Substrate Acidification by Geranium: Temperature Effects

Sudden pH decline (SPD) describes the situation where crops growing at an appropriate pH rapidly (within 1-2 weeks) cause the substrate pH to shift downward one to two units. While the cause of SPD is unknown, previous studies have found nutrient deficiencies, such as iron (Fe), zinc (Zn), and phosphorus (P), to cause plants to acidify the substrate, as well as an acidification effect when plants are grown in high temperatures. 'Designer Dark Red' geraniums (Pelargonium·hortorum Bailey) were grown in three experiments to determine if high temperature causes geraniums to acidify the substrate (Expt. 1), if the temperature effect is independent of tissue P concentration (Expt. 2), and to quantify the amount of acidity produced due to high temperature and P stress in hydroponics (Expt. 3).

The first experiment tested the effect of four day/night temperature regimes (14°C day/10°C night, 18°C day/14°C night, 22°C day/18°C night, and 26°C day/22°C night) on substrate acidification. At 63 days after transplanting (DAT), substrate pH declined from 6.8 to 4.6 as temperature increased. Tissue P of plants grown at the highest three temperatures was extremely low (0.10%–0.14% of dry weight).

It was not possible to determine if the drop in substrate pH was a singular temperature effect or a combination of high temperature and low P; therefore, a second experiment tested a factorial combination of the three highest temperatures from the first experiment and five pre-plant P rates (0, 0.065, 0.13, 0.26, or 0.52 $g \cdot L^{-1}$ substrate). Regardless of tissue P concentrations, substrate pH decreased with increasing temperature (Figure 1). The results at 63 DAT once more showed that temperature acted independent of tissue P and caused geraniums to acidify the substrate.

The amount of acidity produced by roots of plants grown at the two highest temperatures used in the first two experiments was quantified. Plants grown at the higher temperature produced 28% more acid per gram dry root (Figure 2). The results herein indicate that high temperature can induce SPD by geranium.

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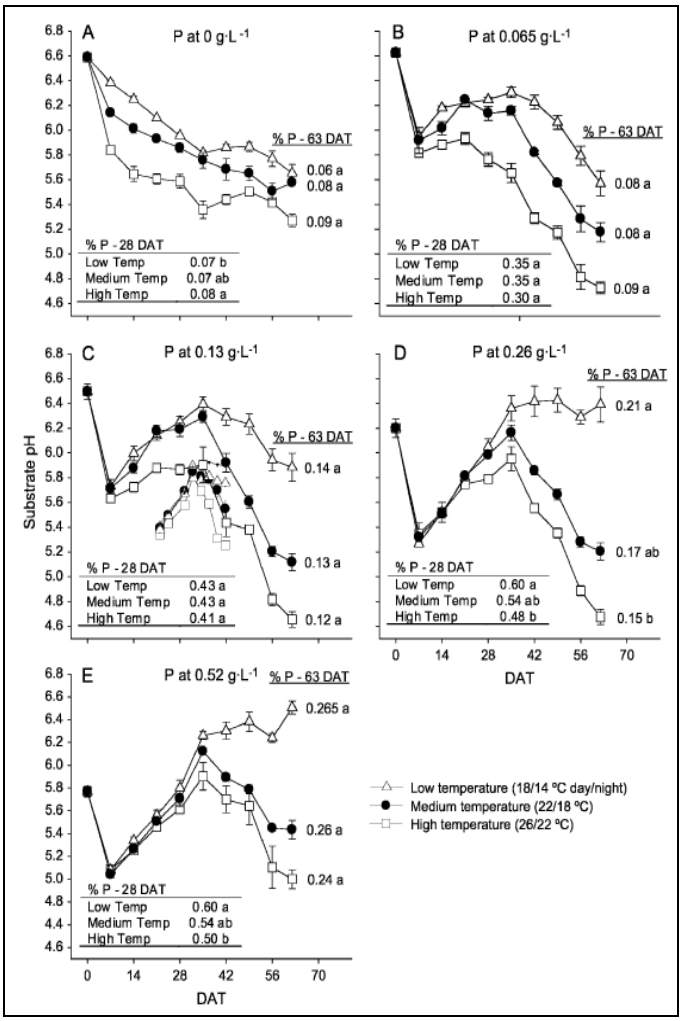

Figure 1 (left). Substrate pH, measured initially and every 7 days after transplanting geraniums (DAT), for each pre-plant rate of P in substrate [(A) 0, (B) 0.065, (C) 0.13, (D) 0.26, and (E) 0.52 $g \cdot L^{-1}$ substrate] at low, medium, and high temperatures. Error bars represent SE (n = 3). In the lower left corner of each graph is a table with tissue dry weight percentages of P at 28 DAT for that particular P treatment at each temperature. On the right side of each temperature curve is the tissue dry weight percentage of P at 63 DAT.

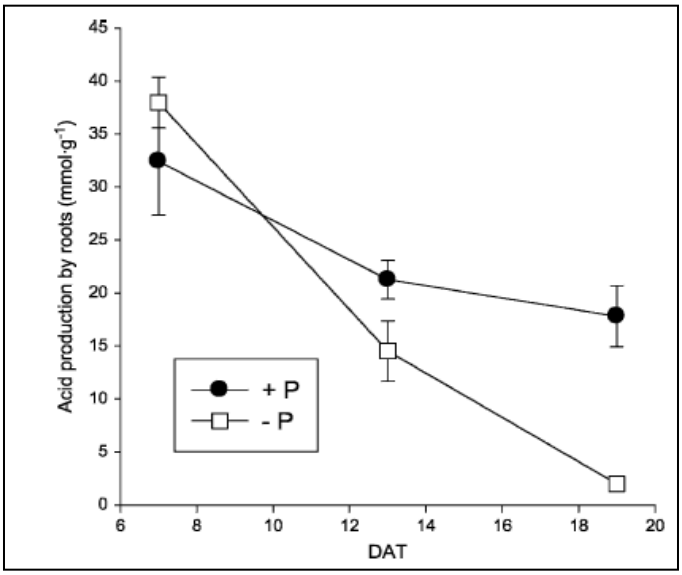

Figure 2 (above). Acid produced per gram of root dry weight for geranium plants grown with (+P) and without P (–P) at 7, 13, and 19 days after transplanting (DAT). Temperature treatments were combined. Error bars represent SE (n = 12).

Taylor, M., P. Nelson, and J.M. Frantz. 2008. Substrate Acidification by Geranium (*Pelargonium* x *hortorum*): Temperature Effects. J. Amer Soc. Hort Sci. 133:508-514.