

Silicon in Ornamental Crops: Detection, Delivery, and Function

Inclusion of Silicon (Si) in fertilizer solutions is not a typical management practice in floriculture crop production in the United States, in spite of the growing body of literature showing a clear, beneficial effect on plant growth for some species. We have evaluated Si uptake in 46 crops utilizing hydroponics with and without Si in the nutrient solution. Approximately 50% of the species tested so far had Si concentrations higher than 0.1% dry weight in the leaf tissue (Table 1).

Potential inputs of Si to the production cycle were evaluated for Si content, including water, fertilizer, pesticides, and various inorganic and plant-based media amendments. Notable amounts of Si were found to be supplied to zinnia and sunflower when Si-containing plant materials were incorporated into the substrate compared to unamended but fertigated control plants. Supplemental Si alleviated stress due to copper toxicity in zinnia and also delayed the progression of powdery mildew on zinnia leaves by up to 3 weeks (Figure 1).

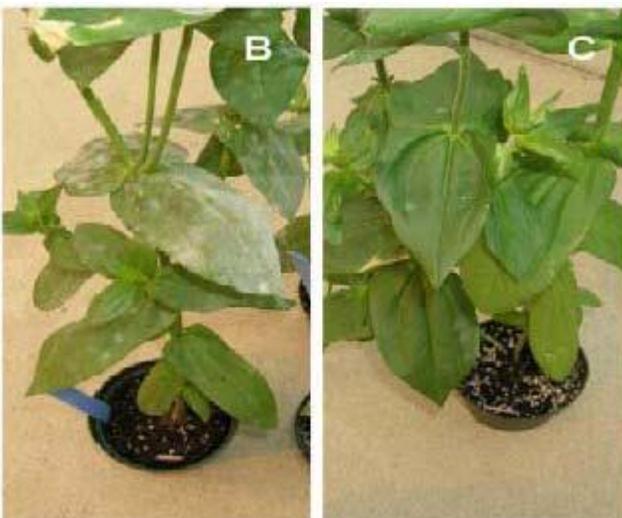
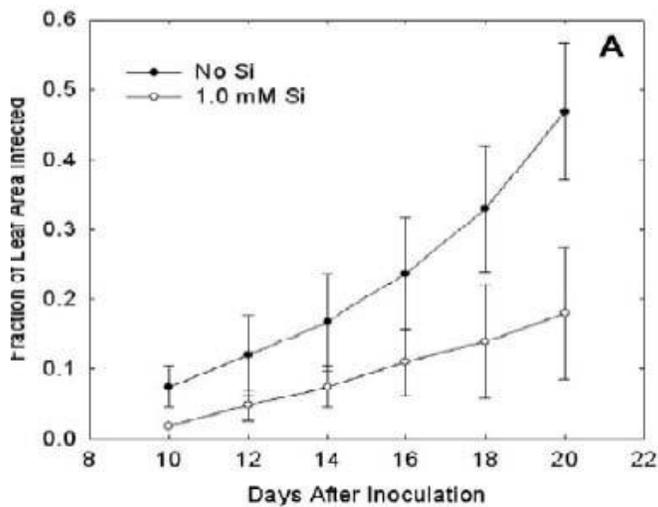


Figure 1. Area of inoculated zinnia leaf covered with powdery mildew with and without supplemental Si addition (A). Error bars represent +/- one standard deviation of the mean. Zinnia grown in soilless media without (B) and with (C) Si ~3 weeks after exposure to powdery mildew showed a reduction in symptomatic leaf surface area.

Crop	Si Content (mg/kg)	Crop	Si Content (mg/kg)
<i>Zinnia elegans</i> (Zinnia)	12,682 +/- 615	<i>Begonia semperflorens</i> (Begonia)	649 +/- 128
<i>Chrysanthemum x morifolium</i> (Garden Mum)	10,430 +/- 253	<i>Coleus forskohlii</i> (Coleus)	615
<i>Cucumis sativus</i> (Cucumber)	10,164 +/- 133	<i>Coreopsis verticillata</i> (Coreopsis)	891 +/- 135
<i>Verbena x hybrida</i> (Verbena)	8,417 +/- 2080	<i>Cyclamen persicum</i> (Cyclamen)	613 +/- 256
<i>Citrullus lanatus</i> (Watermelon)	6,340 +/- 154	<i>Capsicum annuum</i> (Bell pepper)	550 +/- 16
<i>Helianthus annuus</i> (Sunflower)	5,180 +/- 194	<i>Pelargonium x hortorum</i> (Zonal Geranium)	539 +/- 57
<i>Cucurbita pepo</i> (Pumpkin)	4,591 +/- 605	<i>Salvia splendens</i> (Salvia)	529 +/- 98
<i>Torenia fournieri</i> (Torenia)	4,341 +/- 937	<i>Antirrhinum majus</i> (Snapdragon)	501 +/- 68
<i>Dahlia x hybrida</i> (Dahlia)	3,714 +/- 1,243	<i>Rosa chinensis</i> (Mini Rose)	478 +/- 165
<i>Streptocarpella saxorum</i> (Streptocarpella)	3,704 +/- 289	<i>Euphorbia pulcherrima</i> (Poinsettia)	465 +/- 213
<i>Echinacea purpurea</i> (Purple Coneflower)	3,589 +/- 472	<i>Celosia argenta</i> (Celosia)	246 +/- 17
<i>Cucurbita pepo</i> (Summer squash)	3,497 +/- 135	<i>Dianthus chinensis</i> (Dianthus)	362 +/- 94
<i>Rudbeckia hirta</i> (Rudbeckia)	3,469 +/- 781	<i>Hibiscus moscheutos</i> (Hibiscus)	362 +/- 32
<i>Phlox subulata</i> (Phlox)	3,249 +/- 870	<i>Togetes erecta</i> (Marigold)	330 +/- 39
<i>Chrysanthemum x morifolium</i> (Florist Mum)	2,641 +/- 342	<i>Vinca x hybrida</i> (Vinca or periwinkle)	330 +/- 36
<i>Impatiens x hawkeri</i> (New Guinea Impatiens)	2,314 +/- 135	<i>Gerbera jamesonii</i> (Gerbera daisy)	266
<i>Abelmoschus esculentus</i> (Okra)	2,130 +/- 360	<i>Petunia x hybrida</i> (Petunia)	197 +/- 12
<i>Sanpaulia ionanth</i> (African violet)	2,041 +/- 45	<i>Primula polyantha</i> (Primula)	182
<i>Cucurbita pepo</i> (Winter squash)	2,031 +/- 839	<i>Spinacia oleracea</i> (Spinach)	152 +/- 22
<i>Impatiens walleriana</i> (Impatiens)	2,008 +/- 131	<i>Beta vulgaris</i> (Swiss chard)	152 +/- 28
<i>Arabidopsis thaliana</i> (Arabidopsis)	2,000 +/- 91	<i>Viola x wittrockiana</i> (Pansy)	126 +/- 32
<i>Calibrachoa x hybrida</i> (Calibrachoa)	1,536 +/- 50	<i>Allium cepa</i> (Onion)	121 +/- 14
<i>Lycopersicon esculentum</i> (tomato)	747 +/- 61	<i>Nicotiana sylvestris</i> (Ornamental tobacco)	102 +/- 17
<i>Lantana camara</i> (lantana)	8780 +/- 1719	<i>Nicotiana tabacum</i> (traditional tobacco)	290 +/- 39

Table 1. Silicon concentration in the leaves of many horticultural crops grown hydroponically with 1.0 mM Si. Plants were exposed for 3 weeks after establishment in a nonrecirculating hydroponic system. Values of Si are in newly matured leaves initiated after Si exposure.

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