COLORADO FLOWER GROWERS ASSOCIATION

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Progress Report
Effect of Salinity of Roses

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About 34% of Colorado's cultivated land is subject to salinity problems. High salts in well waters have pronounced effects on the greenhouse industry. Growers may be forced to use water containing varying amounts of calcium, magnesium, sodium, chloride, sulfate and bicarbonate. Either separately or together, these ions can be detrimental to roses. In some cases, when required nutrients are added to the water, rose growth can be significantly reduced. Much research has been done with replacement series in which individual ions are varied but the total concentration remains the same. The total actually may be less than is experienced with many of the water supplies available in Colorado. This preliminary experiment was designed to simulate the water applied by Colorado rose growers after fertilizer injection.

Methods

Forever Yours' were grown in inert media in 5-gallon plastic containers. The plants had been in the pots for about seven years and had been selected for uniformity prior to this experiment. For about three years, the roses had been continually fed with a standard solution by automatic injection.

On Aug. 2, 1974, the bushes were cut back to 12" and arranged in 14 treatments, 17 plants in each treatment (Table 1). The treatments were randomly placed in the house. Temperature was maintained at 64°F nights and heated to 72°F days. Relative humidity was maintained at 75% to 85% with a high pressure mist system.

The roses were pinched 21 days after cutback. For 51 days after cutback, the roses were hand watered with standard fertilized water. Treatments, as shown in Table 1, started on Sept. 22, 1974. Data collection was started on the same day.

Results

Within a week of starting the treatments, many of the plants began to show salinity damage in treatments containing bicarbonate and those with high total concentrations. Wilting of the flowering stems was most common. Treatments 7, 10 and 11 regained turgor at night and on cool days, while such treatments as 3, 6, 8, 9 and 12 through 14 did not recover, showing yellowing and some leaf drop. Treatment 13 was the worst (48 total milliequivalents and 6 milliequivalents/liter HCO_3), with four of the 17 plants in the treatment dying back to within 18" of the crown.

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Plants in treatments where the flowering stem had wilted were undercut to a good eye at the end of the fifth week. The four badly damaged plants in treatment 13 were cut back to within 12″ of the crown on Nov. 11, 1974. These roses failed to break after starting the treatment. Treatments 1, 2, 4 and 5 did not show outstanding reactions to the solutions. None of these solutions contained bicarbonate.

By the second crop, about nine weeks after the start, all treatments showed a yield decrease when compared to the check (Fig. 1). Yields continued to decline to the end of the experiment, with the exception of treatment 2 which maintained a lower but constant yield. Table 2 shows the percentages of unsalable and chlorotic, but salable, flowers produced by each treatment. Note that no chlorosis appeared until bicarbonate was added to the solutions. High total concentrations, or high concentrations of sodium and sulfate, did not cause chlorosis. Increasing numbers of unsalable flowers were cut when the total concentration equaled or exceeded 48 milliequivalents/liter (2700 micromhos/centimeter +), or bicarbonate was added to the solution. Chlorosis tended to increase as concentrations of magnesium and calcium increased. Solutions 10 and 11 did not follow the usual pattern (Table 2, Fig. 2). In both of these, sodium was not present even though calcium and magnesium varied radically with some bicarbonate present.

Temperature and humidity were not maintained uniformly through the house. Roses in low humidity sections showed much more severe reactions to salts than those near pads or mist nozzles. Even at the highest salt concentrations, roses were not damaged if their leaves were kept wet. This could have resulted from reduced water stress, or it may have been that the mist was sufficient to dilute the salts in the gravel. Solutions containing bicarbonate were very difficult to handle. When concentrations HCO_3 exceeded 4 milliequivalents/liter, the emitters of the trickle irrigation system were often plugged. Solutions 13 and 14 had considerable precipitate in the tanks.

These preliminary results indicate that fertilizer solutions approaching a total concentration of 48 milliequivalents/liter (2700 micromhos/centimeter +), or containing bicarbonate, will reduce yield and quality. Sulfates did not appear to have a separate effect except as they add to the total solution concentration. Sodium and sulfate by themselves in moderate concentrations did not appear to affect roses drastically. In combinations with HCO_3, however, sodium may have a synergistic effect on reducing yield.

Table 1. Nutrient solution treatments supplied to 'Forever Yours' roses in gravel starting Sept. 22, 1974. Concentrations are in milliequivalents per liter.[1]

Treatments	Treatment Number	EC[2]	pH	K	Ca	Mg	NH_4	Na	NO_3	SO_4	H_2PO_3	HCO_3	Total
Check (good water)	1	1250	6.3	4	6	1	1	0	10	1	1	0	24
1.5 times check (good water)	2	1870	6.3	6	9	1.5	1.5		15	1.5	1.5		32
2 times check (good water)	3	2750	6.2	8	12	2	2		20	2	2		48
Low salinity, Na & SO_4 only	4	1320	6.4	4	6	1	1	1	10	2	1		26
Ave. salinity Na & SO_4 only	5	1750	6.3					4		5			32
High salinity, Na & SO_4 only	6	2620	6.4					12		13			48
Na and HCO_3, slight	7	1370	7.4					2		1		2	28
Ave. Na and HCO_3	8	1750	7.4					6				6	32
Very high Na & HCO_3	9	1870	8.5					10				10	44
High Ca with SO_4 & HCO_3	10	2220	7.4	8	10	5		0	14	5		4	48
High Mg with SO_4 & HCO_3	11	1750	7.8	4	5	10			10				40
High Ca with Na, SO_4 & HCO_3	*12	1600	8.0		10	3		4		7			44
Increasing SO_4, Na, & HCO_3	*13	1870	8.0		8	5		6				6	48
Poor water, high Ca, Mg, Na, SO_4 and HCO_3	*14	2000	8.0		7	7		8		8		8	54

[1]All solutions included 3 ppm Fe sequestrene 330, 0.5 $MnSO_4$, 0.02 $CuSO_4$, 0.5 H_3BO_3 and 0.01 ppm H_2MoO_3.
[2]Electrical conductivity, mmhos/cm.
**Precipitate in tanks.*
Starting with treatment 4, those values underlined indicated concentrations exceeding recommended rates.

Table 2. Effect of nutrient solutions on quality of cut flower roses.

Treatment number	Percent unsalable	Chlorotic but salable	Ave. pH	Remarks
1	5	0	6.3	Check solution, 24 total meq/l
2	4	0		1.5 times check solution
3	13	0		2 times check, 48 total meq/l, EC 2750
4	5	0		Slight salinity, Na and SO_4
5	8	0		Salinity, Na and SO_4
6	17	0		High salinity, Na and SO_4, 48 meq/l, EC 2620
7	14	3	7.5	Low HCO_3 with Na and SO_4
8	12	7		Ave. HCO_3, with high Na
9	16	3	8.5	High HCO_3 and Na
10	4	6	7.5	Ave. HCO_3 and very high SO_4, No Na
11	7	8	8.0	Very high Mg, with ave. Na, SO_4, HCO_3, No Na
12	18	4		Very high Ca, with Na, SO_4, HCO_3
13	16	9		High Ca, with Na, SO_4, HCO_3
14	11	6		High Na, SO_4 and HCO_3

A second phase of the study is being conducted to verify the possibility of a Ca-K ratio effect and the interaction of Mg on this ratio. Another test is re-evaluation of chlorides due to the rising cost of KNO_3 and the fact that many growers are shifting to potash as an alternate potassium source.

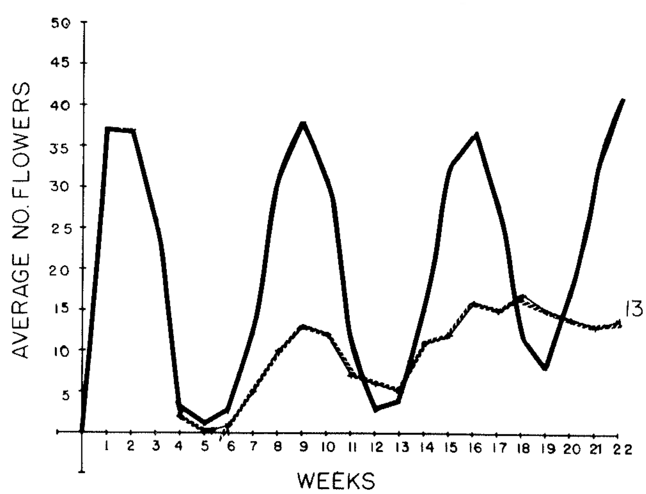

Fig. 1. Effect of extreme treatments on average number of flowers produced per week. Comparison between treatment 1, check, and treatment 13, containing 6 meq/l Na, 7 Na, 6 HCO_3, 8 Ca and 5 meq/l Mg.

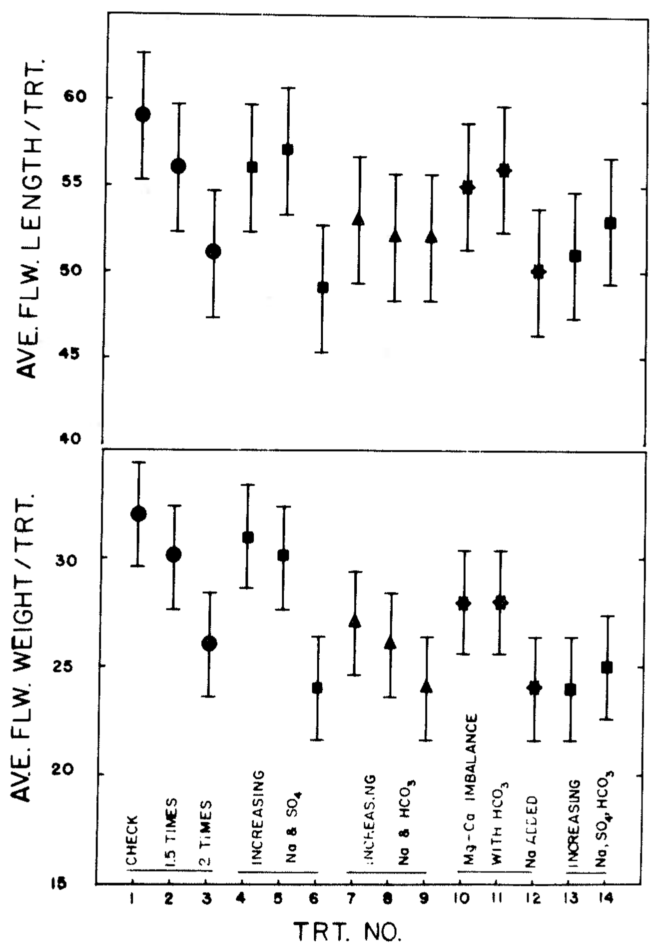

Fig. 2. Effect of treatments on average weight (grams) (lower) and average stem length (cm) (upper) of 'Forever Yours' roses. Treatments are significantly different from each other if the vertical bars do not overlap.