moisture is low. Use split applications for the remaining nitrogen depending on rainfall and plant growth.

Apply fertilizer to established plants in early spring before growth begins. On sandy soils, split applications of nitrogen and potassium reduce leaching losses, and sulfur-containing fertilizers can be beneficial.

**Soluble Salts (SS-I) Interpretation**

Overapplication of fertilizers or inadequate watering can cause salt injury. Salt damage depends on the type of media, moisture content, age of plant, temperature and plant tolerance. General ratings for different media are shown in Table 1 and can be interpreted as follows:

*Low:* Needs additional fertilizer, no effect of salt on plant growth.

*Medium:* Fertilizer can be applied at the lower end but should be adequate near the top.

*High:* Germination and seedling growth affected as salt index increases within this range.

*Very High:* Apply no fertilizer, and water enough to cause salts to leach.

Irrigation water can be a source of salinity. Water quality is important in a production system. Information about irrigation water and testing can be found online at [www.ncagr.gov/agronomi/pdffiles/sflier10.pdf](http://www.ncagr.gov/agronomi/pdffiles/sflier10.pdf).

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**Table 1. Soluble-salt hazards based on growth-media type**

<table>
<thead>
<tr>
<th>Media Type</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>Very High</th>
</tr>
</thead>
<tbody>
<tr>
<td>peat-lite mixes</td>
<td>0–40</td>
<td>41–100</td>
<td>101–180</td>
<td>180+</td>
</tr>
<tr>
<td>silt-clay loam</td>
<td>0–30</td>
<td>31–75</td>
<td>76–135</td>
<td>135+</td>
</tr>
<tr>
<td>sandy loam</td>
<td>0–23</td>
<td>24–51</td>
<td>52–95</td>
<td>95+</td>
</tr>
<tr>
<td>pine bark</td>
<td>0–12</td>
<td>13–26</td>
<td>27–50</td>
<td>50+</td>
</tr>
</tbody>
</table>

---

Nursery crops may be grown in ground or in containers. For crops grown in native soil, soil testing is the appropriate way to measure pH, determine lime requirement and measure nutrient content. It is not recommended for soilless media (pine bark, vermiculite, perlite, peat moss) or any growth mixture containing less than 20 percent soil.

Soilless media extraction (at anytime) and pour-through extraction (during production) are agronomic tests suitable for soilless growth media. For more information, visit [www.ncagr.gov/agronomi/pdffiles/samsme.pdf](http://www.ncagr.gov/agronomi/pdffiles/samsme.pdf) or [www.ncagr.gov/agronomi/pdffiles/pourthru.pdf](http://www.ncagr.gov/agronomi/pdffiles/pourthru.pdf).

**Lime Requirement**

Soil and other growing media must have the proper pH for successful plant growth. Lime neutralizes soil acidity and provides the calcium and magnesium essential for plant growth. Proper pH also provides a better environment for the microbial activity that converts nutrients into forms that plants can assimilate.

The target pH for most field and container-grown plants ranges from pH 5.5 to 6.0. Nursery crops grow well in a pine-bark/
sand mixture at pH 5.5. The pH of native pine bark, however, ranges from 4.0 to 5.0. Application of dolomitic lime raises the pH to a more suitable level and provides calcium and magnesium for plant growth. Native bark is generally low in phosphorus, calcium and magnesium but relatively high in potassium, manganese and zinc.

There are two types of lime: calcitic and dolomitic. Calcitic lime is usually composed of calcium carbonate and calcium oxides and contains little or no magnesium. Dolomitic lime, however, contains magnesium in addition to calcium. A ton of dolomitic lime contains a minimum of 120 lb of magnesium. For maximum benefit, mix recommended lime into the soil or media prior to planting. Surface application of lime should not exceed 1.0 ton per acre (50 lb/1000 ft² or 50M) on established field plantings. Wait 6 months before applying additional lime.

The pH requirement for container and field-grown crops varies widely. The formula below provides a means to calculate the lime rate necessary to achieve the desired pH. Soil pH and acidity (Ac) appear on the soil test report.

\[
\frac{(\text{desired pH} - \text{soil pH})}{(6.6 - \text{soil pH})} \times \text{acidity} = \text{tons/acre}
\]

### Conversion Factors

\[
\begin{align*}
M &= \text{lb/1000 ft}^2 \\
\text{tons/acre} \times 46 &= \text{lb/1000 ft}^2 \\
\text{lb/1000 ft}^2 \div 24 &= \text{lb/yd}^3 \\
\text{tons/acre} \times 1.92 &= \text{lb/yd}^3
\end{align*}
\]

### Micronutrients

A $ appears in the Recommendations section when the manganese (Mn-I), zinc (Zn-I) or copper (Cu-I) indexes are below 25. Follow the $ Note hyperlink on the soil report for information on correcting low micronutrient levels. Most field soils contain adequate amounts.

Broad-spectrum applications of micronutrients can be unnecessary as well as harmful. Therefore, apply micronutrients only as recommended by the appropriate agronomic test. If using a composite micronutrient source, apply the lowest rate necessary to meet plant requirements.

### Field-Grown Plants

Lime and phosphorus do not move readily through the soil. Therefore, it is best to broadcast and mix them into the soil prior to planting. Incorporation enhances soil reaction and nutrient uptake by plants.

Nitrogen and potassium are mobile in soils. Therefore, surface applications are effective. Apply fertilizers 6 to 8 inches from plants to reduce the risk of salt injury. Split applications also minimize the effects of leaching on sandy soils.

Nitrogen recommendations are as follows:

- **First Year**: Apply 50 lb/acre prior to bud swell (approximately 0.5 oz/plant).
- **Second and Subsequent Years**: Apply 80–120 lb/acre/year. Apply two-thirds prior to bud swell and one-third in early June. Do not apply nitrogen after July 1 since late growth may be more subject to winter injury.
- **Nitrogen rates may vary from rates shown above for high population plantings.** The procedure for converting a nitrogen recommendation from lb/acre to oz/tree is as follows:

\[
\text{lb/acre} \div 43.56 = \text{lb/1000 ft}^2 \\
\text{lb/1000 ft}^2 \div 24 = \text{lb/yd}^3 \\
\text{tons/acre} \times 1.92 = \text{lb/yd}^3
\]

### Nursery Seedling Beds

Mix recommended lime, phosphorus and potassium into the soil before planting. Apply lime several weeks in advance to allow time for soil acidity to be neutralized.

Apply nitrogen after plants emerge to prevent damage from soluble salts. Use 25 to 30 lb/acre and follow by irrigation if soil...