Grafted tomato propagation: effects of light intensity and temperature on graft healing and plant regrowth©

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INTRODUCTION

Grafting can improve vegetable productivity by combining desirable traits from two taxa into one plant. However, the grafting process creates severe wounds. Optimal healing of newly grafted plants requires careful light and temperature management (Lee et al., 2010). Grafted tomato plants are commonly healed in enclosed structures shaded to reduce light levels and moderate temperature (Rivard and Louws, 2006). However, what is the optimal combination of light and temperature conditions for efficient healing of grafted tomato plants is not clear. The hypothesis was that light and temperature affect the healing of grafted tomato seedlings separately and interactively.

Objectives were to (a) test the regrowth of grafted tomato seedlings under four levels of temperature and light intensities; (b) heighten the understanding of effects of key environmental variables on graft healing; (c) optimize conditions and management for grafted plant propagation.

METHODS

The experiment was conducted four times in April-June, 2015 at the OSU-OARDC in Wooster, Ohio. Tomato seedlings 'Cherokee Purple' and 'Maxifort' were grown in a greenhouse and grafted using the splice grafting method 3 weeks after seeding. Grafted tomato seedlings were healed under four temperature by light treatments arranged in two growth chambers as a split-plot design. One growth chamber was set at 30/25°C and the other at 25/20°C. Two zones differing in light intensity (50, 150 μmol m^{-2} s^{-1}) were created in each chamber by varying plant distance from the chamber lamps and using open frames covered with shade cloth. The light in both chambers were provided from one Metal Halide 400 Watt lamp (GE Lighting, Inc.) and one High Pressure Sodium 400 Watt lamp (GE Lighting, Inc.). Photoperiod was 12 h from 7 am to 7 pm in all treatments. Relative humidity was controlled at 90% in all treatments for the first 7 days, and reduced to 80% on the 8th day, 60% on the 9th and 10th days. Fifteen to eighteen grafted plants were used per treatment per repeat, placed on a layer of Kapmat. Plants and Kapmat were watered when appeared dry during the study period.

Plant growth was monitored non-destructively immediately after grafting and 10 days after grafting. Leaf area was measured based on digital images taken of five to six plants as a unit and analyzed by WinCAM, which separated the green colors of leaf from the background and calculated the percentage of leaf area out of the known area of analysis. Total plant length was measured from the soil line to the meristem and scion length from the graft union to the meristem by a ruler. Stem diameter at the rootstock and scion was measured by a caliper. Relative growth of the above parameters was calculated as (values 10 days after grafting-values immediately after grafting)/values immediately after grafting ×100%. Besides, plant growth was monitored destructively 10 days after grafting including leaf and stem fresh weight, leaf and stem dry weight after drying in an oven at 50°C for 2 days. Specific leaf area was calculated as leaf area/leaf dry weight. Compactness was calculated as aboveground dry weight/plant length.

Data analysis was performed in SAS. Separate and interactive effects of temperature and light were analyzed by ANOVA. Multiple comparisons were analyzed using the GLM procedure.

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RESULTS

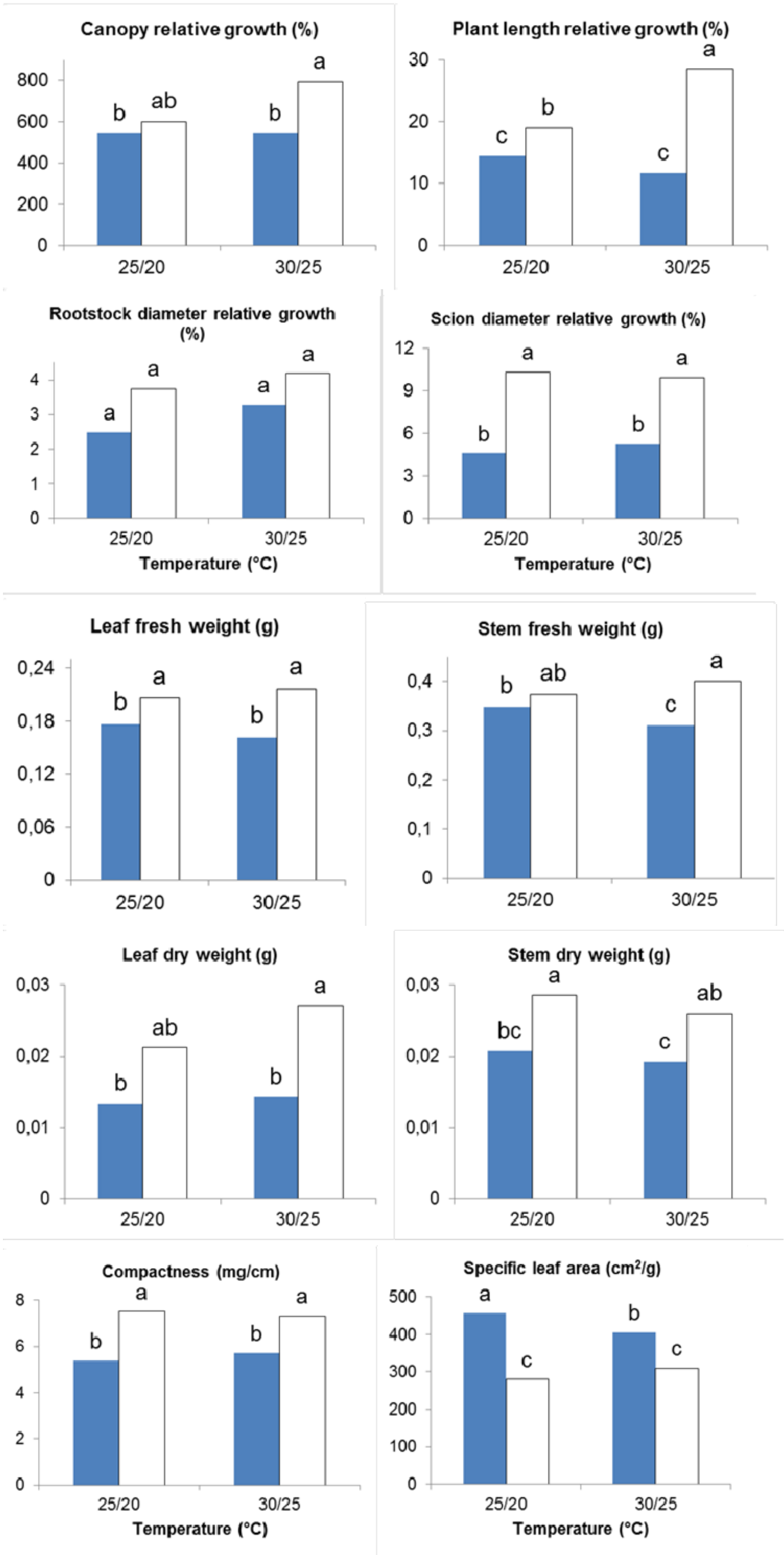

Figure 1. Growth of grafted tomato plants 10 days after healing under two temperatures by two light intensities. Different letters on bars represent significant difference at $p<0.05$. Note: shaded: 50 µmol m^{-2} s^{-1}, not shaded: 150 µmol m^{-2} s^{-1}.

Plant growth was generally unaffected by temperature. The majority of plant growth variables were greater under higher light intensity at 150 µmol m^{-2} s^{-1} compared to those at 50 µmol m^{-2} s^{-1}, while specific leaf area decreased under higher light intensity. The interaction between temperature and light intensity was significant in some healing variables. These results suggest that the conditions under which newly grafted tomato plants are healed warrant further study since increased efficiency in graft healing under optimal conditions is possible.

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