Media Notes
for North Carolina Growers

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Management of Soluble Salts in Container-grown Plants

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What Are Soluble Salts?

Soluble salts (often called fertilizer salts) are produced when ammonium, potassium, sodium, chloride or nitrate dissolve in water. Excessive levels of these essential nutrients can damage or destroy a plant. In fact, the most common cause of soluble salt damage is overfertilization. The risk of such problems in nursery crops is particularly acute because potting media can be low in essential nutrients and thus require significant fertilizer amendments.

When soluble salt levels become high, water in the root cells moves by osmosis out into the soil causing the plant to wilt or—in extreme cases—to die. Critical levels vary depending on the salt, the plant species, the growth stage and the climate. Warning symptoms include reduced germination, stunted growth, leaf burn or chlorosis of new growth.

Table 1 presents a partial list of plants sensitive to high soluble salt levels. Azalea, rhododendron and photinia are among the most salt-sensitive plants. They will often show symptoms before other nursery plants.

Measuring, interpreting and controlling soluble salts in the soil solution are among the keys to a successful nursery. Growers should always be aware that essential fertilizer materials can cause serious problems unless they are managed carefully.

The Soluble Salt Index (SS-I)

The Agronomic Division's soil test report contains an instrument reading of the soluble salt concentration in the sample (i.e., a soluble salt index). Division agronomists evaluate problem samples to determine the risk of salt damage and provide management recommendations.

Media composition, moisture level, temperature, texture and other factors will determine the optimum salt level for each nursery operation. As a general rule, salt tolerance and growth requirements both increase with increases in water- and nutrient-holding capacity.

These capacities are determined by the composition of the media. Sandy mixes, for example, have a lower water- and nutrient-holding capacity than do mixes in which clay or organic matter is a major component. Thus, in sandy soils, a relatively low salt content can injure plants. Soils high in clay and organic matter, on the other hand, can accommodate higher fertilizer and salt levels without damage to plants.

Figure 1 helps growers use the soluble salt index to evaluate four of the most common soil mixtures. Ratings can be interpreted as follows:

Low:	Add fertilizer to the media. Salt effect on plants is negligible.
Medium:	At the lower end of this range, add a small amount of fertilizer; at the upper end, no fertilizer is necessary.
High:	Nutrient levels at lower end of range are adequate; germination problems or seedling injury may occur at the upper end.
Very High:	Do not allow the media to become dry, and do not add fertilizer. At the upper end of the range, water enough to cause some leaching. When values exceed the upper limit of this range, leach extensively.

Table 1. Plants sensitive to high levels of soluble salts.*

Abelia (*Abelia* spp.)
Azalea (*Rhododendron* spp.)
Boxwood, common (*Buxus sempervirens*)
Cotoneaster (*Cotoneaster* spp.)
Dogwood (*Cornus* spp.)
Euonymus, winged (*Euonymus alatus*)
Franklinia (*Franklinia alatamaha*)
Hawthorn (*Crataegus* spp.)
Holly, Chinese (*Ilex cornuta*)
Holly, Japanese (*Ilex crenata*)
Mahonia (*Mahonia* spp.)
Maple, red (*Acer rubrum*)
Maple, silver (*Acer saccharinum*)
Maple, sugar (*Acer saccharum*)
Mountain laurel (*Kalmia* spp.)
Nandina (*Nandina domestica*)
Oleander (*Nerium oleander*)
Photinia (*Photinia* spp.)
Pine, white (*Pinus strobus*)
Poplar, lombardy (*Populus nigra* cv. *Italica*)
Pyracantha (*Pyracantha* spp.)
Rhododendron (*Rhododendron* spp.)
Rose (*Rosa* spp.)
Spiraea (*Spiraea* spp.)
Viburnum (*Viburnum* spp.)

Preventing Problems

Nursery operators can avoid many soluble salt problems by following three rules.

• Initially, do not overfertilize.

• Before planting, submit a representative sample of your medium to a service that evaluates soluble salt concentration. If salt levels are too high, you may be advised to dilute the medium with organic matter or vermiculite. Many growers elect to submit a second sample during the season to monitor changes in the media. The NCDA&CS Agronomic Division performs soil tests free of charge for North Carolina residents.

• If salt levels are too high, apply about 15 percent more solution than is required to saturate the medium. As the solution moves down through the soil, salts are carried from the root zone. Growers should be aware, however, that as the soil dries, salt concentration will again increase. Thus, the soil should be kept moist at all times.

Proper watering is important. Every year, the Agronomic Division confronts problems in which two growers use the same fertilizer schedules but get opposite results. In many cases, sufficient watering proves to be the difference between success and failure.

Table 2 lists salt-index values for various fertilizer and liming materials. For the same weight of material, higher index values indicate a greater risk of soluble salt problems.

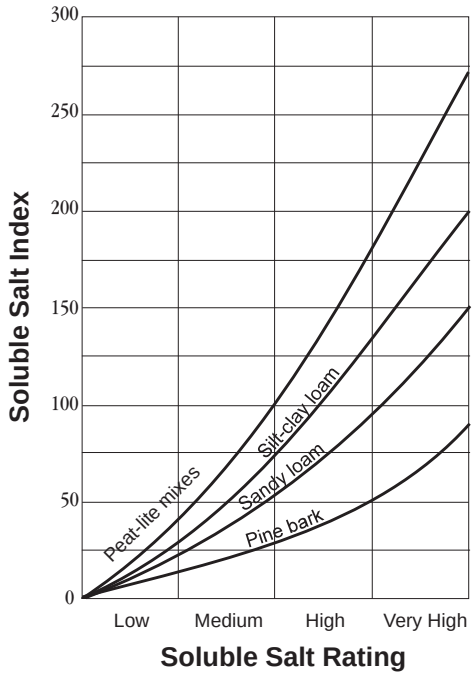

Figure 1. Relative soluble salt index for four soil mixtures.

Keep in mind, however, that a low index value can be offset by a high application requirement (e.g., urea has a slightly higher index value than does calcium nitrate, but almost three times as much calcium nitrate is required to supply the nitrogen in a given unit of urea).

Collecting a Sample

For media stored in bulk, collect about 1/2 pint of material from five separate locations across the pile. Sample to a depth of about 8 inches. Mix the collected material thoroughly. Fill a soil sample box with this mixture.

If problems develop after plants begin to grow, collect about 1/2 pint of material from five pots that typify the problem. Always sample from the root zone. Be careful to exclude surface media, particularly if fertilizer has been applied recently. As before, mix the collected materials thoroughly, and take the lab sample from this mixture.

Use standard soil-sample boxes and information forms when submitting samples to the Agronomic Division's soil testing lab. These materials are available from the Division's Raleigh office, regional agronomists, the Cooperative Extension Service and other agricultural advisors.

When testing is complete, results are posted on the Agronomic Division Web site. Growers also receive a copy of the report in the mail.

Table 2. Salt index of various fertilizer and liming materials

Materials	*Salt Index §*
Monoammonium phosphate (11-48-0)	30.0
Ordinary superphosphate (0-20-0)	8.0
Potassium nitrate (13-0-44)	74.0
Triple superphosphate (0-46-0)	10.0
Nitrate of soda ash (15-0-14)	92.0
Sul-Po-Mag (0-0-22)	43.0
Calcium nitrate (15.5-0-0)	65.0
Potassium sulfate (0-0-50)	46.0
Sodium nitrate (16-0-0)	100.0
Potassium chloride (0-0-60)	116.0
Diammonium phosphate (18-46-0)	34.0
Magnesium sulfate (Epsom salts)	44.0
Ammonium sulfate (21-0-0)	69.0
Calcium sulfate (gypsum)	8.0
Ammonium nitrate (33.5-0-0)	105.0
Calcitic limestone	4.7
Urea (46-0-0)	75.0
Dolomitic limestone	0.8

§ Salt index for equal weights of materials: sodium nitrate = 100; sodium chloride (table salt) = 154.