CARNATION FERTILIZER INJECTION ANALYSIS FOR THE DENVER REGION

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Water analyses from 26 carnation growers in the Denver region showed considerable variation. A part of this arises from the fact that many water supplies already contain various salts complicated by a return to muriate of potash (KCl) as a source of potassium when prices of potassium nitrate (KNO_3) rose rapidly in 1973-74. In order to raise nitrogen levels, with the loss of the nitrate source in KNO_3, ammonium nitrate has more than doubled the ammonium levels originally recommended by Hartman and Holley in CFGA Bulletin 221. Recent work at CSU by Bond and Hartley (CFGA Bulletin 339) indicated that muriate of potash may reduce yield and quality, and Schekel's work (CFGA Bulletins 251, 253 & 254) also emphasized that any increase in total salts above the minimum will reduce yield. Fertilizer for carnations is one of the lesser expenses in production compared to labor and fuel, and failure to pay strict attention to fertilization is a false economy.

A total of 29 growers were originally sampled. However, three samples were rejected either due to an inadequate sample, or having been sampled directly from the concentrate barrel. Figures 1 through 3 present the results in terms of the average values and the percentage distribution of the levels determined. The recommended injection rates for good water supplies (less than 300 micromhos/cm total salts) usually provide a final total salt level of 1600 micromhos. Either due to original salts in the water supply or potash injection, the average sample in this survey approached 2000 micromhos (Fig. 1). This means that in order to control salinity in benches, the amount of water that must be applied at each irrigation should be doubled to where 50% of the water applied passes through the bench. This is an added cost from improper fertilization and poor water supplies. A total salt level of 3000 micromhos/cm in the irrigation water is considered the maximum allowable for successful irrigation of field crops.

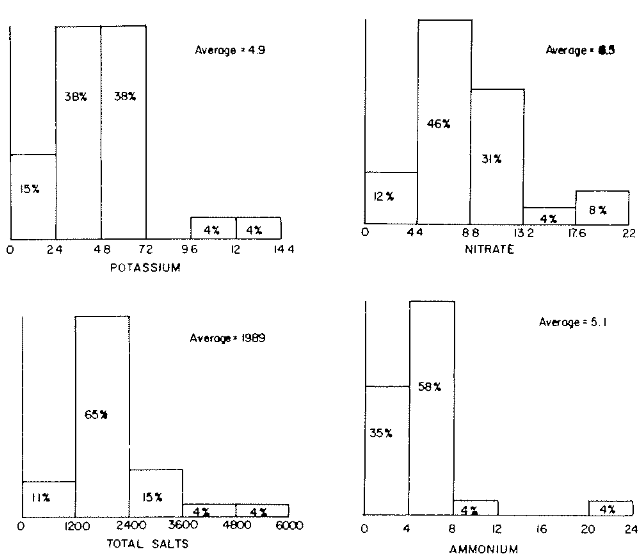

Fig. 1: Levels of potassium, nitrate, ammonium and total salts in 26 water samples from greenhouses in the Denver region which use constant injection. Values are in milliequivalents per liter with exception of total salts which is given in micromhos per centimeter, electrical conductivity. A level of 1000 would be equivalent to 100 as commonly read by most instruments for soil analyses in this region. To convert from meq/l to ppm multiply: potassium by 39, ammonium by 18 and nitrate by 62.

The recommended levels for constant automatic injection with gravel culture are:

Material	Milliequivalents per liter	Parts per million
Calcium (Ca)	3	60
Magnesium (Mg)	1	12
Sodium (Na)	0	0
Potassium (K)	6	235
Ammonium (NH_4)	2	36
Carbonate (CO_3)	0	0
Bicarbonate (HCO_3)	0	0
Chloride (Cl)	0	0
Sulfate (SO_4)	1	48
Nitrate (NO_3)	12	677
Phosphate (H_2PO_4)	1	97

The survey showed that more than half of the samples had nitrates below recommended levels and ammonium above the recommended levels. Half of the samples had potassium levels less than recommended. Note that the average chloride level was 3.7 meq/l (130 ppm). This is an element which is non-essential under our conditions and merely

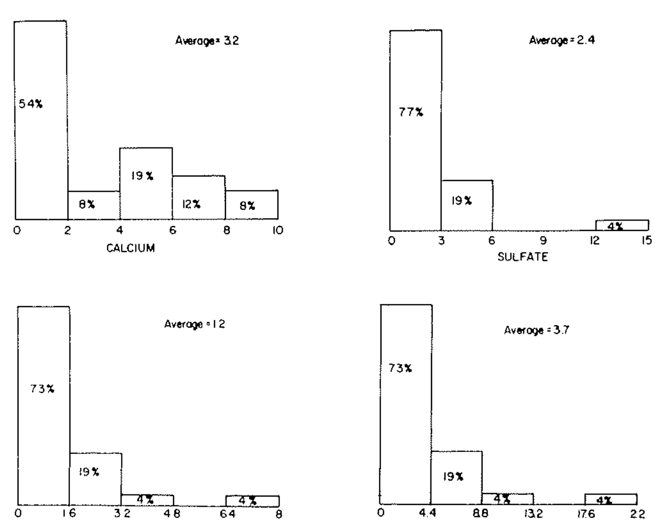

Fig. 2: Levels of calcium, magnesium, chloride and sulfate found in 26 water samples from greenhouses in the Denver region which use constant injection. Values are in milliequivalents per liter. To convert from meq/l to ppm multiply calcium by 20, magnesium by 12, chloride by 35 and sulfate by 48.

contributes to raising the total salinity of the nutrient solution. Calcium, magnesium, sulfate, sodium and bicarbonate are commonly prevalent in Denver waters, particularly shallow wells, and there is no need to add these materials to the water supply if present. Where calcium and magnesium are present, phosphorus cannot be added to concentrate barrels without precipitation and loss of nutrients. There are usually more efficient methods for adding calcium, magnesium and phosphorus such as dry feeding or before planting.

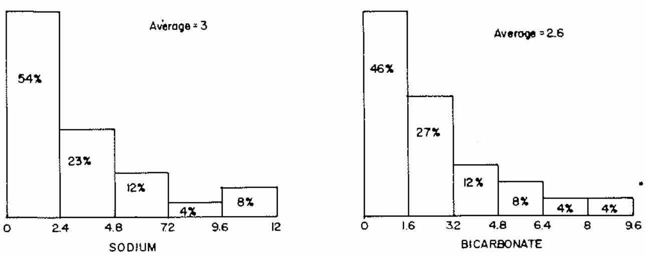

Fig. 3: Levels of sodium and bicarbonate found in 26 water samples from greenhouses in the Denver region which use constant injection. Values are in milliequivalents per liter. To convert meq/l to ppm, multiply sodium by 23 and bicarbonate by 61.

Sodium (Na) in water contributes nothing to the needs of plants, increases total salinity, and may actually cause loss of soil structure if it replaces calcium in the soil. It is necessary to increase calcium applications to soils where high sodium water is used. Carbonate and bicarbonate will tend to raise soil pH, and by precipitating with calcium and magnesium, can stop the emitters on trickle irrigation systems such as double wall tubes. Carbonates can be eliminated by acidification of the water. This may be dangerous, can add additional salts to the water supply depending upon the acid used and can damage piping and injection systems if excessive amounts are employed.

In looking over the survey and comparing carnation growth in the various greenhouses from which samples were obtained, a general picture of better growth and higher production was evident when recommended levels were approximated. In a few instances, where total salts were above 3000 micromhos/cm, growth was generally harder with severe problems from high salinity. According to Hartman and Holley (CFGA Bulletin 221) solutions for soil can have half of the nitrogen as ammonium. However, ammonium in inert media should be kept low (2 meq/l).

A grower may be limited by his water supply as to how he may reduce total salts and still inject fertilizer. Constant feeding has been shown for many years to be an inexpensive method for fertilization, provided it is used wisely. We can expect salinity problems to increase in this region as demands from an expanding population increase. Good water not only improves yield, but reduces the amount of water required. It may be that, in the future, we will be forced to examine deionization more closely as a cost-effective method in carnation production.

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