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?
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

- **Spring**: Active Growth
- **Summer**: Fall Acclimation
- **Autumn**: Dormant Quiescence
- **Winter**: Deacclimation
- **Deep Dormancy (more rest)**
- **Dormant (Rest)**
Active Growth

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

- 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

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

Killing temps
40°F (4°C) and lower

Black cottonwood

Apple leaf

Crabapple flower

www.for.gov.bc.ca
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

Poinsettia, 45°F, 6 hr

Banana, 50°F, 12 hr

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

www.ucd/edu

www.ces.ncsu.edu
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 hardiness
High-sugar sap $\rightarrow$ freezing point depression

Hardy plants 3-5$^\circ$ depression

Not so hardy plants 0 to 2$^\circ$

Genetics
Types of sugars
Age of plant
Health of plant

www.azstarnet.com
Sugars = carbohydrates $\rightarrow$ photosynthesis

Leaf defoliators, skeletonizers

Aspen leaf tortrix
fs.fed.us

Rose leaf rust

Nutrient deficiency
www.cthar.edu

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?

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
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

- Decreasing Photoperiod
  - 0 - 10° increase in hardiness

- Decreasing air temperatures
  - 10 - 20° increase in hardiness

- Combination of photoperiod and temperature
  - 20+° increase in hardiness

Level of hardiness
When does acclimation begin?

- Winter: ~14 hrs
- Spring: ~18 hrs

Subarctic

Upper Midwest
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

Waters moves into spaces between cells

Cells dehydrate

Hormones: Abscisic acid increases

Calcium ions flood cell, activate hardiness genes
The importance of calcium

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

Uneven watering interrupts flow of calcium ions in cells

What happens to hardiness if calcium ions interrupted?
How to promote calcium buildup

- Irrigate in late summer

- Spray leaves with calcium chloride during the growing season

- Check lime requirement of soils
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)
In mid November, temperatures drop over night to -20°F?

In late April, temps drop to 0°F?
All plant parts are not equal!

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

Least hardy

Most hardy
Dormancy (rest)

Inability of a plant to grow even if conditions are favorable

Chemical inhibitors prevent growth
Becoming dormant

- 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

Plants can be acclimated to low temperatures but not dormant
What if:

You fertilize with nitrogen? Prune heavily?

- Stimulate new growth
- Reduce hardiness
- Dormant, no growth
- No growth promoted
- Stimulate new growth
- Reduce hardiness
What if:

Air temperatures increase?

- Lots of growth
- No growth, hardiness reduced
- Growth starts, hardiness reduced
How do you tell dormancy?

Bring plant or branch indoors

Flowers Budbreak = not dormant

No growth = dormant

Flowers Budbreak = not dormant
Cycle of Plant Hardiness

- Summer
- Autumn
- Winter
- Spring

- Active Growth
- Fall Acclimation
- Dormant Quiescence
- Deacclimation

- Dormant (Rest)
- Deep Dormancy (more rest)
How to promote hardy plants?

Start with good genes
Keep plants healthy, lots of leaves
Fertilize with N early in non-dormant season
Check soils for lime requirements
Avoid late season pruning
Protect new growth

Learn your growth, dormancy cycles
Throw out hardiness zone maps!
Assumes good, healthy plant

- Not weakened by disease, insect pests
- Growing well all season
- Sufficient nutrients for stored proteins, carbs

Singleseed ninebark

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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