



Plant Hardiness in Alaska

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It's sold in Alaska, so it must be hardy!



It's hardy to 90 below!

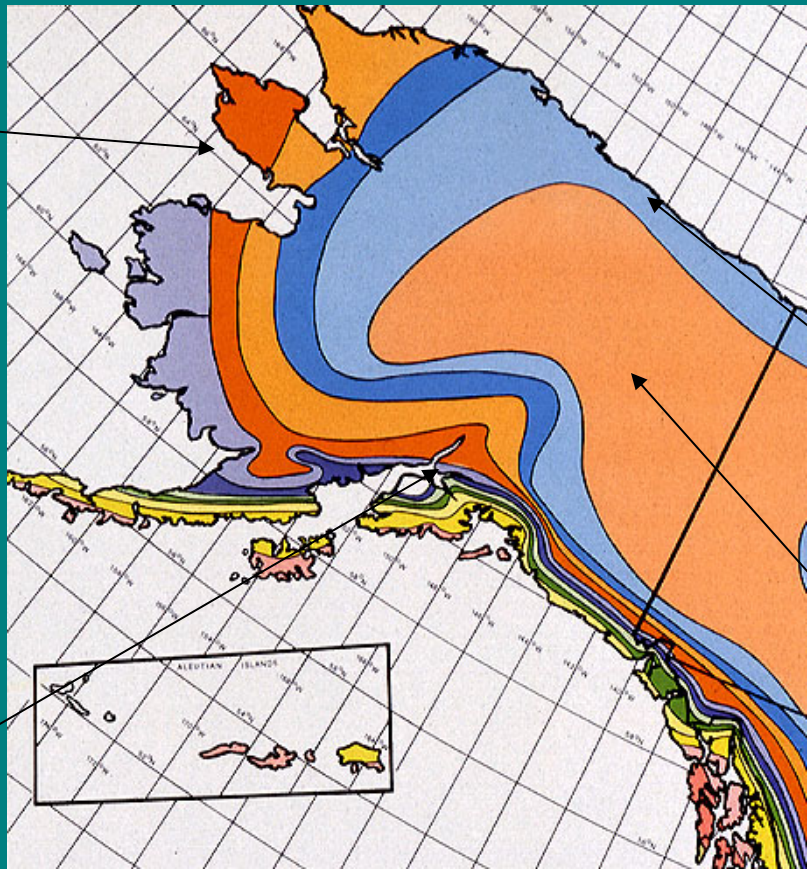


George grows it. Why can't I?

It's native, right? Therefore it's hardy, right?



USDA Plant Cold Hardiness Map



Nome
3b (-30 to -35°F)

Prudhoe Bay
2a (-45 to -50°F)

Fairbanks
1 (below -50°F)

Anchorage
4 (-20 - -30°F)



Frost cracks



Sunscald



Frost canker



Flower
bud
death



Evergreen winter burn

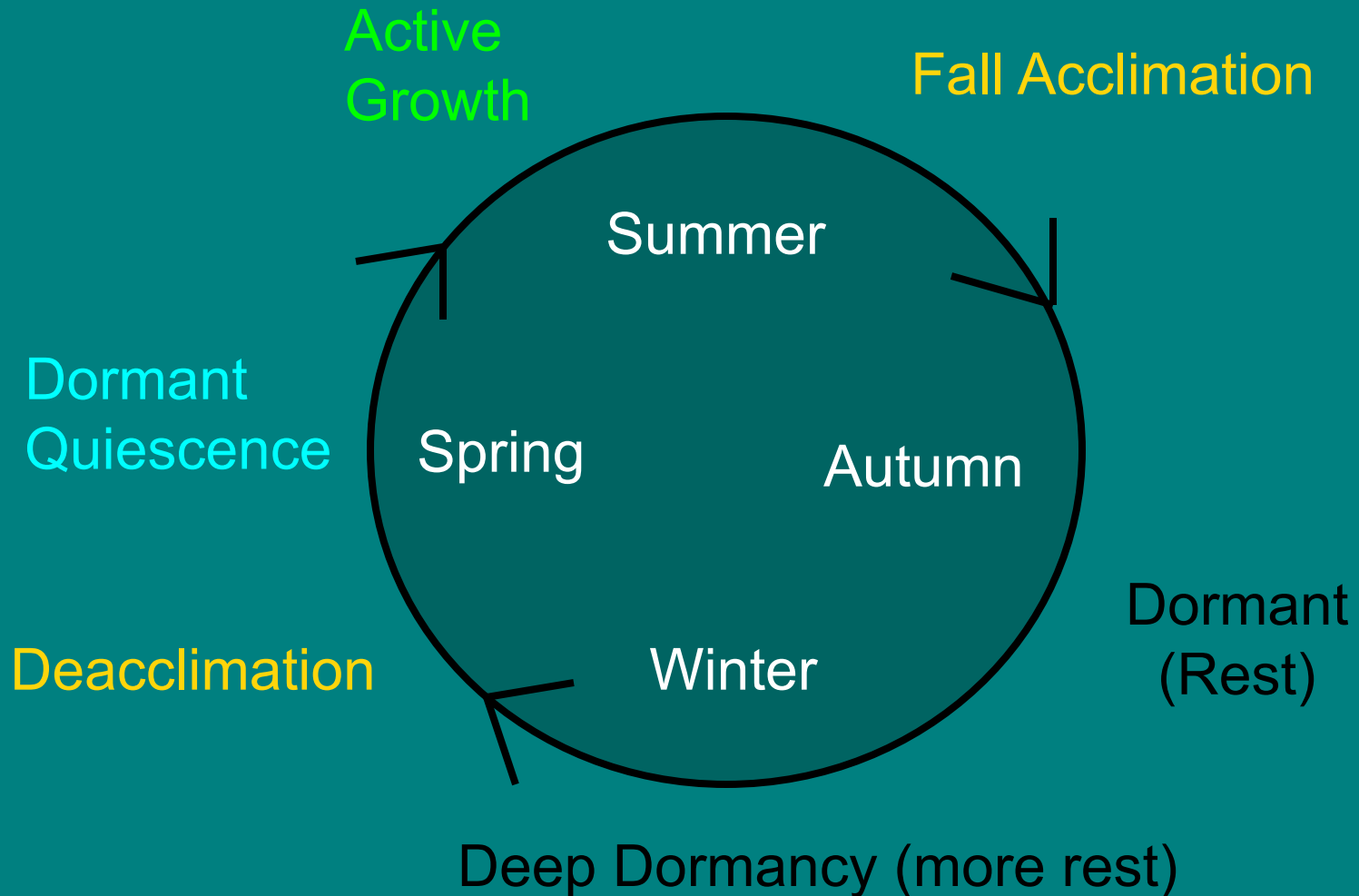
Injury from cold and dehydration stress

Plant Hardiness

The ability of a plant to survive and complete its life cycle in synchronization with its environment (regardless of season).



Cycle of Plant Hardiness



- Bud scales open
- Rapid elongation of shoots
- Flowering
- Early fruit production

Active Growth



- Sap is flowing
- Cells full of nutrients, fuel for cell division
- Cells full of water
- Nutrients, hormones, carbs directed toward growing points

Least hardy time of life cycle

Black cottonwood



Apple leaf



www.for.gov.bc.ca

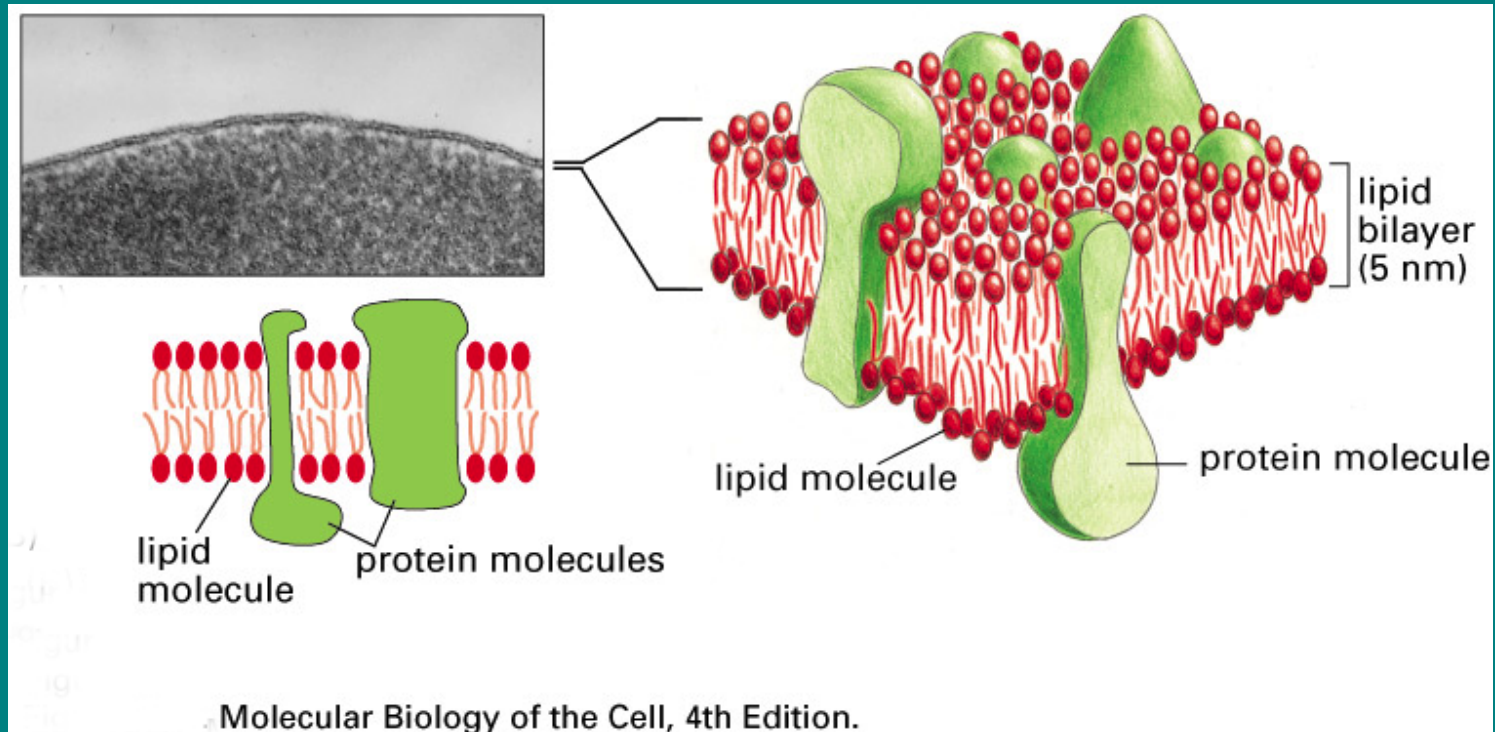
Killing temps
40°F (4°C)
and lower

New growth killed or damaged
Loss of central leaders
Irregular branching
Leaf death, spotting, streaking



Crabapple flower

It's the membranes!



Cell membranes:

- compartmentalize the cell (nucleus, mitochondria, etc.)
- control transport of hormones, nutrients
- control water balance of cell

Hardy plants have flexible membranes!

Fat (lipid) makeup- saturated vs. unsaturated fats

Protein makeup- presence of dehydrins

-determine flexibility of membranes

-determine ability to tolerate chilling or freezing



Room temp.



Freezer 3 hr



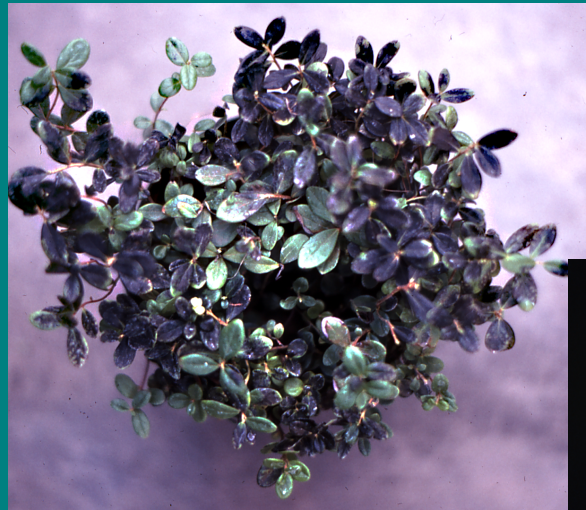
Back to room temp.

Non-hardy plants- membrane failure!

- become leaky
- lose ability to control water
- stick together in dehydration



Banana, 50°F, 12 hr
www.ucd.edu



Poinsettia, 45°F, 6 hr

www.ces.ncsu.edu



Lingon, moved from 75°F to 40°F, rapidly

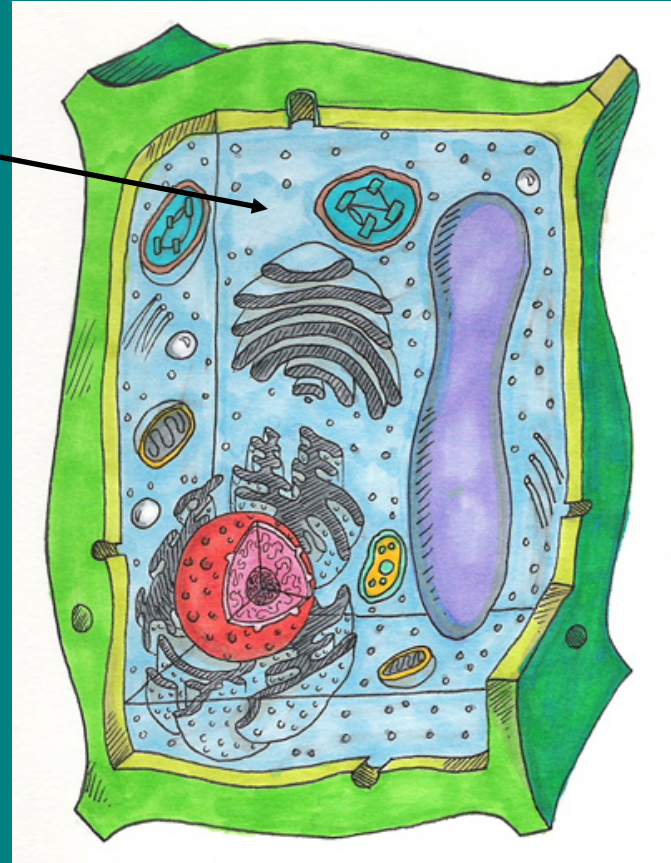
How to have the best acclimated plants:

- 1. Start with good genes, flexible membranes!
- 2. Slow down. Don't move too fast



Cell membranes function in cell sap

- Not pure water
 - Lots of sugars
 - How much sugar?
 - What kind of sugar?
- = antifreeze =
increased hardness



High-sugar sap → freezing
point depression



Not so hardy plants 0 to 2°

Hardy plants 3-5° depression



Genetics
Types of sugars
Age of plant
Health of plant

Sugars = carbohydrates → photosynthesis



Nutrient
deficiency

www.cthar.edu

Leaf defoliators, skeletonizers

Aspen leaf tortrix
fs.fed.us



Rose leaf rust

Disease

How to have the best acclimated plants:

1. Start with good genes, flexible membranes!
2. Slow down.
Don't move too fast



3. Healthy,
disease free
plants



Rosa 'Therese Bugnet'



So how about
winter
hardiness?

Amur maple



Bog blueberry

Cold acclimation

changes in a plant to allow
tolerance of steadily colder
temperatures

Strategies for cold acclimation:

Annuals

- Entire plant dies
- Genes packaged into a seed
- Small bits of dehydrated cells buried in soil



Calendula



Sunflower

Another option:

Herbaceous perennials

- Many produce seeds
- Plant dies to roots or crown
- Plant protected by soil
 - Moderated temps
 - Slow freeze, thaw

Fireweed



Alaska cerastium



Fernleaf Peony



The toughest of them all:

Woody perennials

- Must acclimate to the lowest regional temperature



Rosa 'LacMajeau'

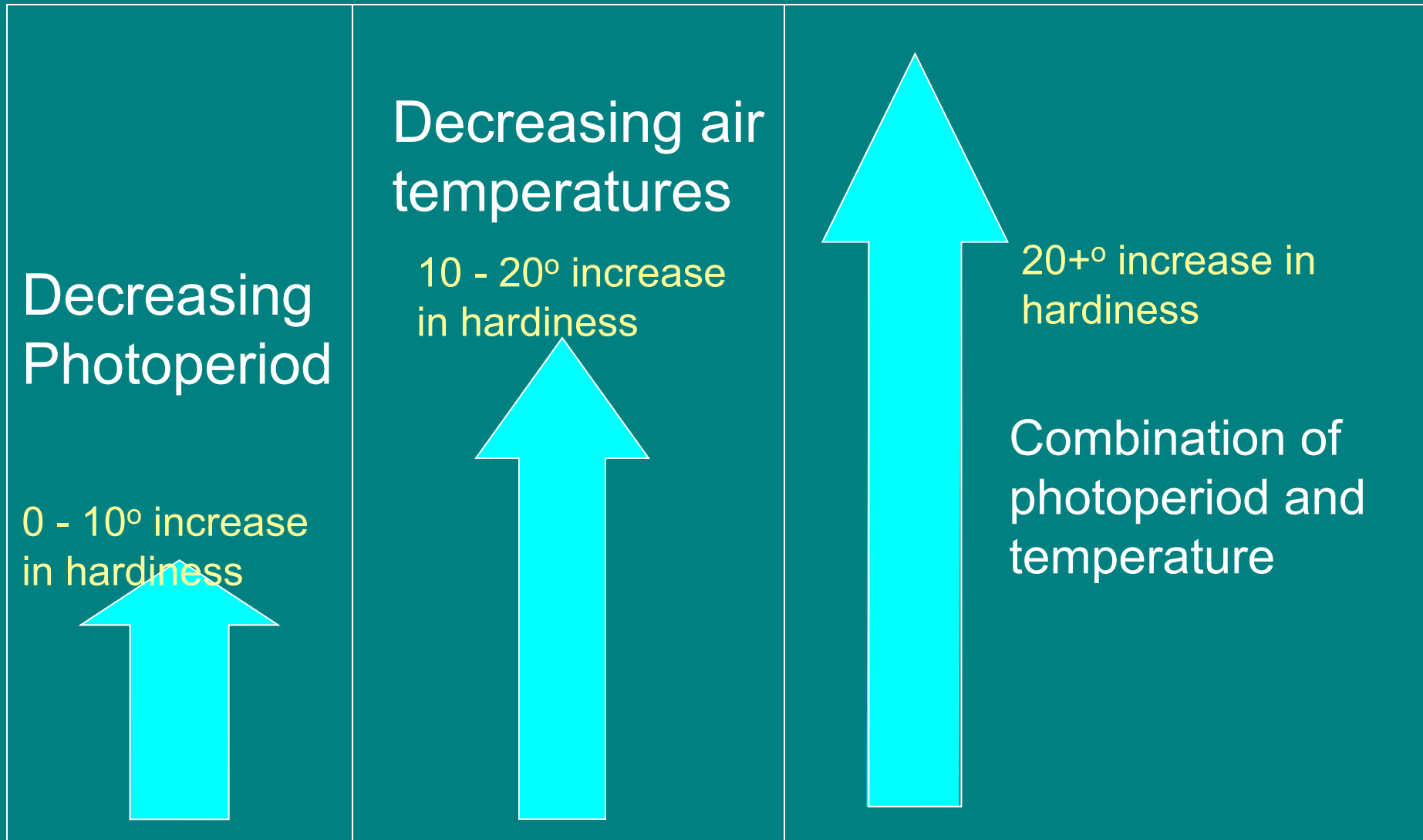


Greene's mountain ash



Western sand
cherry

If capable of hardening, then



Level of hardiness

J F M A M J J A S O N

Winter

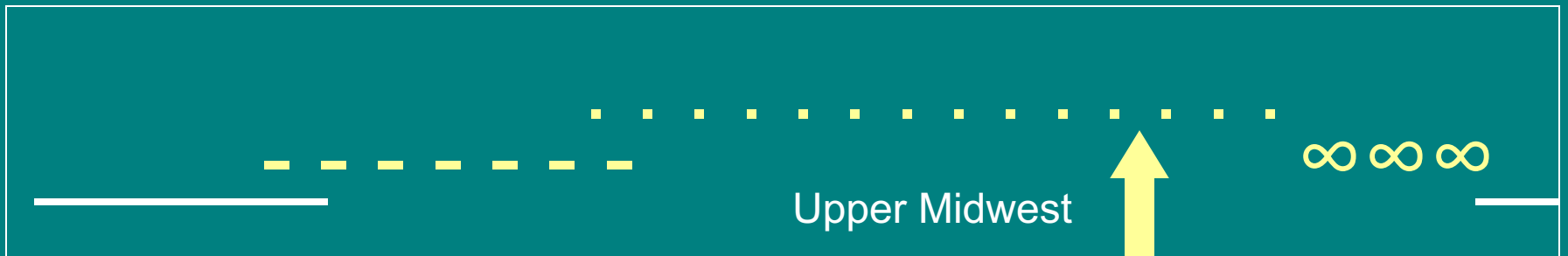
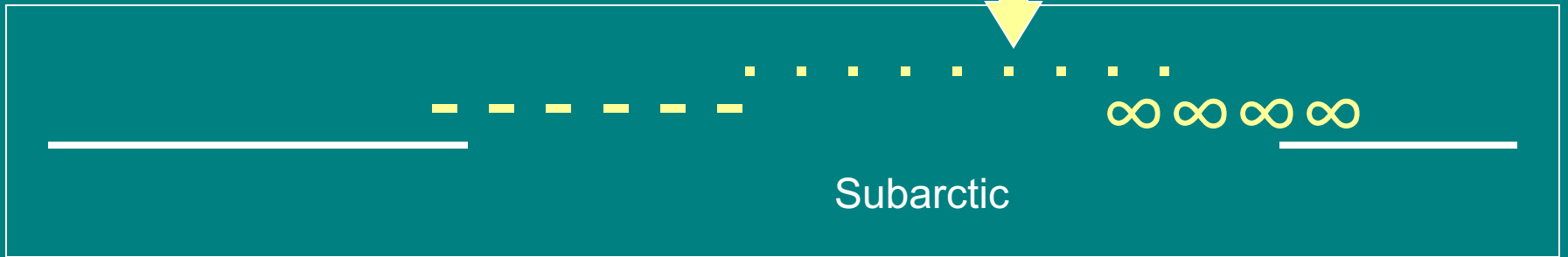
Spring

Summer

Fall

Winter

~18 hrs



When does acclimation begin?

~14 hrs

You purchase a Red maple from Minnesota

Acclimation trigger ~14 hrs

- Fairbanks = Sept 6,
 - Acclimation period 3-5 weeks
- Anchorage = Sept 3
 - Acclimation period 6-10 weeks
- Juneau = Aug 31
 - Acclimation period 10+ weeks



Some plants are flexible, but first planting year is tricky

Start early in greenhouses

Force bare-root plants


Plant in mid summer

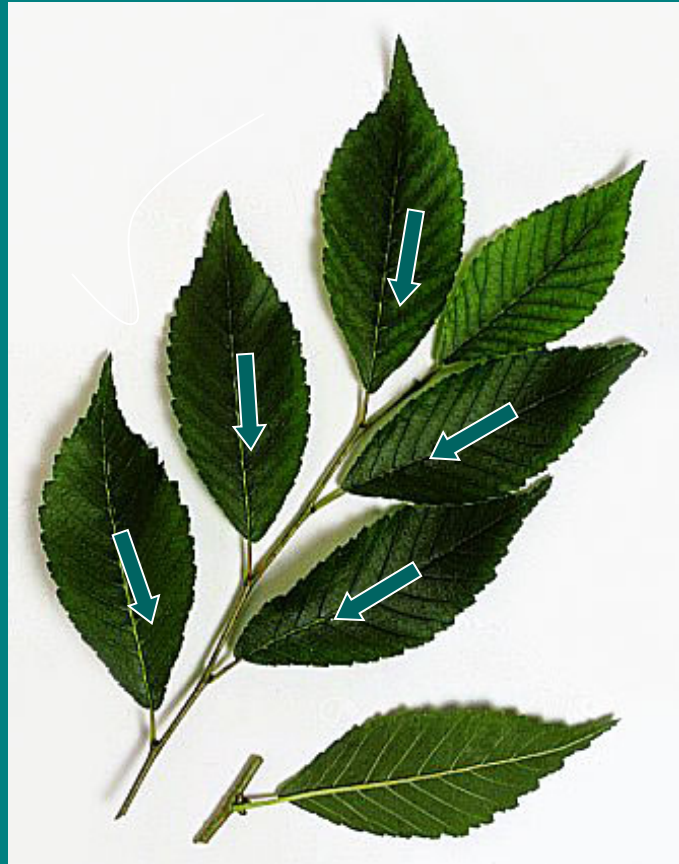
Mulch heavily

Insulating blankets



How to have the best acclimated plants:

1. Start with good genes, flexible membranes!
2. Slow down. Don't move too fast
3. Healthy, disease free plants
-  4. Hardiness gene tuned into photoperiod, temperature cues
5. Give new plants a head start on the season
6. Mulch heavily, winter protection - 1st year



Photoperiod and low temps trigger hardiness factor

- Manufactured in leaves, buds
- Translocated throughout plant

What happens if..



Renovate a shrub
late in summer?

Cut back iris
leaves in early
summer?



Prune young
trees in late
summer?

How to have the best acclimated plants:

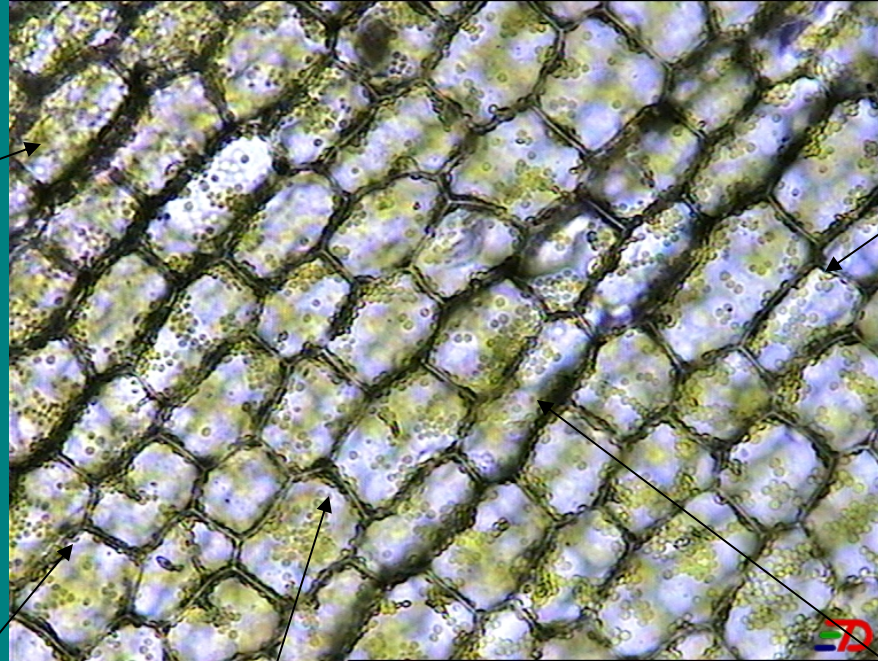
1. Good genes, flexible membranes!
2. Slow down. Don't move too fast.
3. Healthy, disease free plants.
4. Hardiness genes- tuned into photoperiod, temperature
5. Give new plants a head start on the season
6. Mulch heavily, winter protection - 1st year



7. Avoid:

- a. early summer leaf removal on herbaceous perennials
- b. late summer shrub renovation
- c. late summer pruning

What's happening inside?



Sugar & starch
Accumulation
In cell sap =
antifreeze

Membrane
fats and
proteins
change

www.usu.edu

Calcium ions flood
cell, activate
hardiness genes

Water moves
into spaces
between cells

Hormones:
Abscisic acid
increases

Cells dehydrate

The importance of calcium



Uneven watering
interrupts flow of
calcium ions in cells

- Cold hardiness -
 - Calcium ions increase
 - Turn on hardiness genes

What happens to
hardiness if calcium
ions interrupted?

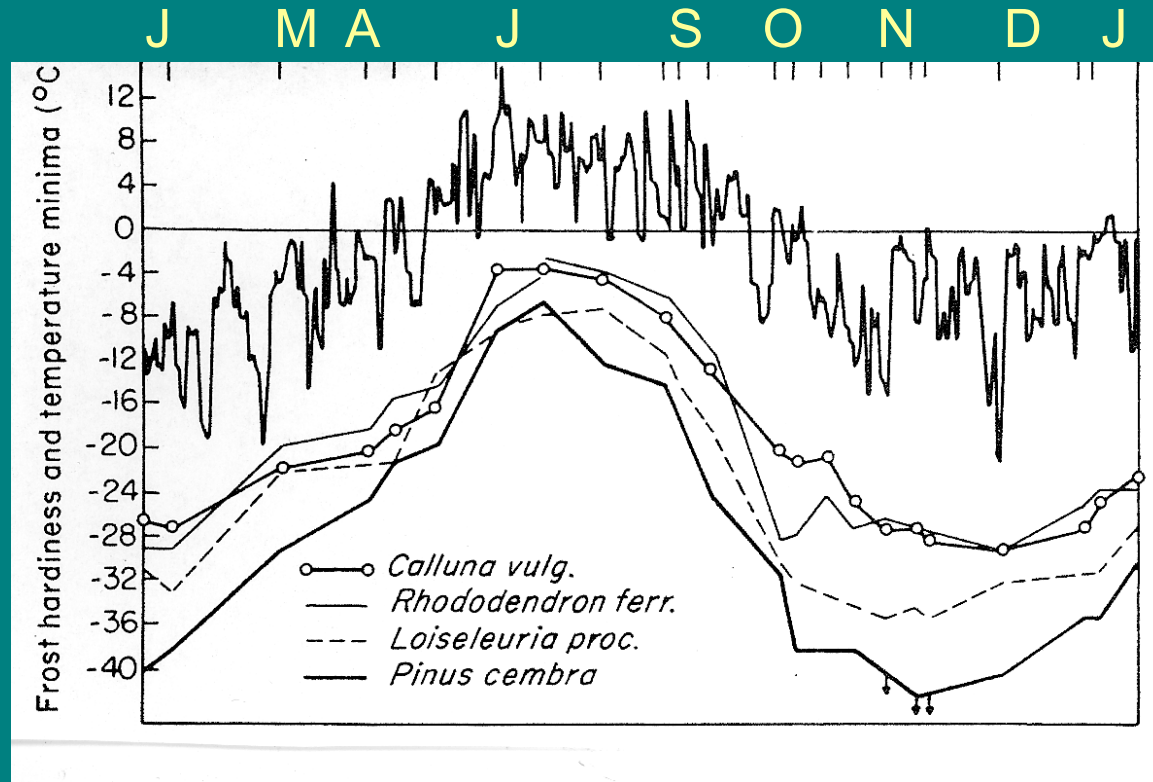
How to promote calcium buildup

- Irrigate in late summer
- Check lime requirement of soils
- Spray leaves with calcium chloride during the growing season



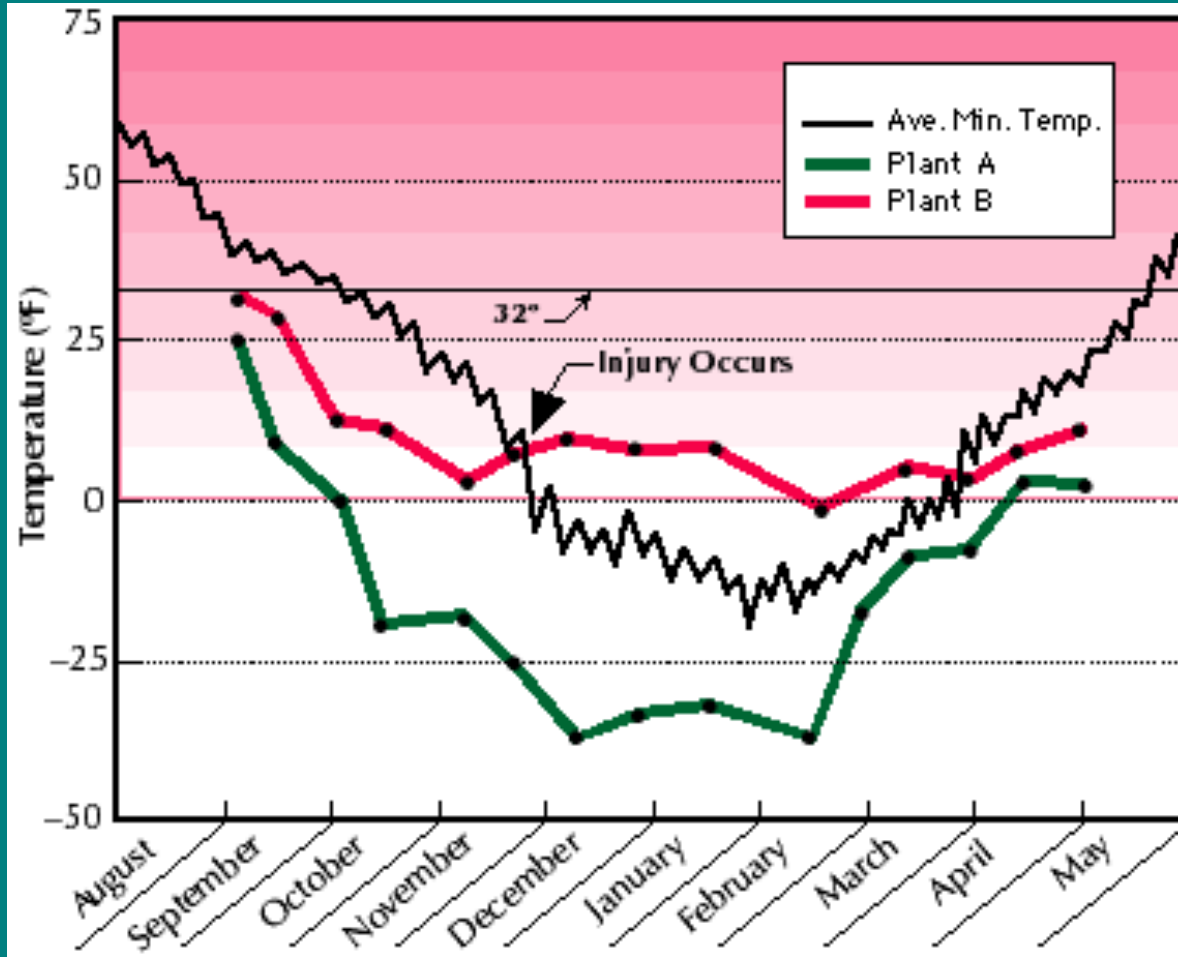
Process is continuous

- Once triggered by photoperiod and temperature
- Hardiness increases with colder and colder temps to genetic limit of the plant



Seasonal changes in frost hardiness for 4 woody plants compared with daily temperature minimum (Germany)

What happens if:



In mid November, temperatures drop over night to -20°F ?

In late April, temps drop to 0°F ?

All plant parts are not equal!

Least hardy

- Roots
- Flowers
- New leaves & shoots
- Flower buds
- Vegetative buds
- Older shoots

Most hardy



Dormancy(rest)

Inability of a plant to grow even if conditions are favorable

Chemical inhibitors prevent growth



Becoming dormant



Cottonwood



Russian crabapple

- Growth in length ceases
- Terminal buds, bud scales form
- Bark thickens
- Needles, evergreen leaves get waxy
- Deciduous leaves drop
- Fruit, seeds ripens

Dormancy- period has specific beginning, end



J JI A S O N D J F M A M

Acclimation- continuous process, daily, hourly response

Plants can be acclimated to low temperatures but not dormant

What if:

You fertilize with nitrogen? Prune heavily?



J JI A S O N D J F M A M



Stimulate new growth
Reduce hardiness



Dormant, no growth
No growth promoted



Stimulate new growth
Reduce hardiness

What if:

Air temperatures increase?



J JI A S O N D J F M A M



Lots of
growth



No growth
Hardiness
reduced



Growth
starts,
hardiness
reduced

How do you tell dormancy?

Bring plant or branch indoors



J JI A S O N D J F M A M



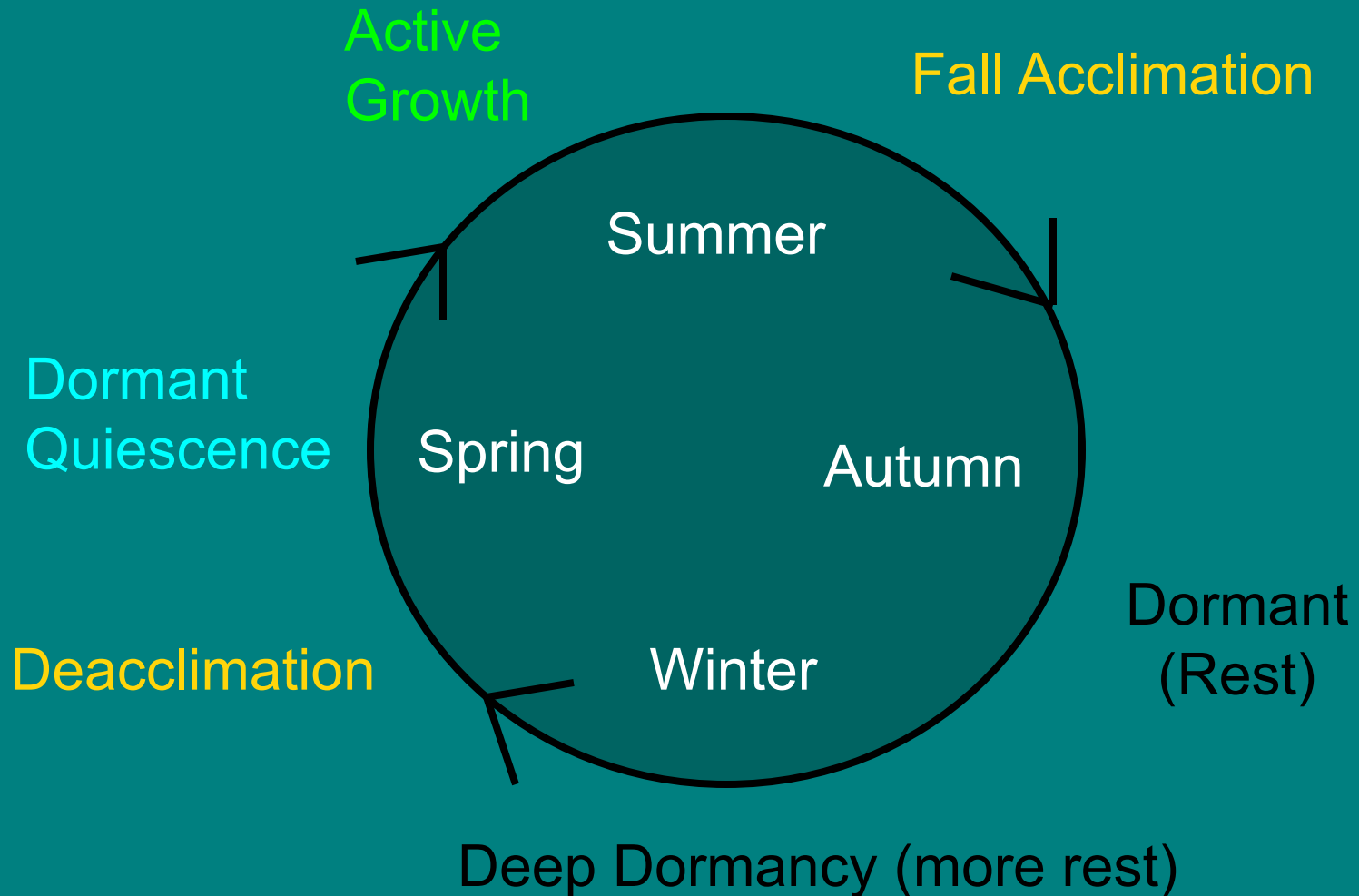
Flowers
Budbreak=
not
dormant

No growth=
dormant



Flowers
Budbreak=
not dormant

Cycle of Plant Hardiness



How to promote hardy plants?



Start with good genes
Keep plants healthy, lots of leaves
Fertilize with N early in non-dormant season



Kinnikinnick

Check soils for lime requirements
Avoid late season pruning
Protect new growth

Learn your growth,
dormancy cycles



Alaska birch



Siberian pine

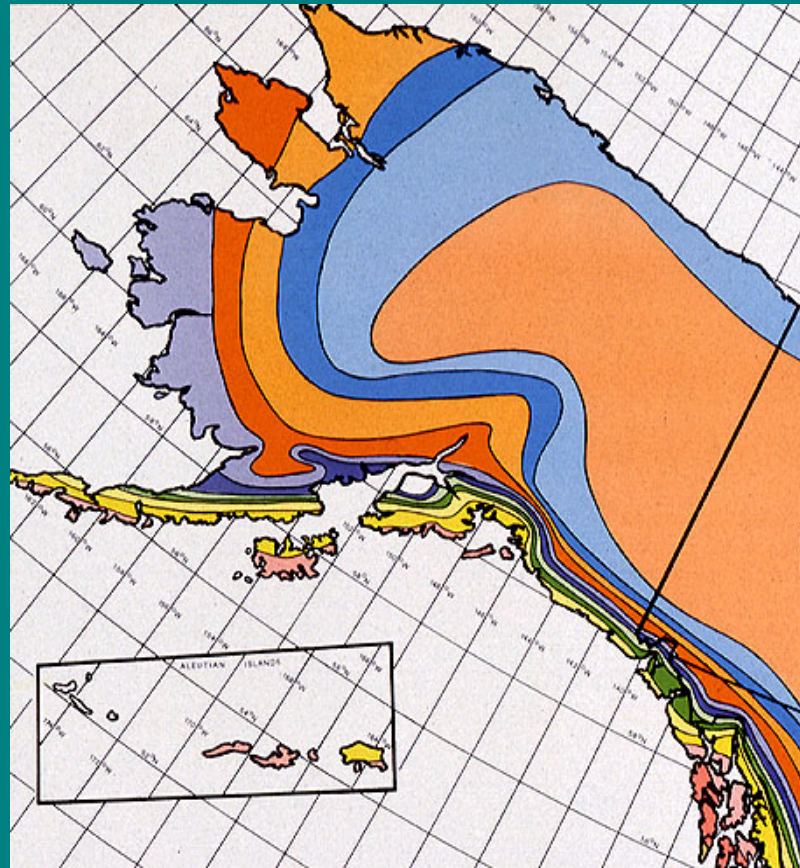


Rosa 'Lac Majeau'



Singleseed
ninebark

Throw out hardiness zone maps!





The End

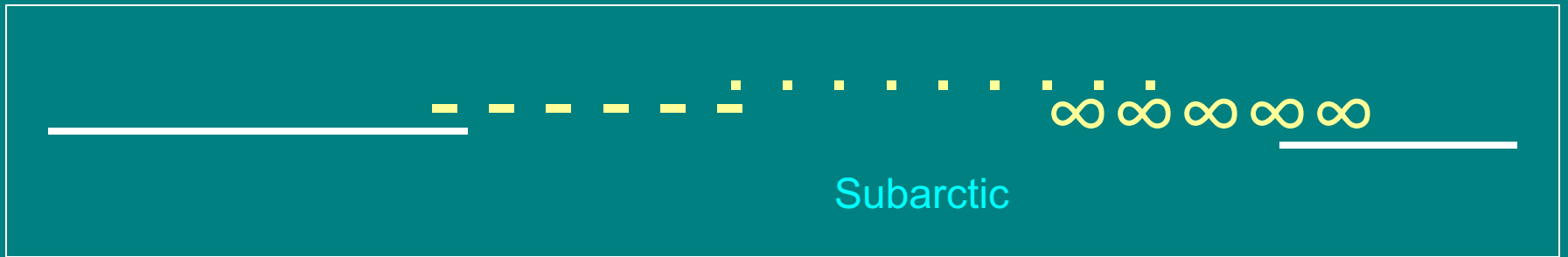
Dormant

De-acclimation

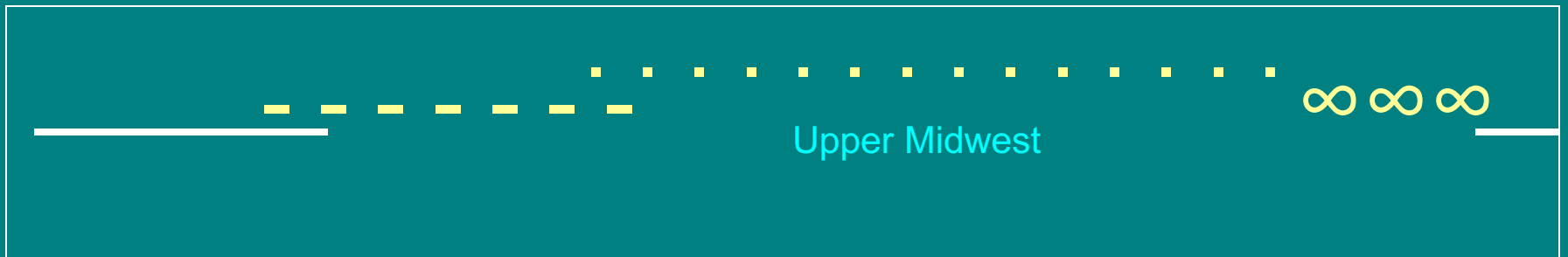
Growth

Acclimation

Dormant



J F M A M J JI A S O N



Assumes good, healthy plant



Singleseed ninebark

- Growing well all season
- Sufficient nutrients for stored proteins, carbs

- Not weakened by disease, insect pests



Braun's holly fern

Promoting good plant acclimation

- Fertilize well early in season, then stop (especially N)
- Irrigate well all season
- Avoid severe pruning in late summer



- Do not remove leaves or cut back stems too early
- Leaf removal late may induce dormancy

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