Trace Element Nutrition of Carnations

by W. D. Holley

In the past few years concern for the trace elements has increased among growers of all crops. Widespread boron deficiency symptoms on carnations in most eastern and mountain areas of this country has added fuel to this fire. Excellent work by Mastalerz and his coworkers at the University of Massachusetts did the most to bring the solution of this problem to our attention.

Recently, several commercial growers have brought in a few benches of new soil for the first time in many years. They have been amazed at the improved growth in this soil when compared to older soils right beside them.

Our first conclusion from an experiment such as this is that something has happened to the older soil. This something may be 1) toxins left by previous crops,

2) a depletion of certain essential trace elements for which there are no really reliable soil tests, or 3) a loss of physical structure which prevents normal root growth. In any case, growth from this soil is no longer normal, but it is so nearly normal that we may have to grow a crop in new soil beside it to show a difference.

The trace element deficiency and excess problem will be treated here, however it should be understood that toxins and physical structure are interrelated to deficiencies of most of the nutrient elements.

YOUR CROPS MAY BE SUFFERING FROM TRACE ELEMENT HUNGER, if one or more of the following conditions exist:

1. Your original soil was low in one or more trace elements.
2. Your water supply is low in trace elements.
3. You use relatively pure forms of fertilizer chemicals such as tech. grade.
4. You use peat moss as the sole source of organic matter added to your soil.
5. Your soil contains unusually high calcium.
6. Your soil contains high potassium.
7. The pH of your soil is high or low.

The more of these conditions you can affirm, the better your chances for growing crops that are hungry for one or more trace elements.

Messing (1) of the Glasshouse Crops Research Institute of Sussex, England, published an excellent description of hunger symptoms on carnations in which he described deficiencies of seven major and minor elements. At Colorado State University we have been able to duplicate most of these symptoms in either soil or nutrient culture.

Of the trace elements, we find boron to be the most likely to become deficient in Colorado greenhouse soils. The symptoms of boron hunger have been pretty well publicized. In Colorado we have noted the sequence of symptoms in order of their appearance as follows: 1) slight discoloration of the margin of the older leaves - usually bleached along edges but developing considerable purplish color in later stages; 2) loss of petalage in the flowers; 3) extreme malformation of developing flowers and buds; and 4) excess branching on flower stems. There are other symptoms, but these seem to be the most prevalent.

It must be understood that boron can be extremely toxic. The optimum level in a nutrient solution is from 1/2 to 1 ppm of B_2O_3 (borate). This should supply all the boron a carnation plant needs for normal growth. In our tests 1/2 ppm seems to be adequate for growth only during the months of lower light. Slight boron hunger signs show on plants receiving this level of boron during the summer months.

Plants growing in solutions containing 4 and 10 ppm of B_2O_3 were almost normal from fall to mid July. Following the highest light (or temperature) period of the year these two higher levels began showing definite signs of toxicity, namely 1) excess branching of a thin, etiolated type, and 2) extremely bullheaded flowers. These symptoms are still very much in evidence and will probably continue throughout the life of the plants.

Recommended for maintaining boron in Colorado greenhouse soils: 1/2 ounce of borax per 1000 gallons of irrigation water. Borax is only slightly soluble in cold water. Dissolve it first in hot water then add it to the other dissolved nutrients in the concentrate tank. Continuous use at this rate should be entirely safe.

For dry applications of boron, one ounce of borax per 100 square feet mixed thoroughly with sand or other fertilizers to facilitate even distribution. Extreme caution must be use in applying borax in dry form as very little is required for permanent injury to a plant.

Most of the trace element mixtures contain boron and other trace elements in various proportions. The following mixtures are available commercially (table adapted from Penn. Flw. Gro. Bul. 73).

Mixture	Percent Boron	Iron	Man-ganese	Copper	Zinc	Molyb-denum
Es-min-el	0.16	3.0	9.87	3.81	3.48	-----
XL-36	0.04	0.15	0.18	0.06	0.06	0.009
Frit FN-501	2.0	12.25	4.9	2.0	4.0	0.13
Frit FN-502	2.8	3.9	9.7	2.0	4.0	0.13

Note the differences in these materials. The first and last have much more manganese than would be required for Colorado conditions. The second has little in active trace elements.

Magnesium

Magnesium hunger signs are not easily produced in Colorado when inert media and ordinary irrigation water are used. The magnesium content of most city water supplies in the Rocky Mountain Area is either adequate or nearly so, for healthy carnation growth. When inert media such as gravel and peat or volcanic ash is used, 1/2 pound of epsom salts per 1000 gal. of water should be added as a precautionary measure. Most well waters are reasonably high in magnesium content.

Magnesium deficiency on carnation (1) is characterized by sudden and severe interveinal chlorosis which spreads rapidly to most of the foliage. Stems become weak, growth slows down and old leaves die rapidly. Messing also described a symptom which develops in the later stages that is quite spectacular. Narrow necrotic bands develop across the leaf blades near their bases and cause them to drop over.

Iron, Manganese and Zinc

Messing was unable to produce deficiencies of these elements. He believed sufficient quantities were available in the growing medium which he used. He did note that in every instance the carnation plants growing in iron deficient solutions produced fewer blooms. At CSU we have also noted this characteristic of plants grown with iron deficient solutions. The plants are invariably thinner, with less branching; however, they show no loss of color as with many other iron hungry plants.

Messing's conclusions, which I believe are good for our guidance, are that the carnation's requirements for iron, manganese, and zinc are probably low. He believes this is especially true for manganese. Molybdenum and copper were not included in Messing's experiments. We have not been able to produce copper or zinc deficiency when using Fort Collins city water. Molybdenum is probably present in sufficient quantities in most waters of the mountain area.

(1) Messing, J. The visual symptoms of some mineral deficiencies on perpetual flowering carnations. Carnation Craft No. 32. 1955.

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