Lesson 4 Biological Factors

40 minutes

Objectives

- Review the eight biological factors from the *Forest Fertilization Guidebook* to consider in the ranking of stands for forest fertilization
- Review the guidelines and statements of advice found in the *Forest Fertilization Guidebook* that are important for selecting stands for fertilization

Equipment Needs

- Overhead projector
- Lesson 4 transparencies
- Copy of *Forest Fertilization Guidebook* for each participant (included in workbook)
- *Forest Fertilization in British Columbia* video
- Television and VCR

Method

- Video learning
- Lecturette with overheads and group discussion

Instruction

Begin by showing the video *Forest Fertilization in BC,* playing up to the end of the stand selection segment. This will provide a summary of the previous lessons and introduce the participants to the material in this lesson. Note that there are some changes since the video was produced. For example, transponders for aerial navigation have been replaced with GPS systems.

Ask the participants if they have any questions, any personal experience to add to the video, or any concerns relating to what the video shows.

The eight biological factors covered in this lesson are:

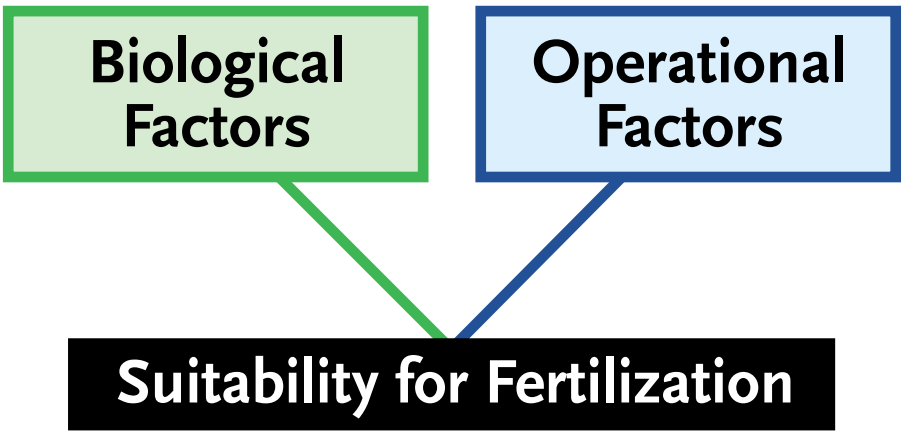
- species
- age and size
- stand density
- soil moisture and nutrient regimes
- site quality
- crown condition
- nutrient diagnosis
- insects, disease and small mammals

Lecture notes for this lesson are contained in the *Forest Fertilization Guidebook*, which is on the web at:

http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/fert/ferttoc.htm.

The overheads for this section display the guidelines or statements of advice from the guidebook.

Biological Factors



Overhead: Biological Factors

Key Points

- Once the strategic issues have been addressed, biological factors are a key component for evaluating each potential stand

Biological Factors

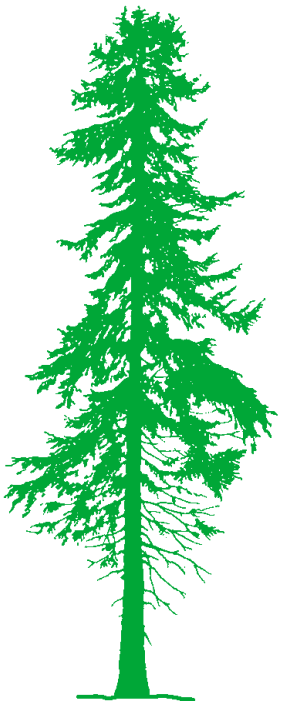
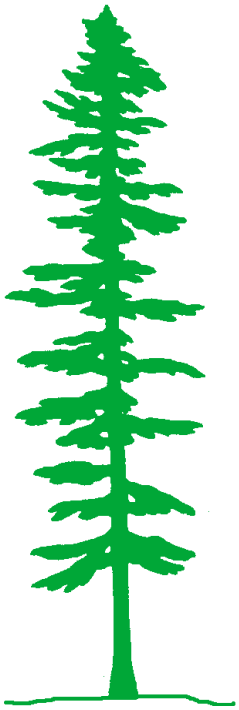
- Species
- Age and size
- Stand density
- Soil moisture and nutrient regimes
- Site quality
- Crown condition
- Nutrient diagnosis
- Insects, disease and small mammal damage

Overhead: Biological Factors

Key Points

- Minimize the time on this overhead since each point will be discussed in more detail with relevant overheads
- Each candidate stand must be evaluated for these eight key biological factors before a decision to fertilize can be made
- The *Forest Fertilization Guidebook* covers biological factors very thoroughly

Coastal Species

Douglas-fir	Western hemlock	Sitka spruce
		
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Overhead: Coastal Species

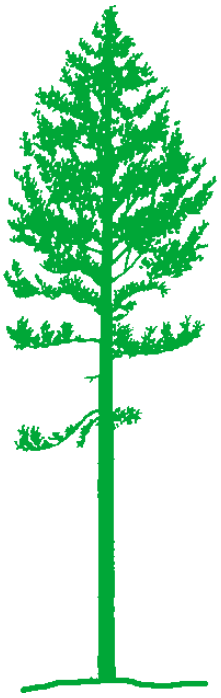
Key Points

- Show the coastal/interior overhead that is appropriate to the workshop location and audience
- Coastal Douglas-fir has been the subject of extensive research on its response to N fertilizer
- Western hemlock has received some research but the results are not definitive
- Sitka spruce responds well but is threatened by the white pine weevil. Analysis of forest health concerns, in particular the risk of increased white pine weevil damage, is essential before prescribing fertilization of Sitka spruce.

Question: What are your experiences with species fertilized?

Interior Species

Lodgepole pine



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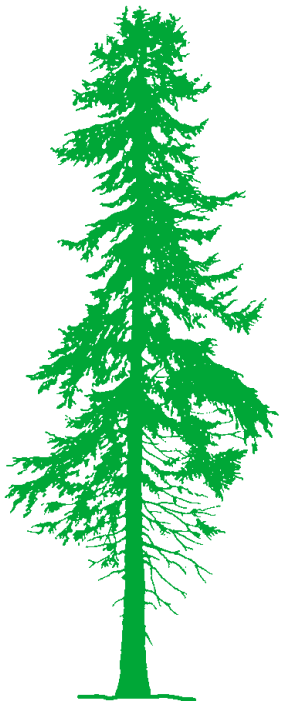
Wetbelt Douglas-fir



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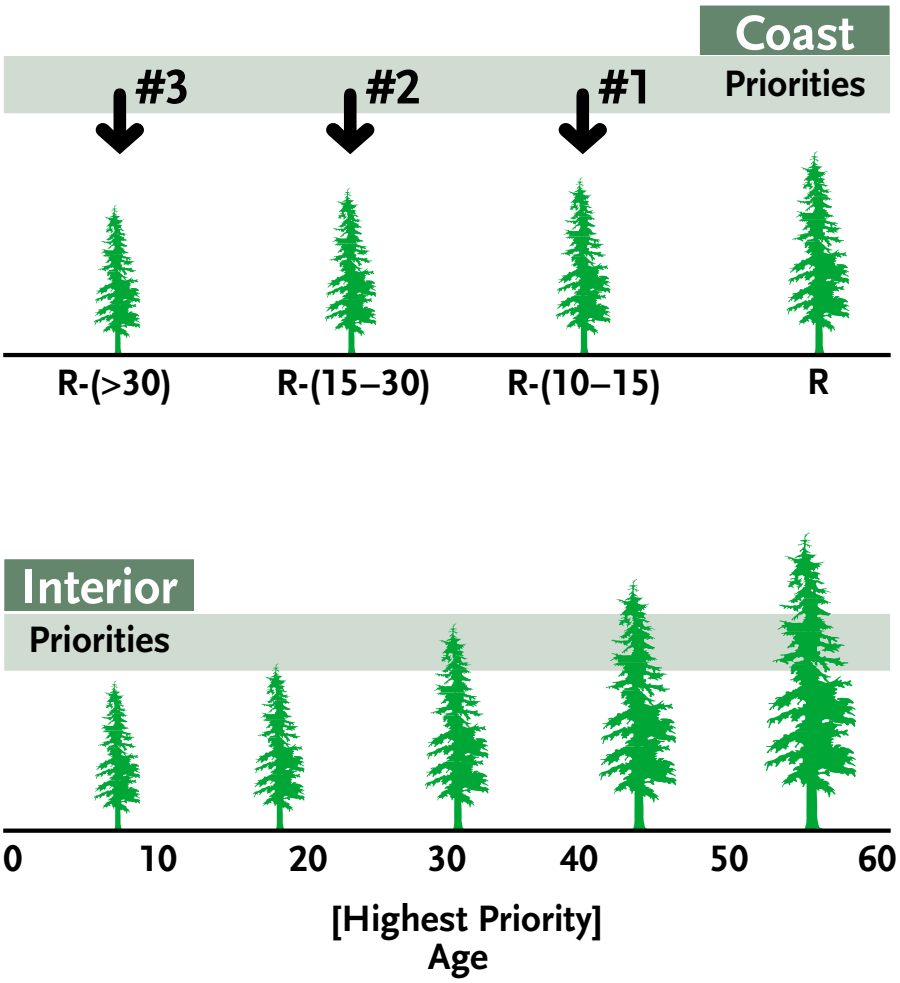
Overhead: Interior Species

Key Points

- Lodgepole pine has received extensive research and can be anticipated to respond well to N fertilization, **however**, sulphur (S) may be required in the fertilizer mix. Foliar analysis will help to determine this need.
- Lodgepole pine may also be deficient in boron (B). A nitrogen-induced deficiency (i.e., from fertilizing with N only) will produce dead tops and eventually multiple leaders, which is very undesirable and eliminates the usefulness of the fertilization treatment altogether.

Question: What are your experiences with species fertilized?

Age



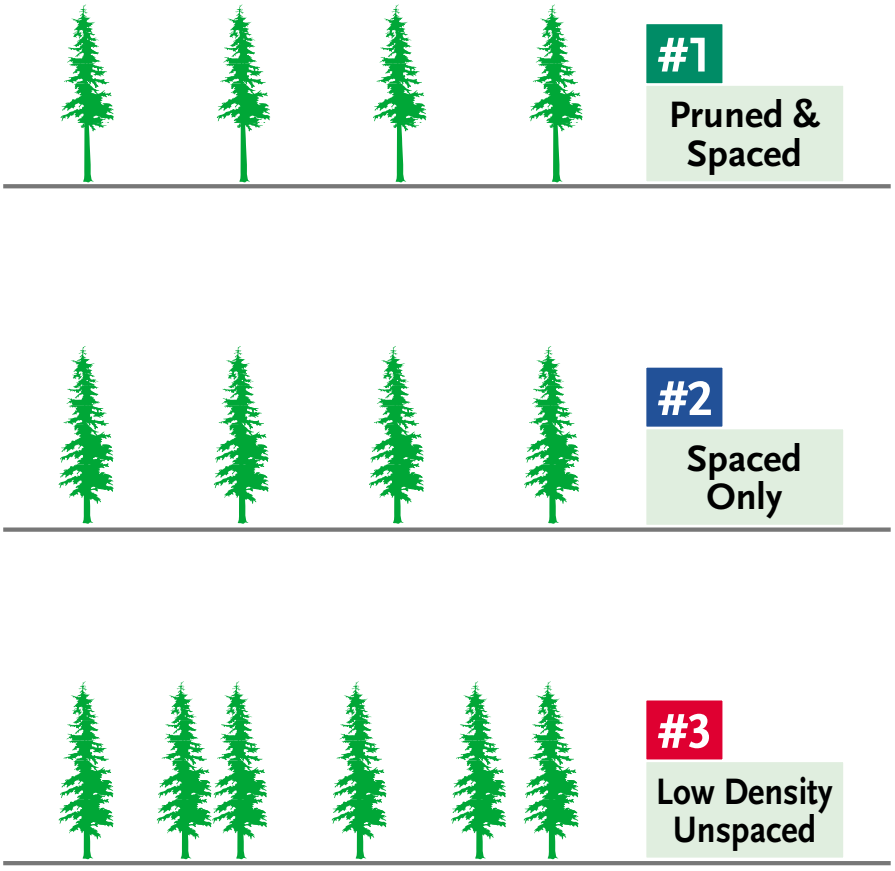
R = Response
(>30) = Number of years for response to occur.

Overhead: Age

Key Points

- The objective is to minimize the period of financial investment of the fertilization treatment cost while ensuring a high potential for increased growth
- Other factors have to be considered, however, so not all prescriptions should necessarily have to follow the age guideline exactly

Stand Density

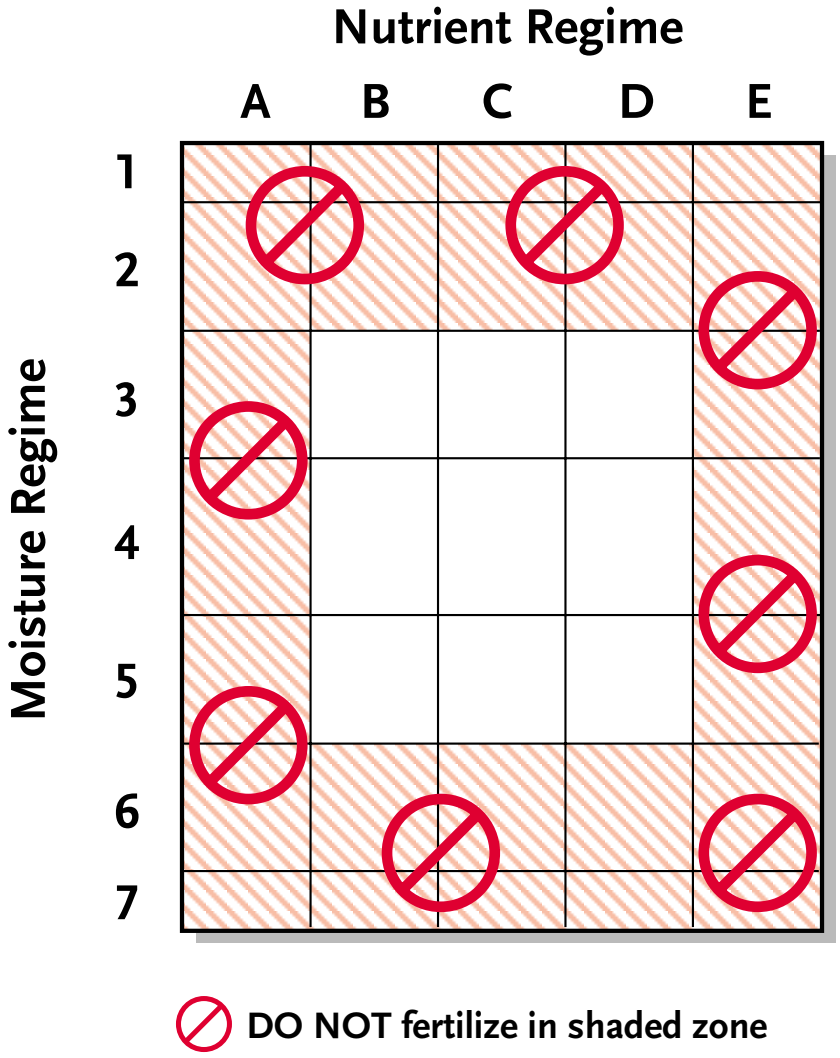


Overhead: Stand Density

Key Points

- Pruned stands have the potential to grow clearwood and thus are the highest priority for fertilization
- Favourable spatial distribution of the stand means that there is sufficient room for significant crown expansion after fertilization, which is critical for realizing the potential of the fertilization treatment investment
- Fertilizing before spacing locks up the fertilized nutrients organically in the spacing slash and provides a beneficial slow release of nutrients to the crop trees
- Beware of the potential vulnerability to wind and snow damage of a fertilized stand with a heavier crown. No stand with a height/diameter ratio of greater than 100 should be fertilized, and for Douglas-fir, a ratio less than 85 is recommended.
- Fertilization too soon after spacing, when there is still a covering of fine slash on the forest floor, may be unnecessary since the slash decomposition is fertilizing the crop trees and the slash may prevent the fertilizer prill from reaching the soil

Soil Moisture and Nutrient Regimes



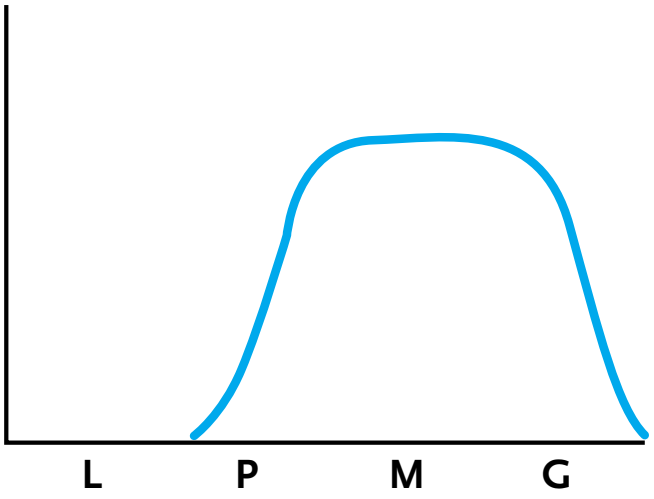
Overhead: Soil Moisture and Nutrient Regimes

Key Points

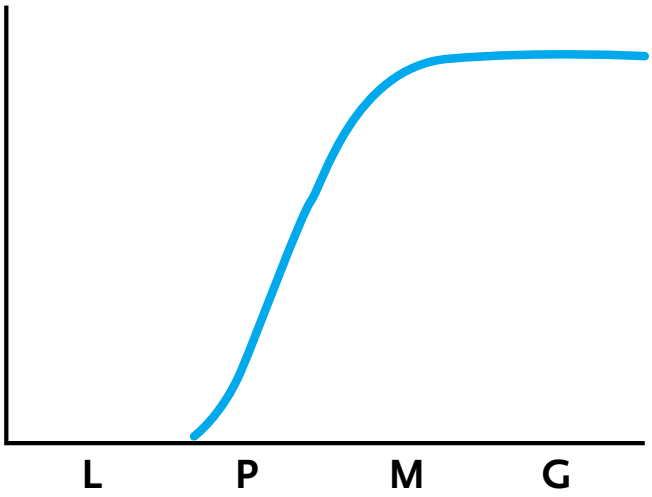
- The edatopic grid shows the sites that should not be fertilized; however, there is no clear line on the grid for delineating whether or not to fertilize
- When prescribing fertilization, only the prescribed nutrients can be the limiting factor to tree growth, or the treatment costs are wasted
- Therefore, do not treat very dry or very wet sites where water is the limiting factor for tree growth, or very poor or very rich sites where nitrogen is not the limiting factor

Site Quality

Coast
Response



Interior
Response



Overhead: Site Quality

Key Points

- Absolute response (net volume increase) to fertilization is higher on poorer sites than best sites
- Absolute response on good sites and under best site conditions (roughly midpoint on edatopic grid) may be desirable at forest estate level
- Highest priority is generally to fertilize poor and medium sites
- Do not fertilize low sites anywhere in BC. Most interior low sites have soil moisture deficit or extreme climate
- The next overhead illustrates the concept of relative and absolute growth increases.

Relative vs. Absolute Growth

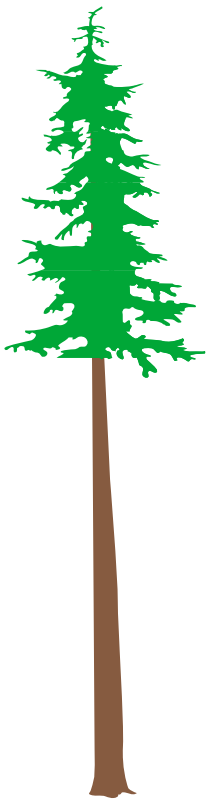
	Site Class	
	Low	Medium
Merchantable volume	100 m^3	250 m^3
% increase due to fertilization	20%	20%
Absolute increase	20 m^3	50 m^3

Overhead: Relative versus Absolute Growth

Key Points

- The same % increase from fertilization produces different absolute increases in volume and significantly different costs/ha overall
- Low sites do not have the potential in volume gains to offset the treatment costs
- Good site not used for example because nutrients are not usually a limiting factor

Crown Condition



≥30% of height

OR

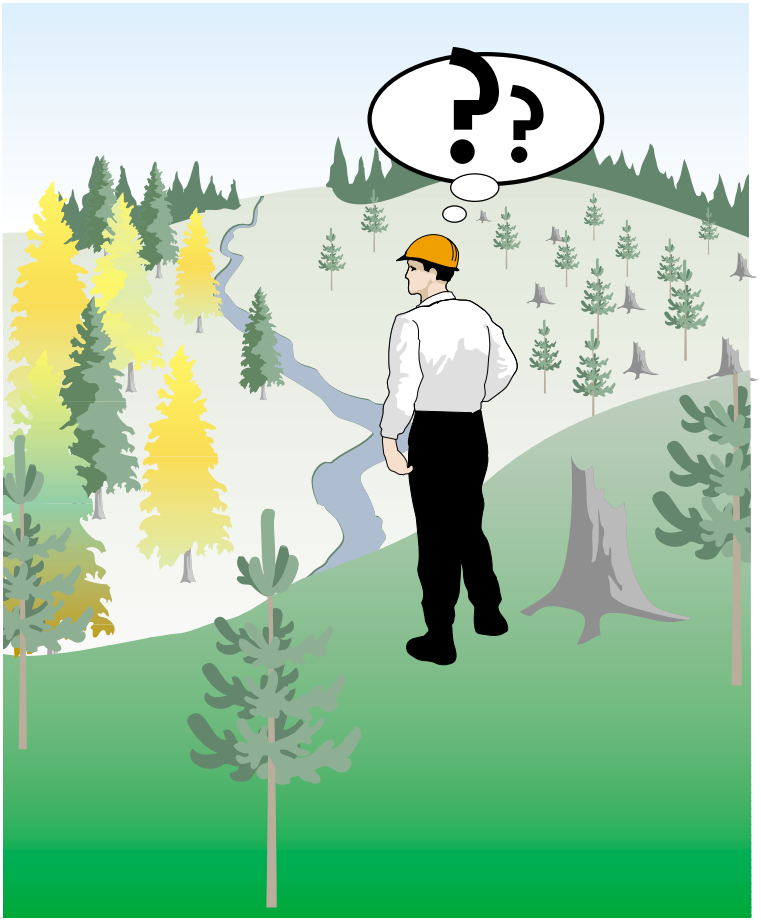
>6–8 m in length

Overhead: Crown Condition

Key Points

- The size and condition of live crowns provide an indication of the stand's nutrient status and productive potential
- The live crown should comprise at least 30% of total height or be greater than 6–8 m in length
- Small crowns do not have the overall potential to increase tree growth after fertilization (the 'factory' is too small) and may indicate stunted growth from reasons other than nutrient deficiencies
- Small crowns also usually indicate a high height/diameter ratio (>100) after excessive inter-tree competition from a high stand density, which disqualifies the stand as a candidate for fertilization anyway

Visual Symptoms



Overhead: Visual Symptoms

Key Points

- Very complicated to diagnose nutrient deficiencies by analyzing visual symptoms of the foliage, such as chlorosis
- Symptoms may differ between tree species and mild deficiencies may not be expressed
- Visual signs may be from a combination of factors, including non-nutritional
- Do not rely on visual symptoms for prescribing fertilization

Nutrient Diagnosis

Overhead: Nutrient Diagnosis

Key Points

- Foliar analysis is the last step in prescribing a stand for fertilization and should only be undertaken after the candidate stand meets all other wood supply, biological and operational criteria
- Collect in late fall/early winter to allow for adequate time for laboratory analysis of samples and data interpretation
- Arrange for foliar sampling before samples are collected (regional stand tending forester or fertilization specialist will know what labs are best) for the lab to schedule analysis
- Samples demonstrating straightforward analysis results, such as only one apparent nutrient deficiency, are the highest priority for fertiliza–tion. When a nutrient level is in the deficit range, that nutrient is likely a limiting factor to tree growth.
- Do not "beef up" a moderate level of nutrient to try to maximize growth unless prior experience on similar sites indicates that this is desirable. There is serious potential for toxicity, which degrades the stand at the expense of the treatment.

Forest Health

- Overall interaction between forest fertilization and forest health agents is poorly understood
- Current damage may increase
- Outgrow small mammal damage?
- Interaction from associated treatments?
- Local experience
- Forest health specialists

Overhead: Forest Health

Key Points

- The overall interactions between forest fertilization and forest health agents is poorly understood
- Interactions will include effects of associated treatments such as juvenile spacing
- Current forest health damage may increase after fertilization, since fast-growing trees become more attractive to pests that feed on them
- A healthy tree may be able to outgrow small mammal damage, even if damage does occur, but this is a risky premise
- Local experience contributes to the knowledge base
- Consult with forest health specialists before prescribing a suspect stand for fertilization