# Optimizing rose crop nutrient status and productivity through balanced cation and anion ratios:

## Initial Flower Harvest

Raúl I. Cabrera
AgriLife Research and Extension Center
Texas A&M University System
1619 Garner Field Road, Uvalde, Texas 78801

Now at Rutgers University
Cabrera@aesop.rutgers.edu

Report Date: June 30, 2012 (2011-12 Final Report)
Funded by the Joseph H. Hill Memorial Foundation, Inc.
ICFG-HILL, P.O. Box 99, Haslett, MI 48840
ICFG.HILL@yahoo.com

Since the previous report our research program with Texas A&M AgriLife Research was transferred from the Dallas to the Uvalde Research and Extension Center. This meant moving all the rose plants and supplies/materials associated with the present studies, and provide for a period of time for the roses to adapt to their new environment. Fortunately, in both research centers we have the same type of glass-covered greenhouses (built by same manufacturer) and thus the transition and plant adaptation went fairly smooth. Nevertheless the move and plant acclimation period delayed our studies for a few months, as reported in previous report to the J.H. Hill Foundation, but we are back on track.

The rose plants, 'Avalanche' grafted on 'Natal Briar', growing on 5-gallon containers filled with a 3 peat: 1 bark: 1 sand (v/v) substrate, were initially fertigated with a commercial nutrient solution Peter Excel Cal-Mag, at 150 ppm N). After a couple of flowering flushes, the plants were exposed to a series of solution treatments based on a slightly modified 0.5X Hoagland solution containing eight cation ($Mg^{+2}$, $K^{+}$ and $Ca^{+2}$) ratios (see Table 1 and previous report for details).

**Table 1.** Composition, EC and pH in solutions used in cation (Mg, K, Ca) ratio study in roses.

| Nutrient | Cation ratio | Cation Conc. (meq/L) | | | | pH | EC |
|---|---|---|---|---|---|---|---|
| Solution | Mg-K-Ca | Mg | K | Ca | $NH_4$ | | (dS/m) |
| T1 | 0.81 - 0.08 - 0.11 | 7.25 | 0.75 | 1.00 | 1.0 | 6.4 | 1.45 |
| T2 | 0.06 - 0.83 - 0.11 | 0.50 | 7.50 | 1.00 | 1.0 | 6.5 | 1.67 |
| T3 | 0.06 - 0.08 - 0.86 | 0.50 | 0.75 | 7.75 | 1.0 | 6.4 | 1.61 |
| T4 | 0.43 - 0.46 - 0.11 | 3.88 | 4.12 | 1.00 | 1.0 | 6.5 | 1.57 |
| T5 | 0.06 - 0.46 - 0.48 | 0.50 | 4.12 | 4.38 | 1.0 | 6.4 | 1.59 |
| T6 | 0.43 - 0.09 - 0.48 | 3.87 | 0.75 | 4.38 | 1.0 | 6.4 | 1.49 |
| T7 | 0.31 - 0.33 - 0.36 | 2.75 | 3.00 | 3.25 | 1.0 | 6.4 | 1.54 |
| T8 (control) | 0.23 - 0.33 - 0.44 | 2.00 | 3.00 | 4.00 | 1.0 | 6.5 | 1.56 |

**Notes:** All solutions had the same fixed anion concentration (7.0, 0.5 and 2.5 meq/L for nitrate, phosphate and sulfate, respectively, plus ½ strength Hoagland micronutrients concentrations and 1 ppm Fe-EDDHA). The EC and pH were measured right after solution preparation, and include the contributions of the previously $H_2SO_4$-acidified [to pH 6.3] tap water).

While theoretically (on paper) we expected the final EC of all the nutrient solution be the same, as the total sum of anions and cations to be the same, just with different ratios, the actual measured solution EC ranged from 1.45 to 1.67 dS/m. Ions in solution are supposed to be either dissociated ("free") or forming precipitates (solids accumulating in the bottom of the solution containers). In our case, we did not observe any precipitation in any of our solutions, but we suspect there was formation of some ion-pairing, a chemical phenomenon whereby an anion and a cation form a ion-par (attracted by their opposite electrical charges), but do not precipitate, staing "suspended in the solution. Ion pairs (like magnesium+sulfate and calcium+sulfate) are electrically neutral, and cannot be registered by EC meters, which only read "free" ions in solution. I suspect that solutions T1 and T6 had a significant formation of ion pairs (these solutions averaged an EC of 1.47 dS/m), whereas, on the opposite end solution T2 (EC of 1.67 dS/m) had the least formation of ion pairs, compared to the rest of the solutions (altogether averaging an EC of 1.57 dS/m). The pH of the prepared solutions was very similar, averaging 6.5, which closely reflected the adjusted pH of the tap water (6.3) in which they were prepared.

**Figure 1.** Layout of cation ratio study. The nutrient solutions from the tanks are delivered, via submersible pumps, to the plants through an irrigation manifold, with one calibrated spot-spitter (emitter) per pot.

So far we have fertigated the plants over one growth and flowering cycle, with the results shown in Table 1. On this first harvest we have not seen any significant differences between treatments, and expected response. Based on experience from previous experiments, the nutrient and carbon reserves of a mature rose crop are such that it takes a couple of harvest cycles before differential results are observed among treatments. We are also collecting leaf tissue and leachate samples and we'll report on their chemical analyses results on the next report.

**Table 2.** Biomass and flower yield and quality of 'Avalanche' roses (on 'Natal Briar') fertigated with nutrient solutions containing different cation (Mg, K, Ca) ratios. Results are for first harvest (August 13).

| Nutrient | Cation ratio | [Cation] - meq/L | | | Biomass | Flowers | Stem | Chlorophyll |
|---|---|---|---|---|---|---|---|---|
| Solution | Mg-K-Ca | Mg | K | Ca | g/plant | #/plant | Lgt - cm | SPAD |
| T1 | 0.81 - 0.08 - 0.11 | 7.25 | 0.75 | 1.00 | 23.0 | 13.5 | 21.2 | 40.5 |
| T2 | 0.06 - 0.83 - 0.11 | 0.50 | 7.50 | 1.00 | 23.3 | 12.1 | 21.1 | 40.8 |
| T3 | 0.06 - 0.08 - 0.86 | 0.50 | 0.75 | 7.75 | 25.1 | 12.9 | 21.5 | 41.5 |
| T4 | 0.43 - 0.46 - 0.11 | 3.88 | 4.12 | 1.00 | 22.8 | 11.8 | 21.1 | 40.7 |
| T5 | 0.06 - 0.46 - 0.48 | 0.50 | 4.12 | 4.38 | 25.5 | 13.1 | 21.6 | 42.0 |
| T6 | 0.43 - 0.09 - 0.48 | 3.87 | 0.75 | 4.38 | 23.8 | 13.3 | 21.3 | 41.7 |
| T7 | 0.31 - 0.33 - 0.36 | 2.75 | 3.00 | 3.25 | 22.5 | 12.8 | 20.7 | 41.5 |
| T8 (control) | 0.23 - 0.33 - 0.44 | 2.00 | 3.00 | 4.00 | 22.9 | 12.0 | 21.2 | 42.3 |

**Notes:** All solutions had the same fixed anion concentration.

## *REFERENCES*


Applied Plant Research, 2001. Handbook for Modern Greenhouse Rose Cultivation. The Netherlands.

Cabrera, R.I. 2003. Mineral Nutrition. In: A. Roberts, S. Gudin, and T. Debener (Eds.), Encyclopedia of Rose Science, p. 573-580. Academic Press. London, UK.

Cornell, J. 2002. Experiments with Mixtures: Designs, Models, and the Analysis of Mixture Data. John Wiley and Sons, Inc., New York.