

# Multiple Measures Reveal that Pre- and Post-Grafting Light Levels Influence the Healing Rate but not Survival of Grafted Tomato Seedlings

Bizhen Hu, Joshua Blakeslee, Peter Ling, Mark Bennett and Matt Kleinhenz<sup>1</sup>

<sup>1</sup>phone 330.263.3810; email kleinhenz.1@osu.edu; internet hcs.osu.edu/vpslab and facebook.com/osuvpslab



## Introduction

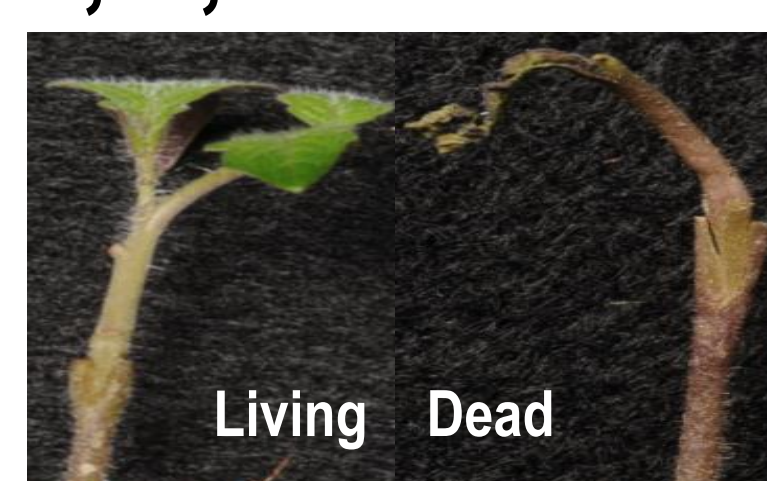


The grafting process creates potentially lethal wounds in seedlings and disrupts root-shoot transport and communication for unknown lengths of time. Not returning the root-shoot axis to full function ends the life or weakens the performance of grafted plants in production systems (Martinez-Ballesta et al., 2010).

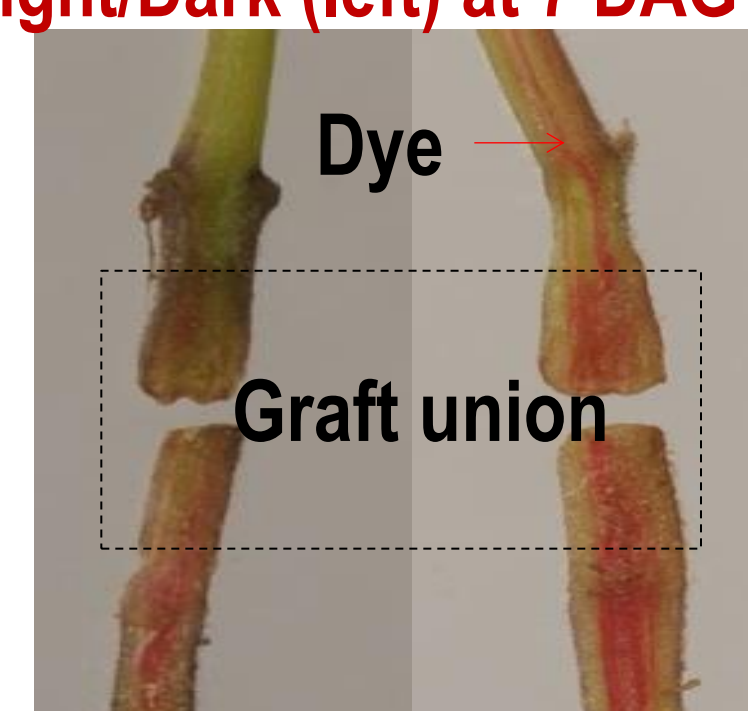
Plant survival can reliably be determined visually 6-14 days after grafting (DAG; Johnson and Miles, 2011) by, for example, inspecting scion turgor. Other approaches, though, are needed to mark when xylem flow and scion growth resume – the first is a prerequisite for healing and the second is evidence that plant survival is likely. Quantitative protocols will also be useful in optimizing pre- and post-grafting plant management.

## Materials and Methods

- Maxifort (rootstock, Ma) and Celebrity (scion, Ce) seedlings were grown in a climate-controlled greenhouse at The OSU-OARDC in Wooster, OH.
- Five days before grafting, duplicate sets of seedlings were transferred to two growth chambers operating at 24/20 °C (D/N) and 40% RH with either no light or a 250  $\mu\text{mol}/\text{m}^2/\text{s}$  14-hr photoperiod.
- A total of 528 light- or dark-treated seedlings were cleft-grafted (384 Ma x Ce; 144 Ce self).
- After grafting, half of each grafted and ungrafted (control) group was returned to the dark chamber, and half to a chamber with a 135  $\mu\text{mol}/\text{m}^2/\text{s}$  14-hr photoperiod. Both chambers were held at 24/20 °C (D/N) and 98% RH.
- Seven measures were taken on rootstock and scion portions of 6-10 plants from each of the four treatments (dark/dark, dark/light, light/dark and light/light) on days 3, 5, 7 and 9 after grafting (DAG).
  - plants were scored as living/dead based on scion condition.
  - plant height (soil line to meristem), scion length (graft union to meristem), and stem diameter tracked plant growth.
  - stumps of de-rooted grafted plants were placed in Erythrosin B dye for 15 min to visualize and measure xylem flow in the shoot. Dye above the graft union was scored as present or absent and distances it traveled were compared to measures of plant height and scion length.
- The experiment was repeated three times in 2013-2014.



Dye (red) was present above the graft union under Light /Light (right), but not under Light/Dark (left) at 7 DAG



## Results

### Survivorship

Plant survival 9 DAG exceeded 90% in all grafted treatments except the Grafted Dark/Dark treatment (34.7% survival).

### Plant Regrowth

Table 1. Rootstock stem diameter, plant height, and scion length 9 days after grafting.

Treatment	Rootstock diameter (mm)	Plant height (cm)	Scion length (cm)
Grafted Dark/Dark	1.58	3.50	1.50
Grafted Dark/Light	1.42 E	4.04 C	1.48 B
Grafted Light/Dark	1.65 CD	3.31 E	1.29 C
Grafted Light/Light	1.65 D	3.67 D	1.68 A
Self-grafted Light/Dark	1.73 ABC	2.78 F	1.01 D
Self-grafted Light/Light	1.77 AB	3.05 EF	1.21 CD
Ungrafted Dark/Dark	1.47 E	4.76 B	
Ungrafted Dark/Light	1.70 BCD	5.54 A	
Ungrafted Light/Dark	1.74 AB	5.49 A	
Ungrafted Light/Light	1.79 A	4.16 C	

### Dye Presence and Distance Traveled in Scion Stem Sections

Table 2. Percentage of plants in which dye was noted above the graft union at 3, 5, 7, 9 days after grafting.

Treatment	Days after grafting (DAG)			
	3	5	7	9
Grafted Dark/Dark	5.6 A	11.1 C	0.0 C	0.0 C
Grafted Dark/Light	5.6 A	61.1 AB	83.3 A	77.8 A
Grafted Light/Dark	0.0 A	40.0 ABC	53.3 B	46.7 B
Grafted Light/Light	20.0 A	76.7 A	96.7 A	90.0 A
Self-grafted Light/Dark	0.0 A	4.2 C	20.8 C	13.9 C
Self-grafted Light/Light	19.4 A	30.6 BC	70.8 AB	63.9 AB

Table 3. Distance of stain migration (rootstock stump to apical meristem) as the percent of plant height at four DAG.

Treatment	Days after grafting (DAG)			
	3	5	7	9
Grafted Dark/Dark	66.5 B	62.8 CD	52.2 D	57.1
Grafted Dark/Light	59.9 BC	86.4 AB	92.4 AB	92.7 AB
Grafted Light/Dark	55.7 C	69.3 C	77.9 C	77.6 CD
Grafted Light/Light	59.7 BC	86.3 B	92.3 AB	88.7 B
Self-grafted Light/Dark	55.5 C	58.9 D	61.1 D	69.3 D
Self-grafted Light/Light	58.6 BC	69.8 C	86.7 BC	85.1 BC
Ungrafted Dark/Dark	91.2 A	91.9 AB	93.3 AB	97.5 AB
Ungrafted Dark/Light	96.2 A	97.6 A	95.3 AB	100.0 A
Ungrafted Light/Dark	95.1 A	95.6 AB	98.7 A	97.1 AB
Ungrafted Light/Light	95.7 A	97.2 A	94.5 AB	99.3 A

## Conclusions

- Pre- and post-grafting light treatments do not affect survival but they may influence regrowth and xylem flow (as evidence of graft healing). Therefore, light treatments warrant further exploration.
- Multiple measures, including the movement of a translocatable dye, can track healing and regrowth, perhaps revealing G X E effects before visual assessments can be completed reliably.

References: Martínez-Ballesta, M.C., C. Alcaraz-López, B. Muries, C. Mota-Cadenas, and M. Carvajal. 2010. Physiological aspects of rootstock–scion interactions. *Sci. Hort.* 127:112–118.

Johnson, S.J. and C.A. Miles. 2011. Effect of healing chamber design on the survival of grafted eggplant, tomato, and watermelon. *HortTechnology* 21(6):752-758.

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