

# Effect of light on phloem transport in tomato plants



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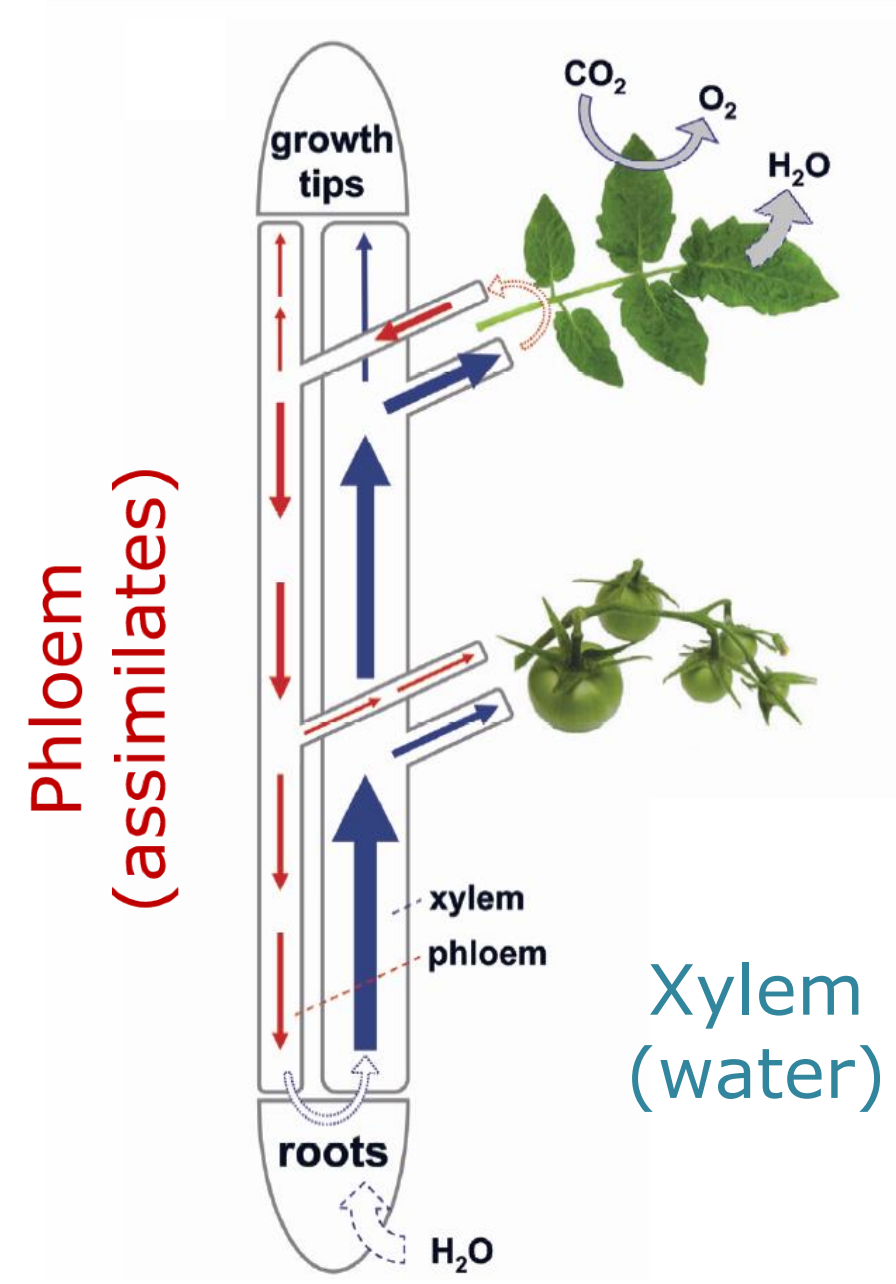
## 1 Objective

- Study the phloem and xylem sap flow in tomato (*Solanum lycopersicum* L.) main stem under different light conditions.

## 5 Conclusion

- Light intensity has an effect on the amount of phloem sap transported in the vascular tissue.
- Combination of xylem and phloem measurements is very informative.

## 2 Background



**Figure 1.** Location and direction of xylem and phloem vascular tissue. (image: Carel Windt, modified)

- Vascular tissue, xylem and phloem distribute water, nutrients, and carbohydrates along the plant (Fig. 1).
- Carbohydrates are products of photosynthesis.
- Effect of light intensity on phloem transport has been barely studied.

## 4 Results

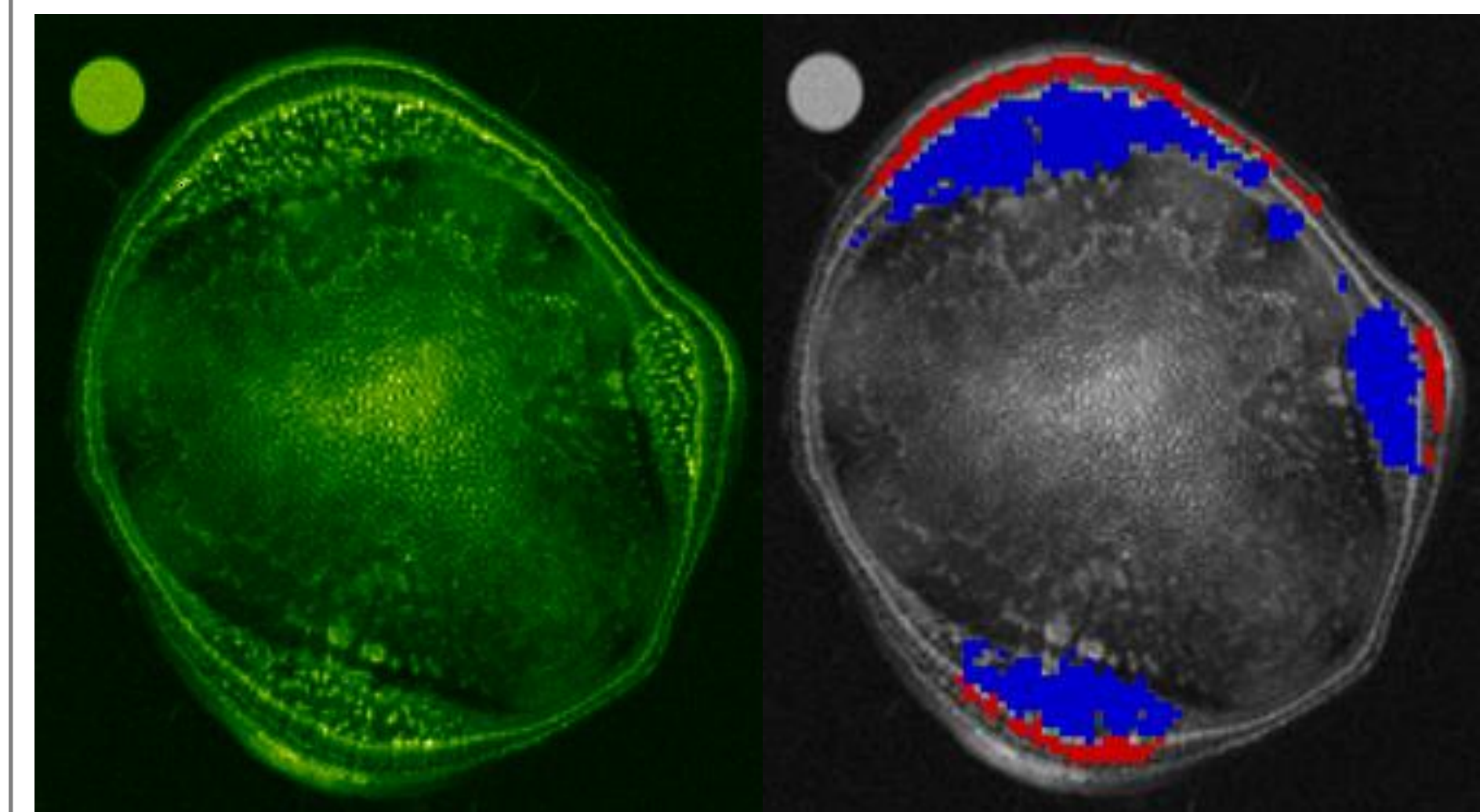
- In both experiments (Figs. 4 and 5) the xylem and phloem flow velocities (mm/s) and volume flow (mm<sup>3</sup>/s) were evaluated.
- **Figure 4** represents a **gradual increase of the light intensity** experiment where xylem sap flow showed standard diurnal alternation. Phloem volume flow increased with increasing light intensity. Both phloem volume flow and velocity showed diurnal alternation.
- **Figure 5** represents a **starving experiment** where after two-day period (600μE) a dark period of 23 hours ensued, followed by 1 hour of light and return to the normal day-night rhythm. During the extended dark period the xylem and phloem flow were strongly affected. In the first hours of the unexpected dark period, stomata opened and xylem flow increased slightly and then dropped, reaching the previous night values. Phloem flow decreased and its diurnal pattern disappeared. Both xylem and phloem flow were immediately restored during the next day period.

## 3 Materials and methods

- 2 three-month-old tomato plants (*Solanum lycopersicum* cv. 'MoneyMaker') were used.
- 72 hours before measurement all fruits were pruned.
- Measurement was conducted in 3T MRI scanner; PFG-SE-TSE pulse sequence was used.
- Day period was 16 hours, night period was 8 hours, the plant was watered every 24 hours.
- An adjustable light intensity LED module was used as the light source (built) (Fig. 2).



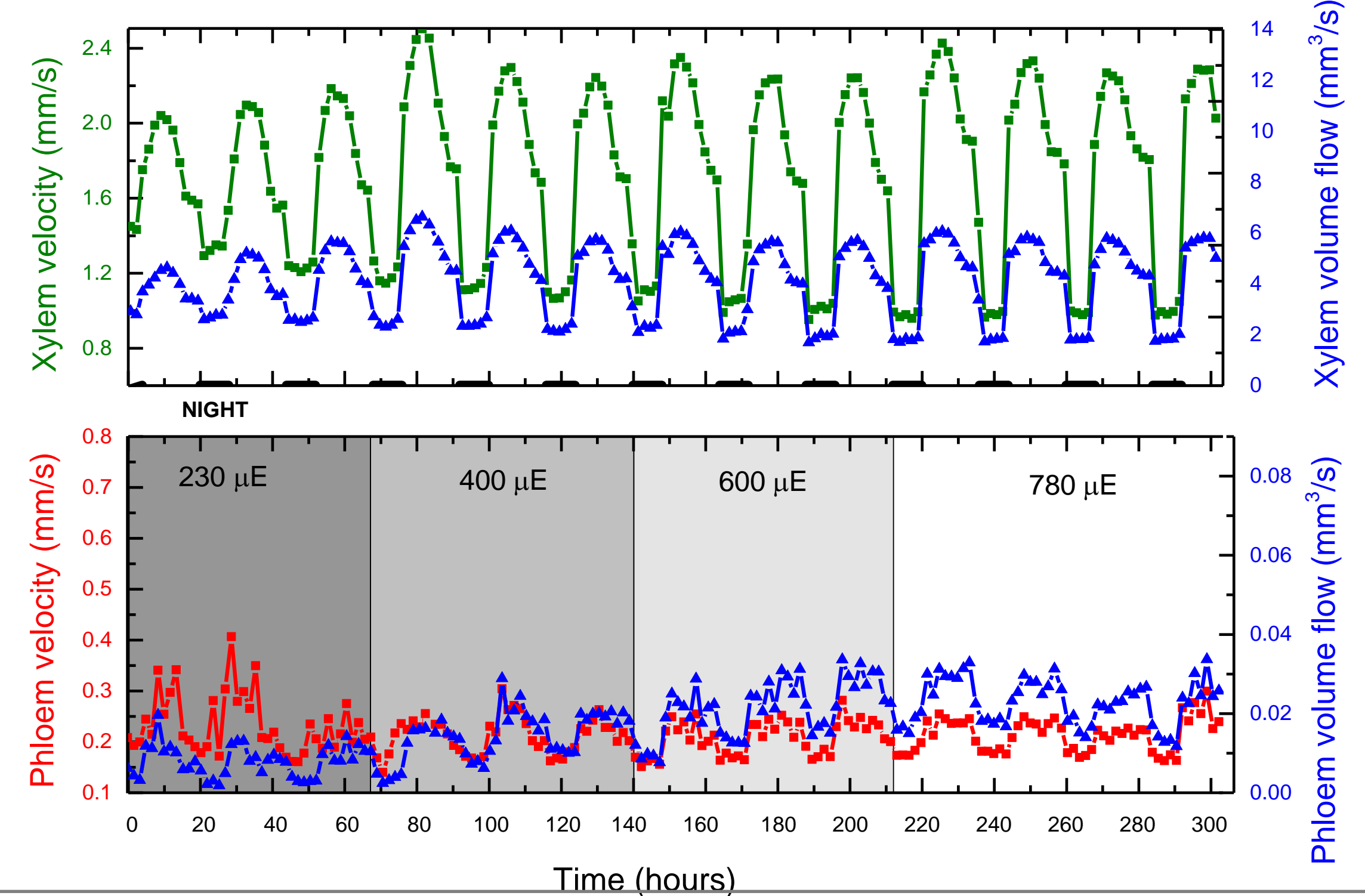
**Figure 2.** upper- cooling of LED module, lower - LED module



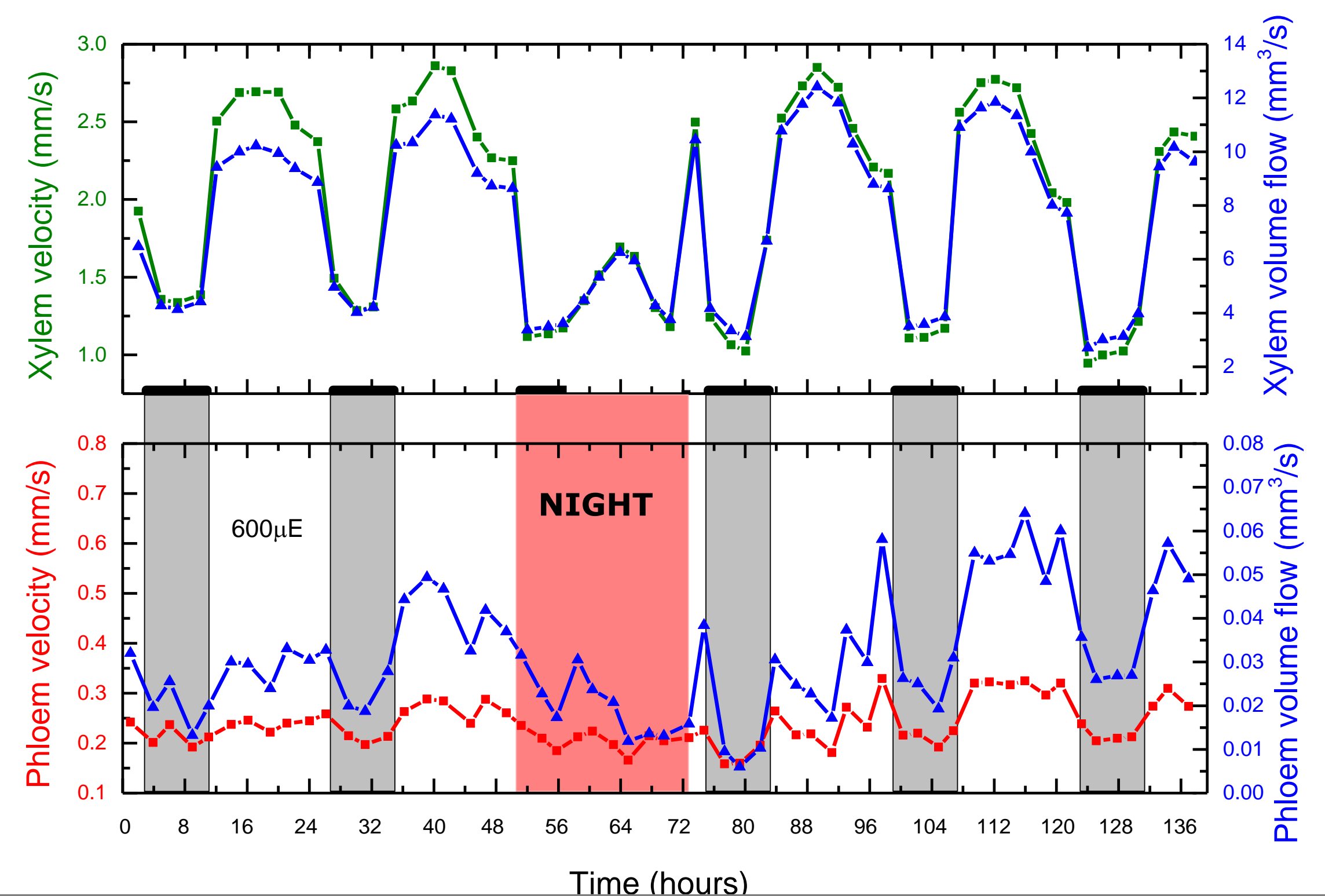
**Figure 3.** Axial image of a stem, red – phloem, blue – xylem.

- Flow masks (Fig.3) are obtained after an analysis of per pixel propagator. From the flow masks the values of xylem and phloem flow velocity and volume flow are obtained.

**Figure 4.** Phloem and xylem flow in tomato plant, gradual increase of light intensity



**Figure 5.** Phloem and xylem flow in tomato plant, 23 hours of darkness



## Acknowledgements

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