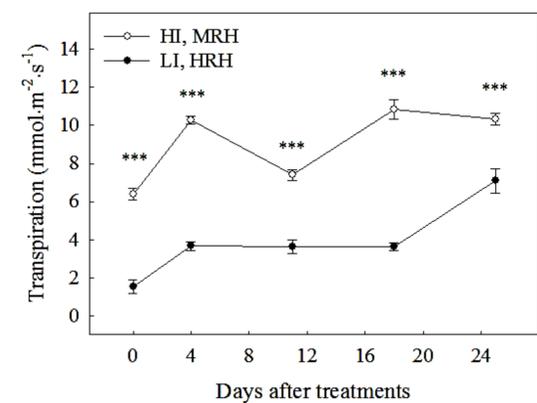


Fig. 5. Transpiration rate of first to third leaves below shoot apex in *Eustoma* 'King of Orchid' grown under HI, MRH (285 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PPF, 74% RH) and LI, HRH (212 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PPF, 91% RH) at 25/18°C. Bars represent standard error of the mean (n=6). ***Significant at $P < 0.001$ by t -test.

Conclusions

- The onset time of leaf tipburn in *Eustoma* 'King of Orchid' occurred at the floral transition phase.
- Eustoma* 'King of Orchid' plants under low irradiance and high relative humidity showed lower transpiration rate and reduced density of vascular tissue, which may limit calcium transport to leaf tip and thus induce tipburn.