TESTING BY THE GROWER FOR SOLUBLE SALTS

GERALD SMITH

University of Georgia
Athens, Georgia 30602

Only a small percentage of southern nurserymen producing plants in containers use a solubridge to test for soluble salts (salinity). This is unfortunate since a solubridge is one of the most important diagnostic tools that a nurseryman can use in making intelligent fertility decisions. A solubridge works on the simple principle that a water solution containing high concentrations of dissolved minerals (ions) is a better conductor of electricity than one with low amounts of minerals. The solubridge is calibrated to measure this conductance of electricity.

Lack of acceptance of this tool in the container nursery industry is basically due to three factors: (1) lack of experience by nurserymen in its use, (2) lack of confidence in interpreting the results due to the wide variations in testing procedures, and (3) cost. Most reliable instruments are in the $200 to $300 range.

Commercial and State University labs will make soluble salts determinations for nurserymen; however, this usually requires at least 10 to 14 days. Most nurserymen need "instant" results in order to make fertilization decisions.

A solubridge allows a grower to "see" the level of salts as a result of dissolved minerals in the water and potting mix plus those from his fertility program. In the south most soluble salts levels are directly related to the amount of fertilizer applied. The instrument allows the nurseryman to decide: (1) if another fertilizer application is needed to stimulate growth, (2) if he should delay application due to the salts level present, or (3) if it would be wise to leach a portion of the salts out by heavy watering in order to reduce a dangerous concentration.

Conflicting information. Unfortunately much conflicting information is available concerning evaluation of soluble salts levels. This is due to the wide variation in testing procedures that have developed throughout the country. The ratio of soil to water in the numerous test procedures has especially resulted in conflicting information. For example, for a pine bark type mix, about four times the amount of water is used for a 1 to 2 soil-water (by volume) test as compared to a saturation paste extract procedure.

Which Procedure to Use. Most scientists agree that a saturation paste extract procedure is the most reliable when comparing a wide variety of potting mixes. This procedure, however, requires vacuum equipment and is more complicated than most nurserymen are willing to follow. The most practical one for nurserymen, in my estimation, is the procedure in which

one part soil is combined with two parts water by volume. The procedure described here is for a quick test that will give a good "ballpark" figure with a minimum of effort and time.

1. *Collecting Samples.* The same individual should collect samples and run the tests in order that identical procedures are always followed. Collect the samples from at least 4 containers in a block. A total of one-half to one cup of soil is adequate. Sampling can be done by a soil sampling tube; however, this can be time consuming. Cutting out a slice of soil as deeply as possible with a garden trowel is much faster. Before slicing, pull back the surface soil in the area if it contains any dry surface fertilizer. Thoroughly mix combined samples. Carry along a container of soil mix to replace the slice removed from each container. It is not essential that the combined samples be air-dried if this will delay results. It is better, however, that the samples not be soggy wet as this dilutes the test solutions somewhat.

2. A small cup is useful to measure one part soil by volume. Firm, but do not pack soil tightly.

3. Add two parts water from the same cup. Plastic freezer containers are ideal for agitating the soil solution. To eliminate confusion, number each container with a nursery marking pen.

4. Stack 4 or 5 freezer containers and agitate for 100 shakes. Test immediately.

5. Pour solution through a kitchen strainer into a tall glass cylinder (to obtain necessary testing depth).

6. Determine temperature of solution. Set temperature dial of solubridge at proper temperature.

7. Dip electrode so that air hole is under water. *This is important.*

8. For Beckman instrument model RD-B15, turn knob until black band appears on green "eye". Stop at widest point on band.

9. Read number on outer scale. The solubridge calibration will be either in Millimhos/cm or Mhos/ $\times 10^{-5}$. The difference is simply two decimal points. Example — a Millimhos/cm reading of 1.25 equals 125 Mhos/cm $\times 10^{-5}$.

10. Check soluble salts of water used in test. Subtract this number from results. If distilled water is used it will not be necessary to do this.

11. Always record results in soluble salts log book.

INTERPRETATIONS FOR GENERAL CONTAINER-GROWN SHRUBS IN PINE BARK MIXES[1] USING 1 TO 2 SOIL-WATER BY VOLUME

Solubridge reading in Millimhos/cm	Solubridge reading in Mhos/cm × 10^{-5}	Remarks
Below 0.25	Below 25	Low
0.25 - 0.50	25 - 50	Low to medium - acceptable for liquid feed or Osmocote programs
0.50 - 1.00	50 - 100	Medium. If above 75 do not re-apply fertilizer.
1.00 - 1.50	100 - 150	High. Do not fertilize. Don't allow soil to become dry.
1.50 - 2.50	150 - 250	Leach with heavy application of water.
Azaleas and Salt Sensitive Shrubs		
Below 0.10	Below 10	Low
0.10 - 0.30	10 - 30	Low to medium. Upper range acceptable for liquid feed or Osmocote programs.
0.30 - 0.50	30 - 50	Medium. If above 50 do not re-apply fertilizer.
0.50 - 0.75	50 - 75	High. Do not fertilize. Do not allow soil to become dry.
0.75 - 1.25	75 - 125	Leach with heavy application of water.

[1] Based upon author's practical experience.

SOLUBRIDGE INTERPRETATIONS IN USE AT WIGHT'S NURSERY, CAIRO, GEORGIA USING 1 TO 2 SOIL-WATER BY VOLUME

General Container Plants in Pine Bark Mixes	
Mhos/cm 10^{-5}	
Below 20	Need fertilizer
25 - 50	Satisfactory
50 - 75	No more fertilizer
75 - 100	Leach with water and do not allow to dry
Sensitive Plants (e.g., Azaleas) in Pine Bark Mixes	
Below 20	Need fertilizer
20 - 50	Satisfactory
50 - 75	Do not add fertilizer Do not allow to dry
Above 75	Leach with water

VARIABLES TO CONSIDER IN INTERPRETING TOXIC LEVELS

1. *Differing Shrub Susceptibility to Salts Injury:* Even in the same medium some shrubs are injured at a much lower soluble salts level than others. Azaleas and rhododendrons, for example, are injured at much lower levels than most other shrubs. Research in California (1) has provided us with a guide to a limited number of shrubs.

SALT TOLERANCE OF SOME ORNAMENTALS

High - *Bougainvillea spectabilis*; *Carissa grandiflora*.

Good - Rosemary (*Rosmarinus officinalis* 'Lockwood de Forest'); *Euonymus japonica*; *Dracaena indivisa*; Oleander (*Nerium oleander*); Bottlebrush (*Callistemon viminalis*).

Moderate - *Juniperus chinensis*; *Pyracantha Fortuneana* 'Graberi'; *Elaeagnus pungens*; arborvitae (*Thuja orientalis*); boxwood (*Buxus microphylla*); *Lantana camara*; *Ligustrum lucidum*.

Poor - *Viburnum tinus*; *Hibiscus rosa-sinensis*; *Nandina domestica*; *Pittosporum tobira*; Algerian ivy (*Hedera canariensis*).

Very Poor - *Ilex cornuta* 'Burford'; pineapple guava (*Feijoa sellowiana*); star jasmine (*Trachelospermum jasminoides*); rose.

2. *Soil Moisture:* Soluble salts do not evaporate along with soil water. As the soil mix increases in dryness, the salts concentration in the soil solution becomes greater. Salt injury to the roots is therefore much greater when the soil mix becomes extremely dry. Soil moisture is often the critical factor in a high salts situation in container production.

3. *Climatic Conditions:* Soluble salts damage to the roots results in drought stress. Plants under this stress are much more severely damaged under conditions of high temperature, high light intensity and also high wind movement.

4. *Time of Sampling:* Growers who do not take periodic samples and do not keep a soluble salts log book can misinterpret results. For example, a grower notes stunted growth or slight foliar symptoms on July 1st and checks the soluble salts level. By that time the soluble salts level could have dropped considerably from when a heavy application of water-soluble fertilizer was applied in late May.

5. *The Potting Mix:* The roots of shrubs in bark mixes are injured at a lower level than those grown in soil. They are also injured at a lower level than are plants grown in finely ground peat-vermiculite artificial mixes.

What To Do If Soluble Salts Problems Develop. Careful watering to keep the soil mix from drying out excessively is important if the level is slightly high. Leaching to reduce exces-

sive salts is recommended if high levels are encountered. Apply 2 to 3 inches of water and test soil again to determine the reduction. Six inches may be necessary to reduce the salts level by one-half. Salts build-up can be prevented to a great extent by applying enough water in each irrigation so that some water runs out of the drainage holes. This is very important in greenhouses where there is no leaching by heavy rains. Needless to say, excess fertilizer rates are the major reason for soluble salts problems in container production.

Developing Your Own Standards. As soon as a nurseryman purchases a solubridge he should begin to develop his own standards for his particular potting mix. Apply varying amounts of fertilizer to several species of plants. Record test results every two weeks along with shrub appearance. This backlog of information will add greatly to a grower's knowledge that will help to make the correct decisions when it becomes critical to do so.

Note the following results that were obtained from applying specific amounts of fertilizer to a mix of 4 pine bark, 1 sand in a one-gallon Lerio container.

SALT LEVELS AT VARIOUS FERTILITY RATES

Teaspoons water-soluble 15-15-15 per gallon container

0 = 4*
½ = 51
1 = 76
2 = 146
3 = 216
4 = 276
5 = 346

Readings in Mhos/cm × 10^{-5} (1 to 2 soil-water by volume)

The following chart is adapted from information from the University of Florida (2).

Soluble Salt Levels at Various Fertility Rates*

	lbs. per 100 sq. ft. 20-10-20		
	0#	1#	2#
Sand + Peat	1*	33*	56*
Shavings + Peat	1	41	83
Shavings + Peat + Perlite	1	37	72
Perlite + Peat	1	45	74
Sand + Peat + Shavings	1	35	76
Sand	1	25	56
German Peat	3	47	71

*SS readings 1-2 soil-water (Mhos/cm × 10^{-5})

Checking Accuracy of Solubridge. Growers must have

complete confidence that their solubridge is working properly. This can be accomplished easily by asking a druggist to prepare a standard reference solution as follows:

Dissolve 0.744 grams of dry C.P. potassium chloride in distilled water and dilute to 1 liter. When the temperature dial is set properly, the instrument should read 1.41 Millimhos/cm, or 141 Mhos/cm $\times$ 10^{-5}. A slight variation from the reading such as 135 Mhos/cm $\times$ 10^{-5} will not affect the usefulness of the solubridge.

LITERATURE CITED

1. Bernstein, L., L. F. Francois, and R. A. Clark. 1972. Salt Tolerance of Ornamental Shrubs and Ground Covers. *J. American Soc. Hort. Sci.* 97(4): 550-556.
2. Waters, W. E., William Dewellyn, and James NeSmith. 1970. The Chemical, Physical and Salinity Characteristics of Twenty-seven Soil Media. *Florida State Horticultural Society Proceeding* 83: 482-488.

TRANSLATING SOIL TESTS INTO QUANTITY OF FERTILIZER NEEDED

BRYSON L. JAMES

Consulting Horticulturist
McMinnville, Tennessee 37110

Converting chemical soil test measurements into recommended amounts of lime and other fertilizer treatments should involve more than simple mathematical calculations. The goal of a fertility program should be to optimize economically the ability of a specific soil to supply essential nutrients for a specific crop.

Many factors affect soil fertility and productivity. Some of these factors are subject to control or change and some are not. We shall not attempt to consider all factors here. However, it should be remembered that when considering the nutritional needs of plants, the controllable, as well as the uncontrollable factors will have a bearing on the fertility program plan and the resulting quality of plants produced.

Crops vary in their nutritional requirements. Soils vary in their ability to supply those nutrients needed to satisfy those requirements. Climatic factors affect crop growth and fertility response as well as management and cultural practices. Standardization of fertilizer recommendations is, therefore, not practical, and we shall not attempt to recommend rates for a specific crop or situation. Our objective simply is to explain certain soil test data and to provide guidelines for translating these into