Characterization of Nutrient Disorders of *Lilium longiflorum* 'Nellie White' and *Lilium* Hybrid 'Brunello'

Easter lilies (*Lilium longiflorum* Thunb., *Liliaceae*) and hybrid lilies are important floriculture crops for potted plants and cut flowers. This paper serves to document the symptomology of nutrient disorders of Easter and hybrid lilies and to obtain critical tissue values.

Nitrogen (N) deficiency: Plants were 40% less in dry weight than controls. Symptoms included yellow lower leaves, leaf loss, and overall small leaf size.

Calcium (Ca) deficiency: Initially, brown spots occurred on the distal tips of upper leaves. As the disorder progressed, the spots became larger, young flower buds became brown and aborted, and large flower buds abscised. Affected leaves then developed a purple-brownish coloration.

Sulfur (S) deficiency: Upper leaves developed a yellowish-green coloration over the entire leaf, with some darker green coloration of the veins.

Boron (B) deficiency: Plants weighed 47% less than control plants. No other symptoms were observed.

B toxicity: Initially, plants exhibited yellowing on lower leaf tips. As the disorder continued, yellowing progressed inward on the leaf toward the stem until the lowest leaves were completely yellow. Leaves in the middle then began exhibiting symptoms.

Iron (Fe) deficiency: Upper leaves became yellowish-green. The coloration was present over the entire leaf and some of the veins appeared to be a darker green color.

No visual symptoms were observed for those plants grown under phosphorus (P), potassium (K), magnesium (Mg), copper (Cu), manganese (Mn), molybdenum (Mo), and zinc (Zn) deficient conditions after 13 weeks of growth. Tissue analysis determined that significant differences occurred in the plant tissue concentrations between deficient and control plants for P, K, Mg, and Mn (Table 1 and 2). It is hypothesized that deficiency symptoms were not observed in this experiment because the levels in the plant had not dropped below the point where growth would be interrupted to induce a deficiency symptom.

For more information, contact: Brian Whipker, brian_whipker@ncsu.edu, Department of Horticultural Science, Box 7609, North Carolina State University, Raleigh, NC, 27695

Table 1. *Lilium longiflorum* 'Nellie White' plant dry weight and tissue nutrient concentration as affected by deficient or toxic induced nutrient treatments and published optimum concentrations.

Treatment	-N	-P	-K	-Ca	-Mg	-S	-B[1]	++B[1]	-Cu	-Fe	-Mn	-Mo	-Zn
							Dry weight (g)						
Element	N	P	K	Ca	Mg	S	B	B	Cu	Fe	Mn	Mo	Zn
Complete control	12.15	20.65	20.65	11.02	11.02	12.15	12.15	12.15	20.70	12.15	20.65	20.65	20.65
Treatment	7.34	20.05	19.42	11.72	9.14	11.56	6.40	10.09	17.80	13.67	17.15	17.66	16.95
p-value[2]	***	NS	NS	NS	NS	NS	***	*	NS	NS	NS	NS	NS
				Tissue nutrient concentration (%)						Tissue nutrient concentration (mg kg^{-1})			
Element	N	P	K	Ca	Mg	S	B	B	Cu	Fe	Mn	Mo	Zn
Complete control	3.19	0.20	3.44	0.80	0.27	0.19	22.0	22.0	7.3	59.0[3]	27.9	-[4]	23.8
Treatment	2.36	0.12	2.41	0.02	0.08	0.12	0.2	168.0	7.9	43.8[3]	9.4	-[4]	21.1
p-value[2]	***	*	*	***	**	**	***	***	NS	NS	***	-[4]	NS
Sufficiency range for *Lilium longiflorum*[5]	3.30-4.80	0.25-0.70	3.30-5.00	0.60-1.50	0.20-0.70	0.25-0.70	25-75	25-75	8-50	60-200	35-200	No data	20-200
Sufficiency range for *Lilium*[6]	2.4-4.0	0.1-0.7	2.0-5.0	0.2-4.0	0.3-2.0	No data	20-25	20-25	5-25	100-250	50-250	No data	30-70

[1] Boron deficiency and toxicity treatments indicated by -B and ++B, respectively.
[2] *, **, or *** indicates statistically significant differences between sample means based on *F* test at P≤0.05, P≤0.01, or P≤0.001, respectively. NS (not significant) indicates the F test difference between sample means was P≥0.05.
[3] Concentration listed is averaged between two samples.
[4] Concentrations were below the detectable limit of 0.5 mg kg^{-1}.
[5] Mills and Jones, 1996.
[6] Dole and Wilkins, 2005.

Table 2. *Lilium* hybrid 'Brunello' plant dry weight and tissue nutrient concentration as affected by deficient or toxic nutrient treatments and published optimum concentrations.

Treatment	-N	-P	-K	-Ca	-Mg	-S	-B[1]	++B[1]	-Cu	-Fe	-Mn	-Mo	-Zn
							Dry weight (g)						
Element	N	P	K	Ca	Mg	S	B	B	Cu	Fe	Mn	Mo	Zn
Complete control	5.60	14.42	14.42	11.66	11.66	11.66	14.42	10.99	14.42	10.99	14.42	14.42	14.42
Treatment	3.59	11.59	11.60	8.63	10.66	9.60	10.92	9.62	12.53	9.74	14.28	14.79	13.93
p-value[2]	**	*	*	*	NS	*	**	NS	NS	NS	NS	NS	NS
				Tissue nutrient concentration (%)						Tissue nutrient concentration (mg kg^{-1})			
Element	N	P	K	Ca	Mg	S	B	B	Cu	Fe	Mn	Mo	Zn
Complete control	3.69	0.28	4.24	1.27	0.25	0.34	65.5	40.8	11.1	98.6	73.6	-[3]	42.4
Treatment	2.79	0.18	2.27	0.04	0.06	0.14	6.9	398.7	10.3	37.5	13.9	-[3]	40.5
p-value[2]	NS	**	**	***	***	***	***	*	NS	**	***	-[3]	NS

[1] Boron deficiency and toxicity treatments indicated by -B and ++B, respectively.
[2] *, **, or *** indicates statistically significant differences between sample means based on *F* test at P≤0.05, P≤0.01, or P≤0.001, respectively. NS (not significant) indicates the F test difference between sample means was P≥0.05.
[3] Concentrations were below the detectable limit of 0.5 mg kg^{-1}.

Barnes, J., B. Whipker, I. McCall, and J. Frantz. 2011. Characterization of nutrient disorders of *Lilium longiflorum* 'Nellie White' and *Lilium hybrid* 'Brunello'. Acta Horticulturae 900:205-211.