Colorado Flower Growers Association Inc.

H. A. Lazier, Executive Secretary,
Bulletin 95 | 809 Sherman, Denver, Colorado | November, 1957

Some Effects of Soluble Salts and Soil Moisture on Carnation Growth and Quality /1

by John W. White and W. D. Holley

White Sim carnations were grown for 9 months in a sandy loam soil and subjected to soluble salts in such concentrations as to give resultant conductivities of 25 to 141 when measured with a 1:5 extract. Basic nutrients were included in the soluble salts. Moisture tensions used were Lark tensiometer readings of 10, 30, and 50.

Soluble salts affected both yield and grade according to an inverse linear relationship. For each addition in soluble salts of 10, mean grade decreased 0.093 of a quality index unit and yield decreased 0.3 of a flower per square foot. Neither salt nor moisture levels significantly affected cut flower life.

Excess salts are known to affect the growth of many crops adversely by reducing plant height, flower size, and number of blooms. While carnations have been considered relatively tolerant to high salt conditions, recent studies indicate that both yield and grade are reduced at relatively low salt concentrations. To apply this work by Lunt, Kohl, and Kofranek (1) to Colorado soils and conditions, this investigation was designed. Since soil moisture tension also contributes to the total stress put on plants, moisture levels usual to commercial carnation culture were added to the study.

Three greenhouse benches were separated by wooden dividers into 36 equal plots constructed in such a manner that intermixing of soil or soil water was at a minimum. The dimensions of each plot were 42 by 32 by 6 inches. The outside plants on all plots were planted to Pink Sim and used as buffer plants. A sandy loam soil from the Table Mountain area near Golden, Colorado, was chosen to represent the major soil type used for carnation production in this area.

The following tests and results indicate the quality of the soil:

Mechanical analysis
- 16.5 per cent clay
- 18.0 per cent silt
- 65.5 per cent sand

Organic matter - 2.85 per cent
Saturation percentage - 38.0
Exchange capacity -- 14.6 me per 100 g soil.

Rooted cuttings of White Sim were planted at a spacing of 6 by 8 inches on June 13, 1956. The plants were put in reasonably steady production by means of a pinch and a half. There were 36 plots with 20 test plants and 8 buffer plants per plot.

Three soil moisture levels were arranged in a Latin square design. Within each moisture level, 4 soluble salt levels were arranged at random. The 12 treatments were replicated 3 times making 9 plots per salt level, and 12 plots per soil moisture level. Plots were irrigated

1/ This is a part of John W. White's thesis for the Master of Science degree in Horticulture.

at Lark tensions of 10, 30 and 50, measured by tensiometers placed in each plot. The plots were thoroughly soaked during each irrigation.

Soluble salts and nutrients were applied by injection into the irrigation water each time the plots were watered by means of a Fert-O-Ject Model PR proportioner. The dilution rate for the machine was 1:34. The 4 stock solutions were prepared for injection into the irrigation water by adding the following salts in 20 gallons of water:

S1. Balanced nutrient solution (BNS) containing 1820g calcium nitrate, 95.3g sodium nitrate, 476.7g muriate of potash and 181.6g magnesium sulphate.
S2. BNS + 1477g sodium chloride + 1400g calcium chloride.
S3. BNS + 2953g sodium chloride + 2800g calcium chloride.
S4. BNS + 4430g sodium chloride + 4200g calcium chloride.

Due to their solubility, chlorides were chosen for use in this investigation. The average chloride levels maintained by the 4 solutions were 35, 70, 140, and 160 ppm, respectively. The soils in all plots were sampled and tested monthly by accepted methods.

Results

There were no differences in yield or grade attributable to moisture levels. Apparently the range of moistures used (Lark tensions of 10, 30 and 50) were all within the range for optimum growth in this soil.

Since it was not possible to maintain exact salt levels, the plots were grouped according to their average conductance readings into four arbitrary categories, with 9 plots per group (Table 4). Yield and grade improved significantly as the total soluble salt content of the soil decreased.

THE EFFECTS OF SOLUBLE SALT LEVELS ON YIELD AND GRADE OF WHITE SIM CARNATION

MEAN SALT LEVEL ($K \times 10^5$)	YIELD 9 PLOTS	MEAN GRADE
25 – 50	1049	4.20
59 – 89	944	4.01
93 – 106	973	3.66
117 – 141	868	3.47

The yield per plot is plotted against the mean salt levels in Fig. 1. As soluble salts increased, yields decreased according to a straight line relationship. The decrease in yield was 0.3 flower per square foot for each increase in soluble salts of 10 ($K \times 10^5$).

The mean grade or quality index was obtained by assigning numbers to the grades as follows: Fancy - 5, Standard - 4, Short - 3, and Design - 2. The mean grade of flowers produced is plotted against the salt levels in Fig. 2. As salts increased 10 units, mean grade decreased 0.093 of a quality index unit. The comparative slopes of the two lines serve as good indicators of the ill effects on carnations. Grade was more seriously impaired than yield.

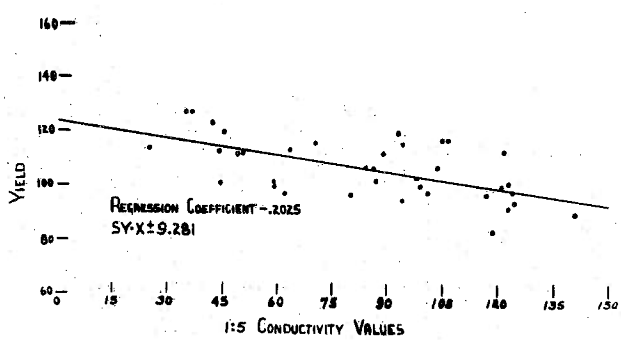

Fig. 1. Yield decreases as salinity level increases.

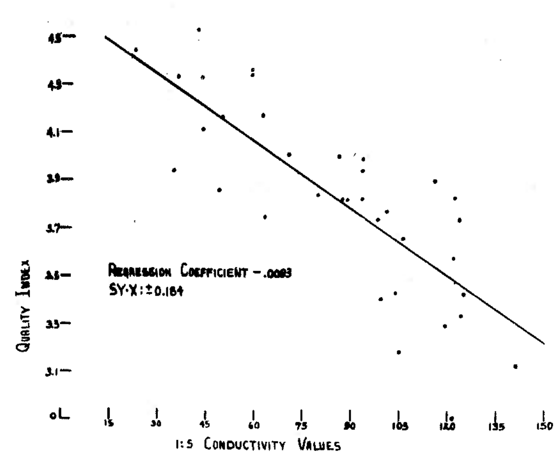

Fig. 2. Mean grade or quality index decreases as salinity increases.

The life of the flowers was measured on 3 occasions during the late winter by placing the freshly cut flowers in a room under reasonably constant temperature and humidity. There were no significant differences in keeping quality which could be traced to different soluble salt levels. This gives us strong evidence that soluble salt levels will stunt growth and reduce the grade of carnations long before it impairs keeping quality.

Recommendations

It is suggested that the specific conductance in sandy loam soils be maintained as low as possible for Sim strains of carnations. To be consistent with good fertility this level may be in the range between 25 and 50 ($K \times 10^5$). The more sand in a soil, the lower the salts plants will tolerate, and the more clay and humus present, the more salts that are tolerated. If you are continually plagued with high salts, check the following:

1. Is your water supply hard?
2. Does your soil drain properly?
3. Has the soil lost its structure?
4. Are you applying fertilizers that leave an appreciable unused portion in the soil?
5. Are you applying sufficient water with each irrigation?

Literature cited:

1. Lunt, O. R., Kohl, H.C. and Kofranek, A.M., Tolerance of carnations to saline conditions and boron. Calif. State Flor. Assn. Mag. Vol. V, No 10. May, 1956

* * * * * * * *

A MANUAL ON THE U. C. SYSTEM
A BOOK REVIEW
by Ralph Baker

It has been recognized for some time that the ornamental industry could adopt certain practices which are unique when compared with the methods of the other agricultural fields. It has been evident also that custom has limited the development and adoption of some of these practices which could be used profitably by floriculturists. Therefore, there has been a growing need for a comprehensive manual which would set forth the potential cultural methods available to the alert grower. This manual would not only have to be a complete and accurate reference book but should be written with imagination paralleling the scope of the undertaking. Such a publication has just been released entitled "The U. C. System for Producing Healthy Container-Grown Plants." Dr. Kenneth F. Baker and nine other outstanding workers have compiled in this manual the techniques for producing the best in ornamental crops.

The common denominator of the U. C. System is the famous series of U. C. Mixes. These admittedly artificial media for plant growth are described in detail. They may be heat or chemically treated without producing injurious toxic residues. Further, salinity problems are reduced. Tables of U. C. mixes are given, and in order to reduce wear and tear on the manual, they are printed in a separate leaflet entitled "The U. C.-Type Soil Mixes for Container-Grown Plants" (Leaflet 89) which is available free with the manual.

The philosophy of disease control is dominated by the fundamental concept of preventive treatment aimed at eliminating the causal organism. "Don't fight 'em, eliminate 'em" is the central core of the system. This is accomplished by the use of clean stock, clean soil, and sanitation. This approach to the problem of disease control is not new but the reader will be pleasantly surprised at the imagination and scope of the methods described for the attainment of this objective. A separate section on the use of mechanization for the solution of this problem may be cited as an example. Detailed information involving processing, stockpiling materials, preparation of soil mixes, filling and treatment of containers by means of transit mixers, fork lifts, skip loaders, mobile binds, automatic can or pot fillers, and the like indeed indicates that mechanization is "a present and future fact in the nursery industry".

While the manual can be used as a handy reference book, one of its main features lies in its discussion of some of the fundamental processes which undergird the whole system of methods used in the ornamental industry. It is well established that an operator who knows why he performs certain practices is the manager who will eventually attain the greatest satisfaction from his work as well as the greatest profits. A case in point is the exhaustive treatment of the principles of heat treatment of soils. Separate sections on nitrogen in nursery soils, the importance of variation and quantity of pathogens, and the possibilities of utilizing beneficial soil microorganisms after steaming are other items which should broaden the readers understanding of fundamental concepts.

Anyone who is acquainted with the editor and authors of the Manual would expect this publication to be exhaustive of the subject matter. If any omission can be noted, it would be that of training unskilled and sometimes temporary labor in the numerous facets of the system. This evidently is taken care of by strict adherence to the principles involved and to mechanization; certainly the grower experiences incorporated in the next to the last section, which testify as to the advantages of the system, would tend to nulify this criticism.

In spite of the comprehensive nature of the Manual, it cannot be thought of as a panacea for every difficulty. For instance, it is unlikely that even close adherence to the methods of the U. C. System will solve fully some of the disease problems common to the Colorado carnation industry. All in all, however, the Manual is a staggering compendium which not only brings together the results of 16 years of work but elaborates a sound, fundamental philosophy which should be sufficient to make it a monument in its field.

This California Experiment Station Manual may be obtained for $1.00 from:

Agricultural Publications
Room 22, Giannini Hall
University of California
Berkeley 4, California

In lots of 10 or more there is a 20% discount.

* * * * * * * * * * *

your editor
W D Holley

COLORADO STATE FLOWER GROWERS ASSOCIATION
OFFICE OF EDITOR
W. D. HOLLEY
Colorado State University
Fort Collins, Colorado

FIRST CLASS