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Boron Tolerance by Carnations and Symptoms of Excess Boron

by

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Recognizable boron hunger signs have shown up on commercial plantings of carnations in several sections of the United States during the past 10 years. Production areas along the east coast and in the mountain area have experienced the most trouble with boron deficiencies.

The role of boron in plant nutrition is becoming better understood, yet the picture is far from complete. Plants deficient in boron lose their root tips followed by complete or partial loss of shoot tips. The symptoms of this partial loss of shoot tips on carnation has been well described by Mastalerz (3). All gradations of symptoms from hollow flowers to completely blasted flower buds are often seen in one greenhouse bench. The severity of the deficiency and the time of the year modify these symptoms. Since boron is in part responsible for sugar translocation in the plant (2), one would expect to, and actually does find more boron hunger signs during the lightest half of the year.

With the use of continuous treatment of irrigation water it becomes increasingly important that we know and supply the boron requirements of our plants. Further, we should know the tolerant limits for boron and recognize the first symptoms of boron excess.

Rooted cuttings of Crowley's Pink Sim were planted in 4-gallon glazed crocks of volcanic scoria on November 20, 1957. No detectable boron had been found in this inert medium. There were 3 plants per crock and 3 crocks were included in each treatment. Boron, the only variable in the experiment was added to the nutrient solutions as boric acid at the rates of $\frac{1}{2}$, 4, and 10 ppm of B_2O_3 (borate). The solutions for the three treatments contained 7.7 lbs. of calcium nitrate, 2.44 lbs. potassium chloride, 2.2 lbs. magnesium sulfate, and 2.0 lbs. 52% phosphoric acid per 1000 gallons. Trace elements, except for boron, were added to all solutions. Tap water and fertilizer grade chemicals were used throughout the experiment.

The nutrient solutions, corresponding to treated irrigation water, were added to the crocks daily at the rate of $\frac{1}{2}$ gallon to 3 crocks. The length of stem in inches and the weight of flower and stem in grams were recorded for all flowers. All malformed flowers were noted. The cutting period was from May 1, 1958 to April 20, 1959.

Table 1. The effects of 3 application rates of boron on the growth of carnations.

Boron rate	Yield	Mean stem length-inches	Mean weight in grams	Weight/ inch of stem	Percentage of malformed flowers			
					Split calyxes	Slab-sides	Bull-heads	Sleepy flowers
½ ppm	225 196	23.3	23.2	0.997	7	4	3	7
4 ppm	196	23.3	24.6	1.055	7	4	10	6
10 ppm	197	23.2	22.7	0.980	16	2	9	3

Results and Discussion

The three rates of boron application had no significant effects on yield or weight of the flowers per inch of stem (table 1). The percentage of malformed flowers (table 1) was increased at the higher boron rates. The number of split calyxes for all treatments was higher than normal when one considers the fact that temperature fluctuation was minimized by fan-evaporative pad cooling during spring, summer and fall, and by automatic fan ventilation during winter. The 10 ppm rate of boron approximately doubled the production of split calyxes. Slabsided and bullheaded flowers are similar, but less severe, expressions of this same malady. Both 4 and 10 ppm of B_2O_3 approximately tripled the production of bullheaded flowers.

A few extremely hollow flowers and two entirely blasted buds produced on plants fed at the $\frac{1}{2}$ ppm rate of boron during late summer showed that this level is sub-adequate during periods of high light and high sugar assimilation. During nine months of the year no boron hunger signs were detectable on plants fed at this rate, however calyx splitting was higher than normal under the conditions of this experiment. Campbell (1) has shown that abnormally high splitting occurs under conditions of boron hunger.

Occasional flowers with tree-shaped red markings in the petals were produced by the two higher boron rates. These came during the highest light and temperature conditions of July and August. All of the sleepy flowers were produced during this same period, about equally in all treatments. The different boron rates apparently had no effect on sleepiness of carnations.

Conclusions

The $\frac{1}{2}$ ppm rate of boron feeding was inadequate for summer requirements of carnations in Colorado. The optimum rate, probably around 1 ppm, should decrease malformed flowers to a minimum.

The first symptoms of boron excess were uniform scorching and death of the leaf tips, which increased with higher levels. Flower color became more intense as boron was increased, and red tree-shaped markings were noted occasionally on the petals of Pink Sim during periods of high sugar assimilation.

Sleepiness of flowers was related to high temperatures and not to rates of boron application.

Literature cited

1. Campbell, F. J. Trace element mixtures as a source of boron for carnations. Mass. Flw. Gro. Assn. Bul. 44. 1957.

2. Gauch, H. G. and Wm. Dugger. The role of boron in translocation of sucrose. Plant Physiol. 28:457. 1953.

3. Mastalerz, J. W. Boron deficiency in carnations. Penn. Flw. Gro. Bul. 73. 1957.