

# Substrate Acidification by Geranium: Light Effects and Phosphorus Uptake

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. Previously, we reported that low tissue phosphorus (P) and high temperature stress caused geraniums to lower substrate pH. In addition, high light may also be associated with SPD. 'Designer Dark Red' geraniums (*Pelargonium hortorum* Bailey) were grown in three experiments to assess the effect of high light intensity on substrate acidification and P uptake. The first experiment tested the effect of four light intensities (105, 210, 575, and 1020  $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ ) on substrate acidification. At 63 days after transplanting (DAT), substrate pH declined from 6.0 to 4.8 as light intensity increased. Tissue P of plants grown at the highest two light levels was extremely low (0.10%–0.14% of dry weight).

It was not possible to determine if the drop in substrate pH was a direct light effect or a combination of light and P; therefore, a second experiment tested a factorial combination of the three highest light levels from the first experiment and five pre-plant P rates (0, 0.065, 0.13, 0.26, or 0.52  $\text{g}\cdot\text{L}^{-1}$  substrate). When tissue P concentrations were deficient, pH decreased by 0.6 to 1.0 pH units within 2 weeks, and deficiency occurred more with high light intensity (Figure 1).

These results indicate high light intensity may suppress P uptake. In a third experiment, P uptake in

hydroponics decreased by 20% when the light intensity increased from 500 to 1100  $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$  (Table 1). While high light intensity suppresses P uptake, it is unclear whether high light intensity contributes to substrate acidification if P is adequate.

Table 1. Main effect of light treatment and days after transplanting (DAT) on geranium root dry weight, the remaining P of 124 mg in 4 L of hydroponic solution, cumulative P uptake per gram dry weight of root, and P uptake per gram dry weight of root per day.

	Root dry wt (g)	P remaining (mg)	P uptake per unit dry root wt ( $\text{mg}\cdot\text{g}^{-1}$ )	P uptake per unit root dry wt ( $\text{mg}\cdot\text{g}^{-1}\cdot\text{d}^{-1}$ )
Light treatment				
Control (500 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ )	0.767	62.8	86.3	6.96
High (1100 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ )	1.05	53.6	69.6	5.55
Significance	*	NS	**	**
DAT				
11	0.538	78.7	87.3	7.94
15	1.28	37.7	68.5	4.57
Significance	***	**	**	***

ns, \*, \*\*, \*\*\*Nonsignificant or significant at  $P \leq 0.05, 0.01, \text{ and } 0.0001$ , respectively.



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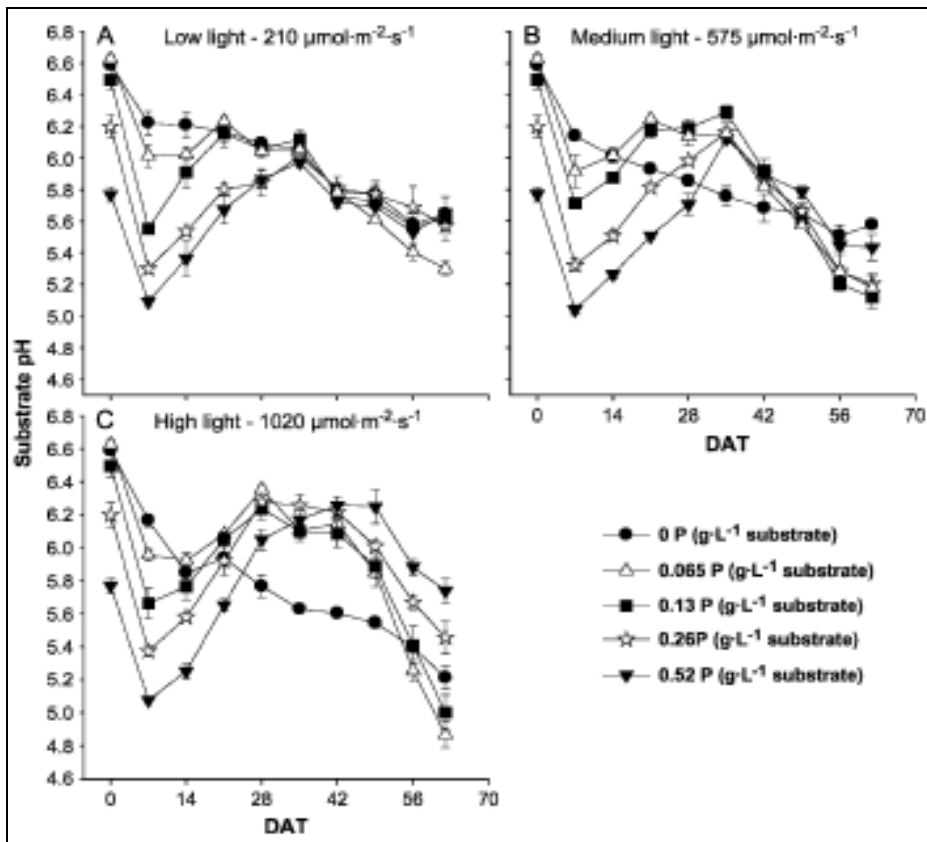


Figure 1. Substrate pH of geraniums measured initially and every 7 days after transplanting (DAT) for each pre-plant treatment rate of P (0, 0.065, 0.13, 0.26, and 0.52  $\text{g}\cdot\text{L}^{-1}$  P in substrate) at low (210  $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ ), medium (575  $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ ), and high (1020  $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ ) light intensities. Error bars represent SE ( $n=3$ ).