

Characterization of Nutrient Disorders of *Primula acaulis* ‘Danova Rose’

Primula acaulis, a member of the *Primulaceae* family, is a floriculture crop grown for use as a cool season colorful bedding plant or as a potted plant in the home. Several different fertilization regimes have been suggested for *Primula*, but nutritional problems have been reported. While some information is provided about the nutritional disorders of this crop, the symptomology for its nutritional problems are not complete. The goals of this study were to provide visual and diagnostic values for *Primula* so that growers will be able to accurately diagnose nutritional problems on site.

Nitrogen (N) deficiency: Symptoms initially showed as an overall pale green coloration, progressing to outer margin developing a stronger yellow coloration on the middle and lower leaves. Leaves then turned lemon-yellow to tan and became crispy. Overall, plants were smaller than controls.

Phosphorus (P) deficiency: Initial symptoms occurred on lower leaves, with tips becoming necrotic. Symptoms progressed with interveinal chlorosis on lower leaves. Marginal browning moved inward on leaf, and leaves began to curl. Some leaves became completely brown. Plants were significantly smaller than controls.

Potassium (K) deficiency: Symptoms began as marginal yellowing on both young and mature leaves. Necrotic spots formed in the yellow region on mature leaves, leading to full leaf necrosis. Overall, stunted growth occurred.

Calcium (Ca) deficiency: Initially, necrotic spots formed on lower leaf margins, which advanced to the development of black veins, yellowing in the leaf margin, and lower leaf curling inward. Yellow coloration moved in toward the midrib, and brown necrotic spots formed near secondary veins. New leaves developed necrotic margins. Plants were visually smaller than controls.

Magnesium (Mg) deficiency: Lower leaves developed a thin band of tan coloration on the outside margin, while larger mature leaves exhibited a yellow color in the

margin. As symptoms progressed, the margin widened, and bleaching began to occur in this area. Eventually, the tan color progressed inward and filled the interveinal areas.

Sulfur (S) deficiency: Symptoms first showed as a greenish-yellow coloration in the leaf margin for younger leaves or variably between the petiole and tip in older leaves, progressing to the whole plant. Necrosis began on the lower leaf margins, progressing to the entire leaf.

Boron (B) deficiency: Plants exhibited a lack of elongation of young foliage and yellowing on mature leaf margins. Browning became prevalent in the young leaves, with yellow coloration progressing in toward midrib. Buds aborted and developed a black coloration, and leaves turned crispy with black coloration.

B toxicity: Initially tan coloration developed along leaf margin in lower leaves, progressing inward, with the border area between necrotic and healthy green tissue developing a yellow band.

Iron (Fe) deficiency: Yellowing occurred on younger and older leaves, confined primarily to margin and outer veinal areas.

Zinc (Zn) deficiency: Initial symptoms showed as tan or brown coloration on the leaf margins in isolated spots, expanding inward as affected areas became crispy.

No visual symptoms were observed for those plants grown under copper (Cu), manganese (Mn), and molybdenum (Mo) deficient conditions, though significant differences occurred in the plant tissue concentrations (Table 1).

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Table 1. *Primula acaulis* ‘Danova Rose’ tissue nutrient concentration as affected by deficient or toxic nutrient treatments.

Treatment	-N	-P	-K	-Ca	-Mg	-S	-B	+B	-Cu	-Fe	-Mn	-Mo	-Zn
	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	3.91A ¹	0.38A	6.23A	0.65A	0.31A	0.54A	35.9A	44.5B	5.00a	148.1a	39.7A	1.7A	23.5A
Treatment	1.80B	0.12B	3.13B	0.51B	0.17B	0.12B	4.4B	373.7A	3.81b	96.0a	7.0B	0.2B	13.7B

¹Significant differences between sample means based on *F* test are indicated by lower case letters if $P \leq 0.05$ or upper case letters if $P \leq 0.01$.