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/sflyer10.pdf.

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

	Soluble-Salt Index (SS-I) Ranges			
Media Type	**Low**	**Medium**	**High**	**Very High**
peat-lite mixes	0–40	41–100	101–180	180+
silt-clay loam	0–30	31–75	76–135	135+
sandy loam	0–23	24–51	52–95	95+
pine bark	0–12	13–26	27–50	50+

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Additional information can be obtained from NCDA&CS regional agronomists or the local Cooperative Extension office.

NOTE 11: Fertilization of Nursery Crops—Container & Field

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 or 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 ft^2 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.

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

Conversion Factors

M = lb/1000 ft^2
tons/acre × 46 = lb/1000 ft^2
lb/1000 ft^2 ÷ 24 = lb/yd^3
tons/acre × 1.92 = lb/yd^3

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.

Container-Grown Plants

Most container plants are grown in a mixture of pine bark and sand. Native pine bark, which is the major component, has a relatively low nutrient content. Successful production in this media requires supplementing with fertilizers. The challenge is to maintain adequate nutrient levels without creating a potential soluble salt problem.

Leaching of nitrogen, phosphorus and potassium is a common problem associated with pine bark and sand media. Nutrient leaching is most prevalent during periods of heavy rainfall or high irrigation demand. Sand that is coated with clay reduces loss of phosphorus and potassium. The clay fraction provides sites that attract and hold nutrients against leaching.

Use of slow-release fertilizers also reduces leaching of nitrogen, phosphorus and potassium. Release of these nutrients depends on source, temperature, moisture and method of encapsulation. Rates of application depend on manufacturer guidelines and grower experience.

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:

lb/acre ÷ 43.56 = lb/1000 ft^2
lb/1000 ft^2 ÷ ft^2/tree = lb/tree
lb/tree × 16 = oz/tree.

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