Effects of plant-fungal interactions on Alaskan treeline dynamics in a warming climate
ALFRESCO state transitions

Conceptual diagram of the processes affecting state transitions in ALFRESCO. Arrows indicate causal relationships (Breen et al. 2013, Gray et al. 2013)
Seedling Recruitment

- Seedling recruitment $\rightarrow$ changes in species distributions
  - Dispersal
  - Establishment
  - Growth
- Fire hypothesized to facilitate treeline expansion
  - Kills plant competitors
  - Opens up high-quality microsites
  - E.g., Fire linked to lodgepole pine migration and tundra shrub expansion
EMF-seedling interactions

- Ectomycorrhizal Fungi (EMF)
  - Conduits of soil nutrients and water
  - Pathogen resistance
  - Facilitate establishment and growth
Fire effects on EMF

• Fire severity
  – Combustion of soil
  – Kills host plants

<table>
<thead>
<tr>
<th>Low severity</th>
<th>High severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low combustion</td>
<td>High combustion</td>
</tr>
<tr>
<td>Low host plant death</td>
<td>High host plant death</td>
</tr>
<tr>
<td>High EMF legacy</td>
<td>Low EMF legacy</td>
</tr>
</tbody>
</table>
EMF-seedling interactions inform model

Conceptual diagram of the processes affecting state transitions from tundra to spruce in ALFRESCO. Arrows indicate the progression from one step in the transition process to the next step in the process. Figure modified from work by the ALFRESCO 2.0 Team (Breen et al. 2013, Gray et al. 2013)
EMF-seedling interactions modify establishment and growth

**Inoculum potential (y) of tundra classes:**
- Wet sedge tundra: y=0.01
- Graminoid tundra: y=0.25
- Shrub tundra: y=0.75
- Forest y=1.0

**Check:** random number generated (x) and compared to vegetation class inoculum potential (y). If x<y→ seedlings establish

**Modifier:** seed:seedling scales with (y). Fewer seeds are required to produce one seedling in forest.
forest < shrub < graminoid < wet sedge

**Modifier:** High fire severity fires reduce inoculum potential (y).
- High crown-HSS =0.2(y)
- High crown- LSS = 0.5(y)
- Moderate, Low, Unburned = 1.0(y)

**Modifier:** Growth scales with (y)
forest > shrub > graminoid > wet sedge